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Discourse Roles: A Mechanism To Establish Coherence

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Abstract

Discourse comprehension involves more than just connecting and interpreting the individual words on the page. We need to establish not only the connections between the words, but also how the situation described in the text relates to our general knowledge. One of the main ways to achieve integration is by the process of anaphoric reference. Sometimes, the antecedent is explicit in the text, other times it is implicit. It is the ability to refer to implicitly introduced information that is explored in this thesis. How is implicitly introduced information represented so it can support subsequent reference? The proposal that implicitly introduced information is best conceptualised in the form of variables, termed Discourse Roles, is evaluated. It is proposed that Discourse Roles contribute to the establishment of discourse coherence by functioning as antecedent sites for reference. The availability of antecedent role information was assessed with respect to Instrument Discourse Roles. By exploring the boundary conditions on the establishment of Instrument Roles, the conflicting empirical evidence for the encoding of implicit instruments is explained.

It is necessary to establish the origin of Discourse Roles. Are they derived from the text, or background knowledge? The contribution of lexical and contextual information to the establishment of Instrument Discourse Roles was evaluated in a series of eye tracking experiments and Questionnaire tasks. "General Verbs" were used because their associated Instruments are context dependent: certain instruments will be used to perform actions in specific contexts. For instance, the instruments used to perform various acts of "cutting" will vary according to the context: "to cut cake" you would generally use a "knife", but "to cut hair" you would normally use "scissors". The questionnaire data demonstrated that "General Verbs" have a preference for a particular Instrument, regardless of context. The Default Instrument for "cut" is "knife". The relative contribution of lexical and contextual information was assessed by exploiting the conflict between lexically and contextually appropriate Default Instruments. i. e., if the verb "cut" is used in the context "cut hair" then the contextual and lexical default values conflict, "scissors" rather than "knife". The experimental results suggest that lexical default information about instruments is rapidly available and assists the processing of a reference to that Instrument. Consequently, it is proposed that verb-based information makes the earliest and strongest contribution to the establishment of Instrument Discourse Roles. The fact that Verbs have a

preference for a particular instrument explains the conflicting findings regarding the encoding of implicit instruments: only the preferred instrument is expected to be immediately encoded.

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Uppermost, I wish to my thank my family for their love, support and encouragement. As a gesture of thanks, I dedicate this Thesis to my Mother, Iris Clark.

Declaration

I declare that this Thesis has been composed and the research reported has been undertaken by me, unless otherwise stated.

Melody M. Terras

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Chapter One

Implicitness in Discourse

1.1 Discourse Comprehension: Integration and Elaboration

Discourse comprehension requires the integration of each new sentence with previous sentences, present in our memory representation of the text. Sometimes, the need for integration is explicitly signalled by the text via an anaphoric expression, other times it is less explicit and inferential processing is required to maintain coherence. Therefore, it is necessary to explore the processes that underlie integration, their time course and the nature of the representation on which they operate.

A salient theme in contemporary views of comprehension (Kintsch, 1988) is the assumption that a reader's mental representation of the text is the product of the interaction of text-based information and pre-existing knowledge. The background knowledge used during comprehension is not some special kind of knowledge; instead it is the specific application of general knowledge (knowledge about particular events) to a particular task, that of text processing. By using background knowledge we have a source of information with which the text can be interpreted and elaborated. These interpretative and elaborative processes are generally assumed to be accomplished by the process of role mapping; in which explicit textual information is mapped into relevant world knowledge, thereby allowing a complete interpretation of the text. Hence, a role-mapping framework can easily account for integrative and elaborative processes: the world knowledge into which the text is mapped serves as the base for elaboration and, as subsequent discussion will show, the ability of roles to function as antecedent sites for reference assists discourse integration and contributes to the establishment of discourse coherence.

The concept of a Role (variable) that can be filled by the relevant information has been used to represent a variety of different language phenomena, ranging from compositional accounts of lexical meaning to discourse integration. Roles are able to represent such a diverse range of phenomena because they can represent any kind of information, providing it is compatible with their associated constraints. The second advantage of Roles is their ability to accept default values. Their capacity to inherit default information has important implications for their use as a mechanism to represent implicitly introduced information.

Before discussing how roles can be used to represent our interpretation of text, we must consider the use of background knowledge in comprehension. Specifically, how background knowledge can assist the process of reference resolution. The following examples illustrate how background knowledge is used to elaborate on a text.

(1) JOHN HIT THE BALL.

On reading this sentence we elaborate on the information provided by the text. We interpret the sentence with respect to our general knowledge, in particular our knowledge of "hitting". General knowledge informs us that "John" is most likely to be male. More specifically, knowledge associated with "hitting", knowledge most likely associated with the verb "hit", tell us that "hit" entails the roles of Agent (someone who carries out the action of hitting) in this case "John", an Object (the entity that is hit) in this example "the ball", and the role of Instrument (the item used to perform the act of hitting). Although no instrument is explicitly mentioned, we have the impression that an instrument was used. General knowledge allows us to elaborate on this intuition by suggesting a default instrument: it is likely that John used a bat to hit the ball.

This simple example illustrates the use of knowledge in comprehension and how we use this knowledge to understand and elaborate on the information given in the text. With respect to example 1, this information seems tightly linked to our knowledge of the "hitting event" denoted by the verb. It is proposed that the verb "hit" establishes an Instrument Role (in addition to the roles of agent and object) in our representation of the text, with "bat" as the most likely default value for the Role. If Roles for implicitly introduced entities are included in the representation of the text; then we must determine the boundary conditions on their encoding and the factors that determine their content. The primary objective of this thesis was to define the factors responsible for establishing and constraining the content of Instrument Discourse Roles.

(2) JOHN HIT THE BALL AND RAN TO FIRST BASE.

(3) JOHN HIT THE BALL OFF THE SIDE CUSHION BEFORE POTTING IT IN THE CORNER POCKET.

Knowledge is again used to understand examples 2 and 3. In these examples, contextual information cues the use of more detailed knowledge that can be used to further define our default assumptions about instruments. If the action of "hitting" takes place in the context of a base-ball game (2), then our default expectations concerning a possible instrument are different from those when the action occurs in the context of a snooker game (3). In example 2, the instrument most likely to be used is "bat" (specifically a base-ball bat); whereas a "cue" is the most likely instrument in example 3.

It is interesting to note that context not only influences the nature of the instrument, but also expectations about other aspects of the event. For instance, the behaviour of the crowd, or the manner in which John is dressed. Such expectations are not as readily evoked by example 1. This difference is interesting as it highlights the need to distinguish between information derived from general background (cued by the context) and information that is associated with a verb (or the event that the Verb denotes) and emphasises the need to define the source of the information used in elaboration. Are Discourse Roles derived from the verb, the context, or both? In some instances, it is clear that information is pragmatic and most likely context-based, i.e., expectations concerning the behaviour of the crowd are easily identified as being context dependent: noisy in base-ball, quiet in snooker. However, this distinction is much more difficult to make with respect to Instruments.

Does a Verb establish an Instrument Role or is it established by context? What are the conditions that determine whether or not a Role is established? Once the Role is established, we need to determine the source of its content. Is the content provided by verb-based information or the context? When a Role is established does it have a default value instantiated or simply a set of constraints on possible fillers? If so, what is the source of the default value and constraints? Are they set by the source that established the Role or are they open to the influence of other factors; i.e., if the role is established by a verb, is its value derived from verb-based information, or is it open to the influence of context? Does the Role have a general Default Instrument that is

initially instantiated and then modified in the light of contextual factors? All these questions are addressed in this thesis.

The relative contribution of lexical and contextual information to the establishment of Instrument Discourse Roles was assessed with respect to General Verbs. General Verbs were used because the associated instrument is context dependent: certain instruments will be used to perform actions in specific contexts. For instance, examples 2 and 3 illustrate that the instruments used to perform various acts of "hitting" vary according to the context: to "hit a base ball" you would use "a bat", but to "hit a snooker ball" you would use a "cue". Despite the influence of context, there intuitively seems to be an instrument, a Default Instrument, associated with the verb regardless of context. Recall example 1, "John hit the ball", we have the impression that an instrument was used to hit the ball, and that the instrument was a bat. This intuition about a default instrument is substantiated by the results of a questionnaire task (cf. Chapter 7). The fact that a verb may have a preference for a particular instrument, together with the fact that the instruments used by verbs can vary according to the context provides an ideal means to assess the relative contribution of verb-based and contextual information to the establishment of Instrument Discourse Roles. The experimental data suggests that verb-based information makes the primary contribution to the establishment and content of Instrument Discourse Roles.

1.2 The Representation of Implicit Information

- (4) JOHN HIT THE BALL AND RAN TO FIRST BASE.
THE BAT WAS MADE OF WOOD.

Most people experience little difficulty understanding examples 4, despite the fact that "the bat" has no explicit antecedent. This example demonstrates that it is possible to refer to implicitly introduced information. The question then, is how implicit information is represented in discourse so it can support reference? It is proposed that implicit information is represented in the form of variables, termed Discourse Roles. These Discourse Roles assist the creation of discourse coherence by functioning as antecedent sites for reference. With respect to example 4, it is proposed that the verb "hit" establishes an Instrument Role in the developing representation of the discourse that functions as an antecedent for the reference to "the bat". However, the Role will not support reference to all instruments.

- (5) JOHN HIT THE BALL AND RAN TO FIRST BASE.
* THE CUE WAS MADE OF WOOD.

In example 5, the reference to "the cue" does not appear to be supported by the Discourse Role, suggesting that contextual factors make an important contribution at least to defining the content of, if not establishing, an Instrument Role. In the course of this thesis, the way in which both lexical and contextual information influences interpretation and contributes to the establishment of discourse coherence by assisting the process of reference resolution via discourse roles is explored.

1.3 Objectives

The primary objective of the thesis is to determine how implicit information is represented in discourse; specifically how implicitly introduced information can support reference. This issue was evaluated with respect to the encoding of implicit instruments. It is proposed that Roles are the best means to represent implicit information in discourse. Such Roles can contribute to the creation of discourse coherence by assisting the process of reference resolution by functioning as antecedent sites for reference. Secondly, the boundary conditions on the establishment of these Roles and the factors that constrain their content are explored.

The objectives were addressed as follows. Chapter One, the current chapter, provides a general overview of the main objectives, empirical work, and theoretical implications contained in this thesis. Chapter Two provides a detailed discussion of discourse processing, especially the mechanisms used to establish discourse coherence. General evidence that supports the "comprehension as role mapping" view is outlined and the specific motivation behind Discourse Roles and their ability to support reference resolution is presented. Chapters Three and Four review the use of Roles to represent knowledge, particularly knowledge associated with language, in Psychology and Linguistics respectively. Chapters Five and Six explore the contribution of verb-based and contextual information to the establishment of Discourse Roles. A review of the relevant literature is given and four experimental studies are reported. The results suggest that both lexical and contextual factors contribute to the establishment of Instrument Discourse Roles; with the conditions under which they operate being highly constrained. The constraints on the immediate use of verb-based information, specifically that of semantic association are investigated in series of questionnaire tasks and a Dictionary Exercise reported in Chapter Seven. The empirical data suggests that a high degree of semantic association between verbs and instruments is a determining factor in the encoding of implicit instruments and Instrument Discourse Roles. The empirical work presented in Chapter Eight assessed the relative contribution of lexical and contextual information to the establishment of Instrument Roles. The results suggest that lexical information makes the earliest contribution to the creation and content of an Instrument Role and supports the proposal that Discourse Roles contribute to the establishment of discourse coherence by functioning as antecedent sites for reference. Lexical default information about instruments initially assists the

integration of a reference with an implicitly introduced antecedent. However, this lexical influence is short-lived and contextual appropriateness rather than lexical default information finally determines the ease of integration of a reference to an implicit instrument. The detailed implications of these findings: the fact that lexical information makes the primary contribution to the establishment of Instrument Discourse Roles and that these Discourse Roles assist the establishment of discourse coherence by functioning as antecedent sites for reference, are discussed in Chapter Nine.

By evaluating the constraints on the establishment of Discourse Roles with respect to instruments, this work also addresses the long-standing debate in the Psychological literature concerning the time course of "elaborative inferences" and the implications that their immediate encoding has for the nature of the discourse representation constructed during processing (cf. McKoon & Ratcliff, 1992). Instrument inferences have been used as the test case for this issue and the conflicting empirical data on their encoding has generated considerable theoretical debate. The empirical results reported in this thesis, particularly the evidence that verbs exhibit a preference for a particular instrument regardless of context, offers a principled explanation for the conflicting results: predict that only the Default Instrument will immediately be encoded.

Chapter Two

Discourse Coherence

2.1 Discourse Comprehension

In order to comprehend text we must integrate each new sentence with previous sentences present in our memory representation of the discourse. Sometimes, the need for integration may be explicitly signalled by the text by an anaphoric expression, other times it is less explicit and inferential processing is required to maintain coherence. We need to explore the processes that underlie integration, their time course and the nature of the representation on which these processes operate.

Textual information is represented either in its surface form or in a more abstract discourse representation. Psycholinguistic evidence (Sachs, 1967) indicates that memory for surface form is relatively brief in comparison to memory for content. Consequently, most models of discourse processing (i. e. van Dijk & Kintsch, 1983) distinguish between the recovery of the linguistic form of a sentence (allows information about lexical form and syntax to be recalled for a short time) and the development of a discourse model which preserves little or no information about linguistic form, but instead represents the situation the text describes. With the exception of Lucas et al. (1990) little attention has been paid to the form of the representation involved in the integrative process. It is commonly assumed that integrating an element in the currently processed sentence involves changing the activation of an element in a memory representation of the prior discourse. However, little experimental work has explored this assumption.

The possibility of reference to an implicitly introduced antecedent is further support for the assumption that a discourse level of representation is accessed during discourse comprehension. The question is, how is it possible to refer to implicitly introduced information? Precisely, how is implicit information represented in discourse so it can support reference? The proposal that implicit information is represented in the form of variables, termed Discourse Roles, is outlined in this chapter; the factors that influence the establishment of one particular type of Discourse Role, Instrument Discourse Roles, are evaluated in subsequent chapters.

In this Chapter, the way in which both lexical and general knowledge can influence interpretation and contribute to the establishment of discourse coherence by assisting the process of reference resolution via discourse roles will be outlined.

2.2 The Concept of Coherence

Coherence is difficult to define for two reasons. Firstly, its definition is dependent on its assumed source. Secondly, the concepts of coherence, cohesion, and general discourse comprehension are often confounded. Two perspectives are generally taken on the source of the coherence: coherence as a property of the text or coherence as a property constructed by the reader of the text (Brown & Yule, 1983). Consequently, it is possible to regard coherence as either being inherent in the text or inherent to the reader, or more accurately, the processes used by the reader to comprehend the text.

Before discussing coherence in any detail, the concept of cohesion must be defined. The term cohesion generally refers to the organisation of surface text into a sequentially related sequence. Cohesion is generally signalled by text, for instance with pronouns, and involves the establishment of referential relations.

(1) JOHN TOOK THE CAR₁ TO LONDON.

IT₁ BROKE DOWN THREE MILES FROM THE CITY CENTRE.

In contrast, Coherence involves the inter-relatedness of the underlying content by establishing the logical or causal links needed to make sense of the events and situations described by the discourse as a whole. The interesting point is that coherence can be established in the absence of explicit referential (cohesive) links.

(2) JOHN DROVE TO LONDON.

THE CAR BROKE DOWN THREE MILES FROM THE CITY CENTRE.

From these definitions, it is clear that cohesion refers to a linguistic level of representation; while coherence relates to a more abstract level of interpretation, a discourse model. It is possible to create a coherent interpretation of this short text (2) by assuming that "the car" is the one that John used to drive to London. This is possible because our knowledge of driving assists the process of reference resolution by establishing a discourse role in the developing model that assists the establishment of discourse coherence.

Whereas coherence emphasises the importance of background knowledge and interpretation, cohesion emphasises the important role that the text itself plays in discourse processing. The text is the primary source of input into the comprehension system, therefore processing is initially data-driven. Does the

structure of the text direct processing? What and when do conceptually driven process exert their influence on discourse processing? It is important to consider why certain linguistic means are used: why is some information left implicit and how is it possible to subsequently refer to this implied information? What does our ability to process implicit information reveal about the cognitive processes used during discourse comprehension? All these questions will be addressed in the course of this Thesis. We will begin by examining how textual information contributes to the creation of textual coherence.

2.2.1 Coherence as a Property of the Text

The concept of cohesion plays a fundamental role in the assumption that coherence is a property of the text; in that cohesion forces us to consider the structure and organisation of a text. By regarding coherence as a property of the text; it is possible to classify texts as being coherent and non-coherent. The rationale is similar to that of grammar rules which are used to define sentences as grammatical or non-grammatical; with coherence rules differentiating between a coherent and a non-coherent text. These rules or text markers are known as "cohesive devices" and a well formed text was thought to be held together (obtain its cohesion and coherence) by the various cohesive devices it contains. This search for cohesive rules that define texts as coherent or incoherent has encouraged the concepts of cohesion and coherence to be confounded.

However, as the short text below illustrates, the presence of cohesive devices alone is not sufficient to obtain coherence.

(3)

I BOUGHT A FORD. THE CAR IN WHICH PRESIDENT WILSON RODE DOWN THE CHAMPS ELYSSEE WAS BLACK. BLACK ENGLISH HAS BEEN WIDELY DISCUSSED. THE DISCUSSIONS BETWEEN THE PRESIDENTS ENDED LAST WEEK. A WEEK HAS SEVEN DAYS. EVERY DAY I FEED MY CAT. CATS HAVE FOUR LEGS. THE CAT IS ON THE MAT. MAT HAS THREE LETTERS.

Although there are formal cohesive links (apparent cross-references) such as: "ford- car", "black-black", "discussed-discussion" the text is not coherent as the formal cohesive devices do not reflect underlying semantic coherence. Although the text contains formal cohesive devices, it lacks coherence. In contrast, texts that do not contain formal cohesive devices can be coherent. So although text structure

can make an important contribution to the establishment of a textual coherence, the simple presence of cohesive devices is not sufficient to create coherence. Explicit cohesive links must reflect underlying semantic structure if they are to contribute to the creation of a coherent text.

Additional support for the inadequacy of cohesive devices as the means to establish coherence is the fact that many texts do not contain explicit cohesion markers, yet we experience little difficulty understanding them. Consider the following example:

(4)

GEORGE'S HIGH PASS WAS HEADED TO THE RIGHT. THE FORWARD SHOT AT ONCE WITHOUT DRIBBLING AND MADE A GOAL. THE REFEREE DECLARED THE KICK OFF-SIDE.

The main consequence of the "coherence as a property of text view" is exemplified in psycholinguistic accounts of comprehension by proposition-based accounts of text comprehension (van Dijk & Kintsch, 1983). From this perspective, implicitness is regarded as deviance from good text structure and special processing is required to deal with it. However, the empirical data doesn't suggest that readers indulge in special processing strategies to comprehend text in the absence of explicit cohesive markers. In fact, implicitness is the norm, rather than the exception. Fraurud (1990) reported that over 60% of definite Noun Phrase referents in a large corpus of written text were first mentions without explicitly introduced antecedents.

Rather than cohesive devices establishing coherence; they may serve as signals to the reader to search for, or establish connections between segments of the discourse. The use of text structure to guide the reader in their processing is consistent with the "coherence as a processing concept" view.

2.2.2 Coherence as a Processing Concept

If coherence is a property constructed by the reader, then we must ask whether it is the result of deliberate effort on their part e. g., strategies to establish coherence, or a by-product of the processes involved in comprehension.

The question, then is what are the processes involved in establishing coherence? Contemporary models of text processing regard the active construction of referential and causal relations in a text as vital processes in establishing coherence (Trabasso & van der Broek, 1985). For instance, the processing of referential relationships, especially argument repetition, was the basis for Kintsch & van Dijk's (1978) propositional model of text comprehension.

2.3 Referential Processing

One of the main devices for discourse integration is anaphoric reference. Anaphoric reference is a general term which covers pronoun resolution, certain aspects of temporal resolution (e.g., the interpretation of verb tense) and the resolution of definite descriptions.

In general terms, an anaphor can be defined as, an expression whose interpretation depends systematically upon the interpretation of another expression.

Consider example 5, below, which illustrates pronoun resolution:

(5) JOHN₁ SAW MARY, AND HE₁ CROSSED THE ROAD.

In order to understand this sentence we must determine that "he", the anaphor, refers to "John", the antecedent. The relationship between the anaphor and antecedent is one of co-reference, with the antecedent and the anaphor referring to the same person, "John".

2.3.1 Direct Reference

Direct reference is when the anaphor (for instance a noun phrase) refers directly to an object, event, or state previously mentioned (Clark, 1977). Consider, the simplest example of direct reference, repetition.

- (6) I MET A GYPSY YESTERDAY.
THE GYPSY I MET YESTERDAY TOLD MY FORTUNE.

In the above example "A gypsy" is the antecedent for "the gypsy I met yesterday" (anaphor).

Alternatively, direct reference could be made in the same sentence by pronominal reference:

- (7) I MET A GYPSY YESTERDAY.
SHE TOLD MY FORTUNE.

As before, the antecedent is "a gypsy", the anaphor is "she". The relationship between them is one of co reference with "she" and "A gypsy" being the same person. Pronominal reference is similar to repetition except that pronouns use only a subset of properties that characterise the previously mentioned object, event, or state.

With direct reference, the process of anaphor resolution is relatively straightforward with little or no inferencing being necessary to resolve the reference. This contrasts with indirect reference where some degree of inferencing is thought necessary to resolve the reference.

2.3.2 Indirect Reference

Clark (1977) discusses two forms of indirect reference: "indirect reference by association" and "indirect reference by characterisation: inducible roles".

(A) Indirect Reference by Association

It is possible to refer to something associated with an object, state or event, rather than to the entity as a whole. For example, it is acceptable to mention a "desk" and then refer to "the drawers". This associated information can have varying degrees of predictability. Clark discusses three degrees of predictability:

(i) Necessary Parts

(8) I LOOKED INTO THE ROOM. THE CEILING WAS VERY HIGH.

Since every room has one and only one ceiling, "the ceiling", is a "necessary part" of the room previously mentioned; therefore it is possible to refer to it.

(ii) Probable Parts

(9) I WALKED INTO THE ROOM. THE WINDOWS LOOKED OUT INTO A GARDEN.

"windows" are a "probable part" because most rooms have windows. They are not a necessary part, as all rooms don't necessarily have windows. The inference required to identify the antecedent of "windows" as "room" has produced the extra information that this room does have windows.

(iii) Inducible Parts

(10) I WALKED INTO THE ROOM. THE CHANDELIERS SPARKLED BRIGHTLY.

It is generally not assumed that a room has chandeliers, but this is what is forced (induced) by example 10. In the search for the antecedent of "the chandeliers" the

reader is forced to infer what they would generally not, i.e., that the room has chandeliers.

B) Indirect Reference by Characterization

Just as it is possible to refer to something associated with an object, state or event previously mentioned, rather than to the entity as a whole; it is also possible to refer to an object that plays a role in an event, or circumstance previously mentioned. For example, “a murder” is an event (the verb denotes an event, and therefore provides roles for the participants in the event) that requires at least one murdering agent, a victim, and a murder weapon. Once the act of murder is mentioned, it is possible to refer to the objects that play these roles. As with associated parts, these roles can vary from completely predictable to almost completely unpredictable. For instance, there are Necessary Roles and Inducible Roles.

(i) Necessary Roles

(11) THERE WAS A MURDER YESTERDAY. THE VICTIM WAS A
TERRORIST.

An essential participant in the event of murder is the person that is murdered, “the victim”.

(ii) Inducible Roles

(12) JOHN WAS MURDERED YESTERDAY. THE KNIFE LAY NEARBY.

A weapon (some means of carrying out the murder) is also essential to “murder”. However, this example provides more detailed information about the murder weapon: it was a knife, and not a gun or poison. Clark assumed that this referential process involves more inferential processing than that needed to resolve references to necessary roles.

These examples of indirect reference illustrate that it is possible to refer anaphorically to an implicitly introduced antecedent. It is interesting to note that it is possible to refer both to objects associated with explicitly mentioned items and roles that are part of the event being described. The process of indirect reference also demonstrates the involvement of inferencing in the reference process.

2.4 Reference Resolution: Inferential and Referential Processing

The phenomenon of indirect reference illustrates how inferential processing contributes to the process of reference resolution. However, it is not always possible to distinguish between inferential and referential processing because inferential processing is often required to establish referential links which contribute to the discourse coherence. Perhaps, the most well-known illustration of the contribution of inferential processing to reference resolution is that of "bridging inferencing" (Haviland & Clark, 1974).

- (13) WE CHECKED THE PICNIC SUPPLIES.
THE BEER WAS WARM.

In order to resolve the reference to "the beer" we must draw on our general knowledge that picnic supplies generally include beer.

Inferential processing can be used to resolve not only definite Noun Phrases but also Pronouns.

- (14) JOHN BLAMED BILL₁ BECAUSE HE₁ SPILLED THE MILK.

For antecedent assignment to occur, we must use our knowledge that spilling milk is generally undesirable and knowledge about the circumstances under which one person blames another.

It is interesting to note that McKoon & Ratcliff (1992), within their "Minimal Inference framework", regard the establishment of local coherence as a main motivation for inferencing. Only inferences required to establish local coherence and those inferences based on readily available information are automatically encoded as a text is read. A typical example of an inference required to establish coherence is a causal inference.

- (15) JANE TOOK TWO PARACETAMOL.
HER HEADACHE WENT AWAY.

In order to understand this example, we must infer that the first event (taking the paracetamol) caused the second (the headache to go away). The making of such a causal inference preserves the coherence of the text. Coherence is established via inferential processing based on knowledge about the effects of paracetamol rather than being signalled in the text by cohesive devices.

There is no doubt that such general knowledge can be used during comprehension; the question is when such information is utilised: always or only when necessary? This issue is highly controversial within the inferencing literature and the timing of the use of such knowledge has important implications for the processes underlying the establishment of discourse coherence.

2.5 Inferential Processing

As the previous discussion illustrates, inferential processes make an important contribution to the establishment of referential links and the creation of discourse coherence. Despite the importance of inferential processing, the actual nature of the inference process, the type of inferences routinely drawn, and the time course of such processing is hotly debated. A brief summary of these controversial issues is outlined below.

Throughout this Thesis the term inference is used to refer to the encoding of information implicit in a text, as part of the representation of that text. Conventionally, inferences are classified into two categories: Necessary or Elaborative. However, this two fold distinction is not absolute, since the definition of which inferences are necessary and which are elaborative with respect to comprehension varies as a function of the nature of the representation constructed during comprehension which, in turn, is determined by what is regarded as the main motivation for the comprehension process. Two distinct forms of representation have been proposed: a text-based representation which contains the propositions inherent in the text or a mental model of the situation described by the text.

The "Necessary/ Elaborative" distinction is derived from the proposition-based view and assumes that the primary aim of comprehension is the construction of a locally coherent proposition-based representation of the text. Consequently, those inferences regarded as necessary are those required to construct a connected proposition-based representation (i.e. those needed to integrate stated information and establish local coherence). A range of data has consistently demonstrated that these so-called necessary inferences are drawn as the text is read. For instance, argument repetition (McKoon & Ratcliff, 1980), and anaphoric reference (O'Brien, Duffy & Myers, 1987). Readers also appear to draw inferences involving causal relations, when one event explicitly stated in the text can be connected by a causal inference to another explicitly stated event (Keenan, Baillet & Brown, 1984). In theory, all other possible inferences i.e. those not essential for integrating propositions are assumed to be deferred and drawn only when necessary. These inferences are regarded as elaborative in the sense that although they add information to the sentence, they are not necessary to connect the explicitly stated information in the text into a coherent propositional structure. In practice, however, the empirical data is not so clear with respect to the time course of elaborative inferences. There is conflicting evidence as to whether elaborative inferences are drawn as the text is read (on-line) or deferred and drawn only when required.

It is important to note that these inferences are only elaborative if a proposition-based representation is assumed. They become necessary if the main aim of comprehension is the construction of a model of the situation described by the text. This change in classification is best illustrated by example. Consider instrument inferences, from a propositional perspective they are not necessary as they are not generally required for the construction of a coherent propositional text base. However, if the aim of comprehension is the construction of a mental model of the events described by the text then instrument inferences become necessary for comprehension and should therefore be drawn as the text is read. It is assumed that readers automatically draw inferences in order to fully represent the situation described by the text. It is necessary to infer so much because a text seldom provides enough explicit information to construct a complete description of the events portrayed. However, this distinction becomes blurred if the inference is necessary to establish coherence. For example,

(16) JULIE SPREAD THE BUTTER ON THE BREAD.

THE KNIFE WAS MADE OF STAINLESS STEEL.

The inference that "the knife", was the one used to carry out the previously mentioned act of spreading is need to create a coherent proposition-based representation of the text. The instrument inference is no longer elaborative, but necessary.

One of the main problems in the study of inference processing is that of establishing their time course. The data concerning the timing of "necessary inferences" seems clear, but not the data on the encoding of elaborative inferences. By establishing the time course of these so called elaborative inferences we can gain insight into the nature of the representation constructed during comprehension. If it is found that inferences, thought to be elaborative, were drawn during comprehension, then this would be supportive evidence for the immediate construction of a complete mental model of the situation described by the text. In fact, McKoon & Ratcliff (1992), regard the determination of the time course of elaborative inferences as the test case for Constructionist (mental model) theories of text processing. On the basis of a highly selective review of the empirical data (they fail to comment on two recent eye movement studies that indicate the on-line encoding of elaborative inferences: O'Brien et al., 1988 and Garrod et al., 1990) McKoon & Ratcliff conclude that elaborative inferences are not routinely drawn during comprehension and use this to argue against the immediate construction of a mental model-based representation of a text. Instead, they advocate the "Minimalist" approach: minimal automatic processing of inferences during reading, which has as its main objective the construction of a propositional representation. They assume that only the minimal number of inferences are encoded during reading and that these inferences serve as the minimal representation of the text from which other more strategic, goal directed inferences are drawn at a later stage of processing. However, as example 16 illustrates, it is not always possible clearly differentiate between minimal (necessary) and non-minimal (elaborative) inferences.

2.6 Coherence as Inference Motivation

The fact that an Instrument Inference can be either necessary or elaborative depending on whether it is necessary for the establishment of discourse coherence illustrates not only problems with inference classification but also the close relationship between coherence and inference processes.

The fact that the establishment of discourse coherence may be a major motivation for inferencing is recognised by Lucas et al. (1990, P. 622) "... inferences can become part of the memory representation for a sentence if the inference is necessary for preserving discourse coherence and if the context is available to provide the elements that will establish that coherence. The fact that inferences as disparate as filling instrument case roles and assigning antecedents to anaphors were made when the right conditions were in place suggest that it is not a particular type of inference but rather the necessity to integrate information that causes the implicit inference to be made".

This quote is interesting because it highlights the inter-relationship between inference and coherence processes. The motivating role that coherence establishment plays in the inference process was discussed by Singer (1980) with respect to instrument inferences.

Singer in a series of studies (1979a, 1979b, 1980) investigated "Case filling inferences" (Agent, Patient, and Instrument). He found that strongly implied case-fillers were not routinely inferred during the comprehension of sentences or short passages. Subjects took more time to verify, recognise, and understand sentences expressing the implications of antecedent material than sentences expressing ideas that were directly stated. Since the number of potential inferences that can be drawn from a single sentence are quite large, priority may be given to those that contribute to establishing coherence. Singer (1980) manipulated the degree to which an inference was necessary to establish coherence (he examined direct, backward and forward inferences). Recognition rates for direct and backward inference conditions were similar, but the recognition rates for forward inferences were very low. From this, Singer concluded that the need to establish coherence can influence the encoding of implicit information.

2.7 Comprehension as Role Mapping

The use of background knowledge in text comprehension is generally and implicitly assumed. Despite its pervasive character the processes governing its use still remain open to debate. We need to explain how background knowledge can function not only as a general framework for interpretation but also how it can support reference to antecedents implicitly introduced by the text.

One of the most popular ideas concerning the use of background knowledge is that of role mapping (variable binding). It is important to remember that background knowledge about events only exists because a situation exists from which this knowledge is derived. The background knowledge used during comprehension is not some special kind of knowledge, instead it is just the specific application of a subset of general knowledge (knowledge about particular events) to a specific task, that of text processing. By using background knowledge we have a source of information against which the text can be interpreted and elaborated. This interpretative and elaborative process is thought to be accomplished by the process of role mapping. Role assignments connect explicit textual information to relevant world knowledge and therefore allows a complete interpretation of the text.

Sanford & Garrod (1981) suggest that the making of role assignment inferences is a natural consequence of attempting to interpret a discourse with respect to a knowledge based model (Scenario) of the situation portrayed, and the reassessment of this type of inference is a further consequence of this type of interpretation. The immediacy and automaticity of role assignments is best illustrated by example. When presented with the following piece of text most readers encounter difficulty with the third sentence and take inordinately long to read it. They experience even more difficulty with the final sentence.

- (17) JOHN WAS ON HIS WAY TO SCHOOL.
HE WAS WORRIED ABOUT THE MATHS LESSON.
HE HOPED HE WOULD BE ABLE TO CONTROL THE CLASS TODAY.
IT WAS NOT PART OF HIS JANITORIAL DUTIES.

This simple example illustrates that a reader does more than represent John as human male individual, although that is all that has been stated in the text. To understand the text fully, the reader seems to have placed John at the centre of a situation where he is a boy on the way to school who is worried about his maths

lesson. John has been assigned the role of "school boy". This example illustrates that the mapping of textual information into our knowledge of the situation described by the text seems to be an automatic part of the comprehension process.

The use of Roles (variables) to represent both explicit and implicit information can be traced from its initial introduction in A.I. through to use in Psychology. The concept of a variable (role) that can be filled by the relevant information has been used to represent a variety of different language phenomena ranging from lexical meaning (decompositional accounts), capturing the syntactic co-occurrence of verbs and their associated arguments (Thematic roles), describing the structure of our knowledge of events and situations (Scripts and Schemas), and most recently to assist in the creation of local discourse coherence (Implicit Thematic Roles). Roles are able to represent such a diverse range of phenomena because they can represent any kind of information, with their content being constrained by restrictions on the nature of their (acceptable) content in different situations. Another advantage of Roles is their ability to accept default values. Their capability to inherit default information has important implications for their use as a means of representing text and our interpretation of the text where so much information remains implied.

2.8 Role-based Reference Resolution: A Mechanism to Establish Coherence

As outlined earlier, Sanford and Garrod (1981) regard text comprehension as a process of role mapping. The starting point of the comprehension process would seem to be the text itself, as the text is the primary source of input to our language comprehension system. We must use the text in some way to assist our integration processes. Such a view suggests that the text may serve as a trigger to activate our general world knowledge. Garrod & Sanford (1981) assume that all understanding is based on the "primary process" of mapping (integrating) the text input, as soon as possible, into the relevant general world knowledge. This mapping process is accomplished through a method of role assignment with roles being provided by the background knowledge of the situation (scenario) the text describes. A new situational role slot becomes available as a consequence of focusing on different aspects of the referent situation (scenario). Such a scenario may be cued in one of two ways: either by identifying the stereotypical situation of which the event described by the text forms a part, or by the use of certain verbs that identify stereotypical situations. It is the use of verbs to identify complex situations that support particular roles that enables verb-based information to assist the comprehension process. Consider how the verb "dress" (example 18) brings to mind a "dressing scenario" in which "clothes" play a central role.

(18) MANDY DRESSED THE DOLL.
THE CLOTHES WERE BRIGHTLY COLOURED.

It is assumed that reading the verb "dressed" brings to mind a scenario (relevant background knowledge about dressing) that contains a role for "clothes" as they are an essential part of "dressing". It is therefore possible to resolve a subsequent reference to "the clothes" because the discourse role, included in the scenario can function as antecedent for the definite reference.

Background role information can also be accessed by the general theme of the text, and not just thorough verbs. Consider example 19, below:

(19) JOHN SAT IN THE CORNER OF THE DIMLY LIT RESTAURANT.
THE WAITER BROUGHT THE MENU.

It is possible to refer to "the waiter" and "the menu" in the absence of explicitly introduced antecedents because our back ground knowledge of restaurants allows

us to establish discourse roles that can function as antecedents for these references.

By representing background knowledge in terms of Roles, it is possible to explain how this knowledge can support the process of reference of resolution and contribute to the creation of discourse coherence.

Garrod & Sanford acknowledge that this background may be general in the sense of stereotypical knowledge about an event or situation, or it can be specifically related to an event denoted by a verb. Perhaps, the most well known example of the use of role-based verb information that contributes to the establishment of discourse coherence is that of Open Thematic Roles (Carlson & Tanenhaus, 1988).

Carlson & Tanenhaus (1988) demonstrated how an unfilled thematic role associated with a verb can assist the integration of a reference consistent with such a role. In example 20,

(20) JOHN HURRIED TO UNLOAD THE CAR
THE SUITCASES WERE HEAVY.

the unassigned role of Theme associated with the verb "unload" remains open in the discourse model and assists the integration of a subsequent reference "the suitcases" that fills the role (cf. Chapter 4 for a detailed discussion of Open Thematic Roles).

2.9 Concluding Remarks

In this chapter, general assumptions concerning the nature of discourse comprehension have been reviewed. In particular, the processes used to establish discourse coherence, especially the process of anaphoric reference. The ability to refer anaphorically to an implicitly introduced antecedent raises important questions concerning the way in which discourse is processed and the nature of the discourse representation. Notably, how implicit information is represented.

It is suggested that discourse comprehension is best conceptualised as a process of role mapping and it is through this process of role assignment that references with implicitly introduced antecedents are resolved. The viability of role mapping and role-based reference resolution as an explanation for the establishment of

discourse coherence will be assessed in subsequent Chapters. The main Psychological uses of roles (variables) to represent both linguistic and general knowledge are discussed in Chapter Three; the Linguistic perspective on Roles, most notably thematic roles, is outlined in Chapter Four. Subsequent chapters empirically examine the possible origin of Discourse Roles (lexical or contextual) and show that Discourse Roles can function as antecedents for definite descriptions and thereby contribute to the establishment of discourse coherence.

Chapter Three

Roles, Knowledge Structures
and
Discourse Comprehension

3.1 Roles and Knowledge Representation

The main objective of this chapter is to review the major Psychological uses of roles to represent information, with a particular emphasis on the use of roles to represent information involved in language comprehension. Close attention will be paid to the origin of roles, their advantages for representing information, and why roles are especially well suited to represent implicit information in discourse.

Previous discussions (Clark, 1977; Sanford & Garrod, 1981) have illustrated how role-based inference can assist the creation of discourse coherence. The question is How? What is the origin of these roles? Are they derived from our general knowledge of events or are they associated with the meaning of verbs. Perhaps both sources of information interact to assist role-based integration. In addition to their origin, their content must also be considered. Can verb-based roles have their content over-ridden by a strong biasing context? If so, what is the time course of this process? These issues will be discussed with respect to the encoding of implicit instruments. The reasons why implicit information about instruments is best conceptualised in the form of roles, and how these roles can assist the creation of discourse coherence by functioning as antecedents for subsequent reference will be discussed.

Roles are a highly effective means to represent information. The use of roles to represent information can be traced from its initial introduction in A. I. ("variables") through to current Psychological accounts of knowledge representation. Roles are particularly well suited to represent information associated with our knowledge of language. In fact, they have been used to represent information at all levels of language: compositional accounts of lexical meaning (Verb Schemata), to capture the syntactic co-occurrence of verbs and their associated arguments (Thematic Roles), to describe the structure of our knowledge of events and situations used during comprehension (Scripts & Schemas), and most recently to assist in the creation of local discourse coherence ("open roles").

Perhaps the best known example of a role-based explanation is the use of roles to represent general knowledge. This concept is discussed in the literature under a variety of different names: Schemas (Rumelhart & Ortony, 1977), Scripts (Schank & Abelson, 1977), and Frames (Minsky, 1975). Despite differences in terminology and procedural differences in their actual A. I. implementations, they share the

same underlying character in that they all use roles as a way to represent information. Such role-based explanations have been used to represent a range of information associated with language. Roles can represent the knowledge we use to interpret language (Scripts), to represent knowledge associated with linguistic concepts i.e., verbs (Verb Frames or Verb Schemata), and finally, they can be used in the representation of discourse which expresses our knowledge concerning the interpretation of language. In fact, roles are capable of representing information at all stages of the comprehension process and it is to a detailed discussion of these uses that we now turn.

3.1.1 Roles as Variables

3.1.1a Schemata

As mentioned earlier, role-based accounts of knowledge representation are widespread. Perhaps the most general instance of roles to represent knowledge are Schemas (Rumelhart & Ortony, 1977). A schema is best described as a basic unit of knowledge; a generalisation based on past experience of the world. Schemas organise past experience and provide a framework for understanding future events. They not only help us to understand, but they also enable us to generate expectations about events. Our knowledge of events and situations concerns the participants in these events, their relationship to each other, the actions they perform, and the consequences of these actions. Role-based accounts capture these intuitions in terms of roles and their contingent relations. This is analogous to the use of thematic roles to represent the relationship between events and their participants, except that Psychological accounts are not limited only to participants expressed by the syntax.

Consider the "GIVE schema" (Fig. 3. 1), it captures our intuition that an "event of giving" includes an Agent (who performs the act of giving), an Object which is given- the gift, and a Recipient who receives the gift.

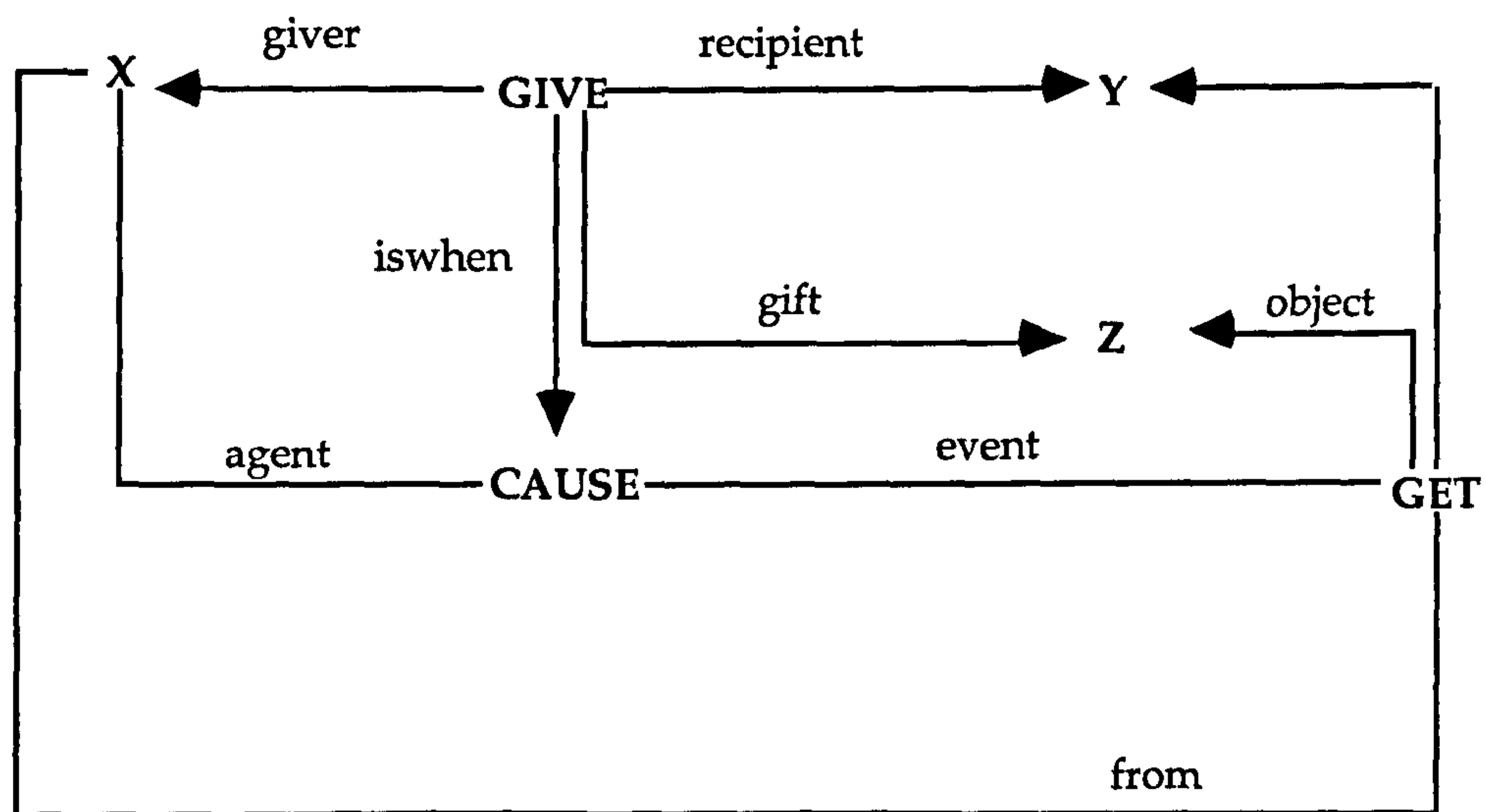


Fig. 3. 1 Example of a Schema for GIVE (Rumelhart & Ortony, 1977)

The schema for GIVE has three variables associated with it : a "Giver", a "Gift", and a "Recipient". These variables are assumed to capture important aspects of the verb's meaning: they represent the stereotypical event of "giving". On different occasions these variables will take distinct values. Although the variables can be bound by different values on different occasions; their relationship within the GIVE schema will remain constant. In particular, the GIVER will somehow cause the RECIPIENT to get the GIFT. This is generally true regardless of the identity of the GIVER, the RECIPIENT, or the nature of the GIFT. A variables' ability to accept different values, yet retain its relationship with other variables is very important. It allows consistency to be maintained within the event (accounts for stability of meaning and use) whilst allowing the participants to vary (enables description of different instances of the same event, sometimes involving the same participants).

For example, consider these two simple sentences:

(1) JOHN GAVE THE DOG TO MARY.

(2) MARY GAVE THE DOG A BONE.

In example (1) "John" would be the GIVER, "Mary" the RECIPIENT, and "the dog" the GIFT. However, in sentence (2) "Mary" is the GIVER, "the dog" the RECIPIENT, and "the bone" the GIFT.

These examples illustrate some of the essential characteristics of Schemas that make them a powerful concept for representing knowledge associated with language. Schemas contain, in fact they are composed of, variables. These variables are represented in a way that captures the relationships between them. In short, they represent information in a structured way. Recall, the "give" example where the Recipient regardless of their identity receives the Gift. Secondly, Schemas can represent information at all levels of abstraction; therefore they can represent information at all levels of language.

Although initially conceived to represent general knowledge, the following quote illustrates the benefits that can be derived from schemas when used to represent our knowledge of language.

"Schemata have variables that may become associated with, or bounded by, different aspects of the environment on different occasions" (Rumelhart & Ortony, 1975, P. 101).

The ability of variables to capture different aspects of the environment means that they can be sensitive to the language environment i.e., context. For example, a verb in one context may result in its associated variables being bound in one way, while in another context these variables will accept different values (cf. examples 1 & 2). However, context cannot only explicitly provide role values, it can also constrain the content of the default values associated with the role.

3.1.1b Variable Constraints and Default Values

The variables in a schema have restrictions on the types of object that may be bound to them. In the Give example (Fig. 3. 1), the schema might specify that the GIVER must be capable of wilful action (therefore most likely to be animate). Constraints on variable values serve two functions: they define the nature of objects that can be bound to the variable, and in the absence of sufficient information they allow speculation about possible fillers, Default Values.

Constraints on variables within the schema allow default assignment where the variable is bound by its most probable value. The important point about default values is that they are dependent on the values of other variables in the schema. They are assigned contingently, with the default value assigned to a particular variable depending on the value of the other variables in the schema. The contingent assignment of default values allows the default assignment process to be sensitive to contextual factors.

Consider how context can influence the nature of the instrument default associated with the action of "hitting". In the context of "a joiner hitting a nail", the most likely default instrument would be "hammer". However, in the context of "a cricketer hitting a ball", the default instrument would most likely be "bat". It is clear that default values are not set, but open to influence from the values assigned to other variables in the schema. The question is what process underlies this variable binding and the assignment of default values.

3.1.1c Variable Binding

Consider how the process of variable binding would progress for the following three sentences:

- (3) JOHN BROKE THE WINDOW.
- (4) THE BALL BROKE THE WINDOW.
- (5) JOHN BROKE THE BUBBLE.

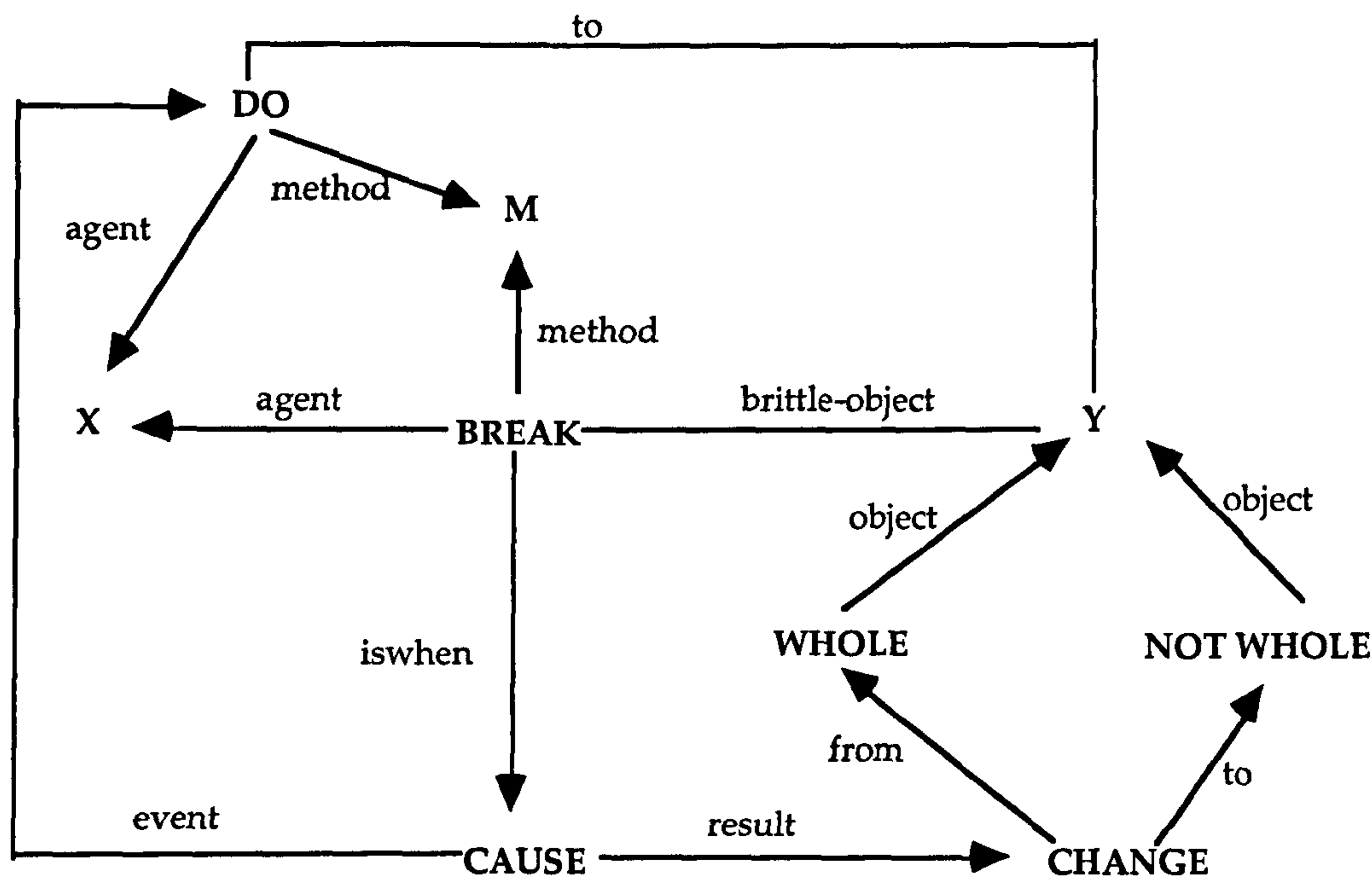


Fig. 3. 2 Rumelhart & Ortony's (1977) "BREAK" Schema

The schema representation assumes three variables are associated with the verb BREAK: the Breaker, the Object, and the Method by which the object was broken together with the following constraints in their values. The Breaker must be an Agentive force, the Object must be rigid or brittle, and the Method must be some action of which the breaker is capable and which is sufficient to break the object in question. Each of the above example sentences suggests different interpretations of the event of BREAKING. Consider sentences (3) and (4) and how their respective values would be bound to the variables in the BREAK schema.

Binding is guided by the constraints on the variables. In both examples "the window" will be taken as the value of the Object variable (associated with variable Y in the schema) as it clearly meets the constraint of being a rigid object. In sentence (3) "John" is taken as being The Breaker (X) as "John" is presumably the name of a person and people are stereotypically agentive forces. However, in sentence (4) "the ball" can not as easily be taken as The Breaker because it is not generally considered to be an Agentive force. Thus we must guess about the value of variable X. The variable (X) can be bound to an unspecified person, but what about "the ball". Perhaps "the ball" can be bound to the method variable which would result in "someone caused the window to become broken by using

the ball". But what action did this someone perform? The sentence provides us with no direct information, so we must guess; the variable constraints indicate that whatever it was, it must have been sufficient enough to cause the window to break. As a result, although no particular method was stated, the variable constraints contained by the schema enable a probable (default) value to be assigned to the variable. It is important to note that the default value was not fixed independently of the values of the other variables. Instead the default value assigned (Method) depends on the value of other variables such as the object, in example (4).

Compare sentences (3) and (5). Binding The Breaker (X) and The Object (Y) causes no problems: in both cases "John" is the Breaker. In sentence (3) the Object is "the window" in sentence (5) "the bubble". However, both sentences suggest a different method of breaking for each case. This difference is due to our knowledge about the sorts of activities that are sufficient "to break" either "a window" or "a bubble". This information could be abstract but directly associated with the BREAK Schema, or it could be discovered by consulting our memories for various instances of things like windows and bubbles having been broken. By representing information in this way we can allow world knowledge to influence our interpretation of the text.

The process of variable binding can occur in one of two ways. A schema can either actively look for an aspect of the text to bind to one of its variables (conceptually driven) or the input itself may demand some variable to which it can itself be bound (data driven). All role-based Schema accounts of interpretation are conceptually driven. However, recent psycholinguistic uses of roles (Carlson & Tanenhaus, 1989; and more specifically Mauner, Tanenhaus & Carlson, 1995) are moving towards a more bottom-up (data driven) approach with implicit arguments of verbs being encoding that can later assist the interpretation of subsequent discourse. Such an approach allows a richer interpretation of the text to be created without the immediate use of contextual information.

In summary, Schemas contain variables and their associated constraints. These constraints serve two functions: firstly, to assist the assignment of values to variables by specifying the sorts of things that can fill the various roles; secondly, when assignment can not be made they generate default values that satisfy the constraints. It should be noted that variable constraints are seldom absolute. It is rare that a variable cannot ever accept a value of a certain sort. Instead it is useful to think of variable constraints as representing distributions of possible values,

with some values being more typical than others. The variable constraints prefer values closer to the average of the distribution, but will accept deviant values if no other interpretation can be made.

(6) JOHN CUT THE PAPER WITH SCISSORS.

(7) JOHN CUT THE PAPER WITH A RAZOR-BLADE.

(8) * JOHN CUT THE PAPER WITH A BRICK.

In sentence (6) "scissors" are a more stereotypical value than "razor blade" (7) for the instrument used in the action of "cutting paper", but we can still understand how John can cut paper with a razor blade because a razor-blade fulfils the basic constraints on an instrument associated with cutting, must have a sharp edge. In contrast, sentence (8) is difficult to understand because "brick" does not possess these qualities and hence does not satisfy the variable constraints associated with instruments for the verb "cut".

The flexible nature of variable constraints combined with the fact that schemas represent knowledge enables them to be deal with pragmatic inference. This is the main differences between Schema-based accounts of word meaning and definitional accounts (dictionary entries). Schemas represent knowledge that is encyclopaedic (knowledge of the world) rather than Definitional in character, and even when essential characteristics are represented, they are represented in most cases as prototypical instances. Also, while dictionaries attempt to provide records of the meanings of words, schemata represent knowledge associated with these concepts. Schemas can cope with deviations and distortions because they represent what is normally true rather than what is necessary true. They don't fail because of logical contradictions between variable constraints and attempted assigned values. In short, Schemas are an attempt to represent knowledge in a flexible way which reflects human tolerance for vagueness, imprecision and quasi-inconsistencies.

To conclude, the major advantages of roles is their ability to represent any type of information in a structured and context sensitive way. In addition, the ability of variables to accept default values which are dependent on the values assigned to the other variables in the schema provides a means to explain expectations and elaborations of events.

3.2 Roles and Text Comprehension

One of the main questions concerning discourse comprehension is how we are able to build such a rich representation of a text from the limited resources with which the text provides us. We need to explain the way in which a text is enriched, expanded and elaborated by a reader, together with the time-course of this enrichment process. The commonly accepted view is that in order to comprehend text a reader must establish a connection between the text and the ideas it evokes (the situation it describes and the inferences it triggers). This may occur by relating incoming text to previously stored knowledge through a process of role mapping (cf. Sanford & Garrod, 1981).

The obvious starting point for the integration process would seem to be the text itself, as it is the primary source of input to the language comprehension system. It seems reasonable to assume that we must use the text in some way to assist our integration processes. The text may serve as a trigger to activate our general world knowledge. This assumption underlies Sanford & Garrod's (1981) proposal that language understanding is based on the "primary process" of mapping (integrating) the text input, as soon as possible, with the relevant general world knowledge. This mapping process is accomplished by Role Assignment (cf. Chapter 2 for a detailed discussion).

Role representations are derived from a reader's knowledge of the situations referred to by the text (scenarios). A new situational role slot becomes available as a consequence of focusing on different aspects of the referent scenario. Such a scenario may be cued in one of two ways. Firstly, it may be cued through the use of certain verbs which refer to complex situations that support particular roles. Garrod & Sanford (1982), using a self-paced reading time procedure, found that in contexts like "Keith drove to London" readers have no difficulty in interpreting a subsequent reference to "the car". They behave as if an explicit antecedent "car" had already been introduced into the discourse. One possible explanation (Garrod & Sanford, 1982; Cotter, 1984) is that the verb itself activates an implicit instrument role (vehicle) which is incorporated directly into the discourse model where it serves as an antecedent for "the car". Such an explanation attributes the establishment of a Instrument Discourse Role directly to the lexical structure of the verb (verb-based roles).

More generally, role representations may be accessed as a consequence of identifying the stereotypical situation of the event described in the text. Garrod & Sanford (1983) have shown that readers do not encounter difficulty in

comprehending an anaphor, even if no explicit antecedent referent has been established, providing that the context as a whole is sufficiently restricting. For example, the sentence "The lawyer questioned him" in the context of a passage about a court case took no longer to comprehend in the absence of an explicitly stated antecedent "lawyer" than in its presence. It seems that just knowing that the text is about "a court case" facilitates the contextual interpretation for the definite reference because the reader can establish that the lawyer in question, is the person playing that role, in that situation (script-based roles).

The empirical evidence (Garrod & Sanford 1982, 1983; Cotter 1984) seems to support a distinction between roles being derived from the lexical structure of the verb and the more general process of roles being provided by the context/general knowledge; with Instrument Roles being derived from lexical structure. However, recent evidence suggests that the use of Instrument Role information may also be related to the nature of the situation described by the whole sentence and not just sensitive to the lexical-semantic constraints associated with the verb per se. For example, in the context "Jane washed her hair" "shampoo" is readily accommodated, whereas in the context "Jane washed her clothes", "the powder" is readily accommodated. This suggests that context, in addition to lexical structure, may be involved in the establishment of Instrument Roles. The task, then, is to assess the relative contribution of context and lexical structure in the establishment of Instrument Roles and decide whether Instrument Roles are verb-based or more general script-based roles.

It is only relatively recently that the use of verb-based information to assist discourse integration has been discussed. Prior to this, the most extensively discussed use of role-based information in comprehension was that provided by the background knowledge of the reader in the form of script-based roles.

3.2.1 Scripts & Role Assignment

Perhaps the best-known example of Roles to represent background information used in language comprehension is that of Scripts (Schank & Abelson, 1977). Script-based roles can not only assist comprehension, they can also function as antecedents for subsequent reference (script-based referents).

Whereas Schemas represent general knowledge, Scripts are more specific in that they represent stereotypical knowledge of a situation. Within the script-based view of comprehension, understanding is achieved through a process of role-mapping in which the text input is mapped onto the variables contained in the script. From a script-based perspective, comprehension is simply a process of variable binding. Scripts not only guide comprehension by providing the relevant background knowledge, but the availability of this knowledge, most notably the default values associated with its roles, allow scripts to serve a predictive function. i.e., support elaborative inferencing.

A script can best be defined as a representation of a predictable situational sequence. It is a detailed, sequenced, list of events which characterises a standard situation. It contains Roles, the characters and their goals which play these Roles, as well as an indication of what happens when things go wrong. Schank discussed various types of Scripts: instrumental scripts (how to make tea), role scripts (being a spy), situational scripts (eating in a restaurant). It is situational scripts that are of most interest here, as narrative texts typically describe events and situations.

The rationale behind Scripts is that text can best be understood if it can be interpreted with respect to a situational stereotype. Once the appropriate script is accessed it provides information about the general structure and content of events. In short, it provides expectations about the participants, objects and actions most likely to be involved in the situation. Once this information is available it can be used not only to guide comprehension, but script-based constituents can also function as antecedents for items in the text. It is possible to refer to roles, props and actions described in the script without explicitly introducing them in the text. There is no need for them to be explicitly introduced as their existence is supported by their position in the script.

This use of script-based knowledge in reference resolution is nicely described by Sanford & Garrod (1981, P. 54) as extending "the domain of reference in a limited,

context-dependent way". The fact that the domain is extended in a context-dependent way is very important as it allows the context (in the form of the information contained in the script) to constrain the range of roles available for reference. By restricting elaboration to information currently available in the script, the extent of the elaboration is limited in a principled fashion. The difficulty in constraining elaboration has long been one of the major arguments against the immediate use of conceptual information in discourse comprehension.

Consider the short narrative below.

- (9) JOHN SAT AT HIS FAVOURITE TABLE IN A QUITE CORNER OF THE RESTAURANT. THE WAITER SMILED AS HE BROUGHT THE MENU.

It is possible to refer to "the waiter" and "the menu" because the text can be interpreted within the general situation of "a visit to a restaurant". Reading the text is thought to activate information about eating in a restaurant (possibly in the form of a restaurant script) therefore, we expect to find a waiter, a menu etc. in such a situation. Hence, it is possible to refer to these expectations as they are already present in our representation of the text.

Schank (1975) discussed examples that not only illustrate how script based-entities can serve as antecedents, but also how scripts can be used to resolve pronominal reference and select the appropriate sense of a verb. Assume that reading sentence 10 activates "a travel agent script".

- 10) JOHN WANTED TO GO TO HAWAII.
 10') HE CALLED HIS TRAVEL AGENT.
 10'') HE SAID THEY TOOK CHEQUES.

There is no ambiguity concerning the antecedent of "He" in sentence 10" because "He" is clearly related to travel agents, as they take money. This information is derived from the travel agent script. The script provides pragmatic information that can assist reference resolution. Also within the context of the travel agent script "took" is interpreted as "accepted" and not as "steal" as in the example 11.

- 11) THE POLICE INTERVIEWED JOHN ABOUT THE BREAK-IN AT HIS HOUSE.
 11') HE SAID THEY TOOK CHEQUES.

The empirical data supports the use of script-based referents. Garrod & Sanford (1983) examined the use of script-based roles to support reference. They compared the reading time for a target sentence with or without an explicit antecedent in either a supportive or non-supportive script-based context. The results show that script-based information can assist the integration of a reference.

The preceding discussion demonstrates the many advantages of using script-based information. In addition to their ability to support reference resolution they also have the ability to predict, and consequently support elaborative inferential processing. It is to a discussion of this predictive function that we now turn.

3.2.2 Roles & Defaults

As outlined earlier, one of the main advantages of scripts is that they contain default values. Scripts contain default values because they contain variables which can be assigned different values depending on the restrictions associated with them. In most instances, there is a default value associated with the variable, and if the variable does not become bound during the comprehension process it can accept this default option as being the most likely value. From the perspective of text comprehension, it is the binding of variables with their default values that explains the process of elaborative inference.

Sanford & Garrod (1981) highlight the need to distinguish whether the variables of an active schema are conceived of as containing default values or regarded as empty slots. These two assumptions concerning the status of unbound variables have important, and different, processing consequences. In a default-value interpretation, variables take their default values whenever the schema is activated. These default values are then replaced with values stated in the text. On this interpretation, a variable always holds a specific value, and highly typical instances will automatically be instantiated in the absence of explicit information. Sanford & Garrod (1981) argue for the alternative view of default instantiation where the binding of variables is a more flexible process depending on the importance of the variable in the text. In such a view, the binding of variables to their default values is not an automatic process but is instead determined by aspects of the text; with factors such as focusing constraints, and the goals of the reader determining the extent of elaboration.

Whether Roles allow prediction or simply assist integration depends on the perspective taken on the instantiation of default values. Viewing comprehension as "role mapping" suggests that roles facilitate integration. However, if we assume, as most empirical studies of elaborative inference do, that schemas always bind variables with their default values, then they serve a predictive function.

3.2.3 Default Values and Elaborative Inference

As outlined earlier, schema-based theories of comprehension capture the use of knowledge in comprehension, most notably expectations, and provide a means (Roles) by which it can be used. It is the ability of scripts to capture detailed information about an action or event and the ready availability of this information that makes script-based knowledge an ideal base for the generation of elaborative inferences. The question then is what enables scripts to support elaborative processing. They are already used to elaborate the text (background information serves as basis for interpretation) but the question is how much of the background information is incorporated into the representation of the text.

The key to a script's ability to support elaborative inferencing is that it contains default values. Recall the script-based assumption that once the relevant schema is selected, comprehension is simply the process of filling the slots in the schema with values that are either stated directly or consistent with the text. Elaborative inferences are produced when roles are filled with their default values. Inferred information is then represented in the mental representation of the text in the form of a default option within the schema selected for understanding.

If, as assumed by schema theory, elaborative inferences are the result of the immediate filling of roles with their default values then evidence for elaborative inferencing should be wide spread during comprehension. However, as we shall see, evidence for immediate elaboration is limited (McKoon & Ratcliff, 1992).

The immediate use of default information has its disadvantages as well as its advantages. The major disadvantage with knowledge-based default processing is the number of inferences that it supports. This problem is especially relevant to large scale schema structures. The more extensive and detailed the knowledge base, the greater the number of roles and associated default values that can be taken, hence the greater the number of possible inferences that can be drawn.

The problems entailed by the encoding of a large number of inferences can vary depending on the assumed time course of the inference process. Within the schema view it is assumed that defaults are immediately instantiated as role values. However, this may not always be the case as some inferential processing may be delayed until needed. If this is so, the processing load of the system would be greatly reduced as the scale of inferencing would be constrained. Since the problem of constraining the number of inferences is a crucial one, it may be simpler to examine inferences associated with verbs, as verbs would seem to support a more restricted set. Before a detailed discussion of role-based accounts of verbs one final issue regarding the use of default information and inferencing needs to be discussed.

It is important to differentiate between the use of script-based antecedents to assist reference and default values that support elaborative inferences. An overlap may occur if the default value in a script is used as a script-based antecedent for a subsequent reference. Default information seems to play an important role in the inference process. For example,

- (12) THE HAIRDRESSER CUT THE GIRL'S HAIR.
THE SCISSORS WERE VERY SHARP.

In this example, a script-based Instrument Role (what the hairdresser used to cut the girl's hair) is functioning as an antecedent for the definite reference "the scissors". In addition, the content of this reference is consistent with the contextual default instrument. The question is whether this default information is immediately available to assist the integration of the reference. The nature of instrument default information is complex because it is difficult to decide if the default information is associated with the verb (cut) or the context (general context of visiting the hairdresser and cutting hair). This difficult issue will be discussed in greater depth later in this chapter (section 3.4.5) and forms the basis for much of the empirical work presented in subsequent chapters.

3.2.4 Advantages of Roles

In summary, Roles are an ideal way to represent the use of background knowledge during comprehension. Role-based accounts capture our intuitions about the participants and the structure of events. People and objects serve particular functions in events and a role-based explanation provides a straightforward means to capture this information. The default values associated with roles provides a means to explain how text can be elaborated by background knowledge and how such elaborative processing can support subsequent reference. Roles can not only been used to represent general knowledge and explain how this background information can assist comprehension; they have also been used to represent verb-based information and how it can assist comprehension.

3.3 Roles and Verbs

In contrast to Scripts which were used to represent stereotypical sequences of events, Verbs can be conceptualised as representing simple events. Verbs are regarded both in the Linguistic and Psychological literature as a rich source of information. Such information can then be used to assist the interpretation of a sentence and situate it within the discourse context. Verbs appear to play a central role in comprehension and inference making. Recent evidence suggests that their influence may not only operate at the sentence, but also the discourse, level. The central importance of verbs at the sentence level has been discussed in great length within the linguistic literature (cf. Chapter 4). Recent psycholinguistic evidence (Carlson & Tanenhaus, 1988) suggests that the influence of the verb may extend beyond the syntactic level: it may assist in reference resolution and contribute to the creation of discourse coherence.

3.3.1 Verbs as Event Concepts

Like our knowledge of situations, our knowledge of events is structured. People and objects serve particular functions in events and these functions are recognisable across a wide range of instances. It was the need to capture this relationship between events and their participants that motivated the linguistic use of Roles (Fillmore, 1968). The assignment of Roles is an attempt to capture our

intuitions about events, together with the actions and participants involved in them.

Verbs are generally regarded as "action concepts". They can best be conceptualised as denoting actions and specifying the relationships between the involved participants, expressed by the nominal concepts in a sentence. These nominal concepts can play various Roles depending on the meaning of the verb. Given their important function within the sentence is not surprising that their influence, as we shall see, may extend not only to the integration of concepts at sentence level but also influence integration at the level of discourse.

Both Psychologists and Linguists have used roles as a means to express the information conveyed by verbs; therefore, it is not surprising that the roles (agency, causality, instrumentality, etc.) assigned by Verbs in Psychological and Linguistic theories are comparable: they differ only the terminology used to describe them. If anything, Psychological accounts of role assignment tend to be broader than those of Linguistic theory as Psychological accounts are not so constrained by the need to explain syntactic correspondence. The concept of understanding the nouns in a sentence with respect to their relationship with the verb it contains is not simply a theoretical construct. The results of Shafto (1973) illustrate that intuitions about the relations between verbs and nouns are used to understand language (see section 3. 4. 3 for a more detailed discussion).

3.3.2 Role-based Accounts of Lexical Structure

Numerous proposals use Roles as a means to represent the information conveyed by Verbs. Just as scripts are used to represent our knowledge of stereotypical action sequences, roles associated with verbs have been used to describe our knowledge of simpler events. The two most notable accounts are "Case Frames" (Minsky, 1975) and "Verb Schemata" (Rumelhart et al, 1977) . Both utilise roles and variable binding as a means to express how the information associated with verbs can structure (at both the level of syntax and semantics) a sentence in which it occurs.

3.3.2a Verbs as Data Structures

3.3.2a (i) Case Frames

Case Frames are a more specific example of Minsky's general proposals for knowledge representation. He represents knowledge in a structured format. Knowledge is stored in hierarchical data structures called "Frames" which he views as the basic building blocks of knowledge. Frames are organised in such a way that the rules and procedures relevant to a particular situation are stored together as single, modular units, rather than the information being dispersed in an arbitrary way, or organised in a formal hierarchy. Frames are organised in a hierarchical fashion, with the top level of the hierarchy containing the fixed, necessary features of the situation. Lower down the hierarchy are lists of features which become progressively less well defined and most likely optional. Such a method of organisation allows certain aspects to be identified as being more important; while the use of default values captures expectations about what would normally happen in a given situation. Like Scripts, Frames represent information in terms of Roles, with understanding being achieved through the process of variable binding. Although Frames operate on a smaller scale than scripts they can be combined to form larger scale knowledge structures (sequences of events).

Minsky (1975) regarded verbs as conveying information about events (verbs as information structures) and since Frames are used to capture knowledge relating to individual actions or events, they are an ideal means of representing information associated with verbs which are generally thought to denote actions. Minsky assumed that knowledge of meaning (semantic knowledge) is simply a form of information. He equates knowledge of meaning with knowledge of any other kind; therefore, it can be represented by the same means: Roles.

Minsky conceptualised verbs as "Case-frames", or information structures which organise the other parts of speech in a sentence, in terms of the relationship between them and the verb. Consequently, a Case or Verb-frame can be viewed as the centre of the action described by the sentence in which it appears. In this respect, verb-frames capture the central organising function of verbs. A verb and its associated "Case frame" can structure the sentence in which it appears because the frame contains a number of roles (variables) that are associated with the verb to account for all participants in the action described by the verb. These roles, like the roles in scripts have default values associated with them. These values can

either be overwritten with real values from the text or become instantiated with their default value. When applied to language comprehension, these default values can be used to elaborate on unstated information in the text. Like Scripts, Frames are regarded as providing background information, but on a smaller scale, about the event described by the text. The understanding of a verb and the sentence in which it occurs is a process of mapping the text onto the roles provided by the Verb-frame.

3.3.2a (ii) Verb Schemata

A similar approach to representing the information associated with verbs is that of Verb Schemata (Norman & Rumelhart, 1975). It differs from Minsky's proposed Frames in that rather than simply organising concepts of the sentence into the case roles associated with the verb, schema-based accounts have the additional objective of representing the meaning of the verb via a process of semantic decomposition (see earlier discussion of the break schema Fig. 3. 2). As with all schema-based accounts, the roles contained in the verb-schema have default values associated with them. This default information (as subsequent discussion will show) can be used to support verb-based inference.

Since the roles in the schema are derived from verb meaning, schema based accounts emphasise the importance of lexical meaning. This contrasts with Case (thematic) roles which largely ignore verb meaning. Such a view has implications for both semantic representation and language processing. If a verb's meaning becomes immediately available then the content of the lexical entry may influence integrative processes. However, like Case assignment, the process of semantic decomposition has its own specific set of problems. Semantic decomposition requires the detailed specification of the important aspects of the meaning of the verb. The main problem is one of depth: how much detail is required? This problem can be illustrated with reference to a simple example of a verb schema. Consider a possible schema for "drive" (adapted from Sanford, 1983):

DRIVE is when X (an agent) TRAVELS from Y (a place) to Z (a place) by means of X (an agent) controlling a vehicle (a necessary instrument).

The problem is when to stop decomposing. Do we include definitions of a vehicle, list types of cars, list all actions used to control the car, etc.. A detailed evaluation of the use of a decomposed semantic representation of a verb during

comprehension is given in Chapter 5. At present, it is important to note that such a representation and its influence on processing, has been expressed using Roles.

3.3.3 The Psychological Validity of Role Assignment

The concept of the allocation of information with respect to its relationship to a verb is not simply a theoretical construct. Shafto (1973) investigated whether we have conceptual notions that correspond to the semantic relationships between verbs and nouns as proposed by Linguistic and Psychological accounts of Case assignment. In other words, do subjects recognise Case relationships between verbs and nouns when they interpret a sentence.

The problem for a psychological based account of Case assignment is how to define Cases sufficiently enough to allow them to be assigned to the noun phrases in a sentence. These defining properties may be associated with the object (noun) itself rather than the Case. Shafto examined subjects' perceived semantic relationships between Verbs and their associated Agent, Experiencer, Instrument, and Object Cases. He found that Case assignment was made using features from two main dimensions: living/non-living and active/passive. It is obvious that the living/non-living dimension is a property of noun, but the active/passive distinction is not a property of nouns, but of their interpretation within the sentence. For example, in the sentence "The rock smashed the window", "the rock" is assigned the case of Instrument. That "the rock" is non-living is part of its definition, but that it is "active" is determined relative to its interpretation in the sentence. Although there seems to be some correspondence between semantic features and Case definitions, it is not sufficient to discriminate all cases. To establish the exact role of a noun in a sentence some form of syntactic analysis is necessary. The process of Case assignment appears more complicated than the linguistic discussion suggests (cf. Chapter 4 for detailed discussion). It needs to extend beyond the level of single words and examine the noun as it is interpreted within the entire sentence.

Shafto's results indicate that Case-based accounts are not sufficient to account for either lexical meaning or to provided a comprehensive representation of the events described by a sentence. Case representations are not sufficient to capture meaning: the simple allocation of noun phrases to Cases doesn't uniquely define the event. However, Shafto's results are very important as they illustrate that people can use ideas about the possible relationship between verbs and nouns

during the process of comprehension. The use and nature of the conceptual relationship between nouns and verbs may not be quite as clear cut as linguistic proposals suggest. Nonetheless, it seems that we can, and do, conceptualise nouns as standing in particular relationships with verbs. At a higher level, we can see these same roles manifested in the use of script-based information and the inferences they support. The process of Role assignment allows us to structure our knowledge of events in a principled way. Since the roles are generalisations they don't restrict our interpretation to specific instances: instead the same general organisation can be applied to similar concepts.

3.4 Verbs and Sentence Comprehension

As outlined earlier, Verbs and their associated roles can be thought of as the central organising concept in a sentence. The structure of the verb schema is assumed to capture the meaning of the verb (or at least the relationship between the verb and the arguments with which it occurs), and a sentence is understood when the associated variables are filled with their appropriate values from the sentence. Consider the simple sentence "Mary stirred the coffee with a spoon". The schema associated with the verb "stir" would contain Roles for an Agent, in this instance Mary, and Object, the coffee, and a Role for the Instrument used to accomplish the action, in this case a spoon. The memory representation for the sentence is then a modified schema.

Comprehension is therefore a process of mapping the information in the text onto the roles (variables) associated with the verb. This is analogous to the use of scripts in comprehension. The roles have default values which can be taken in the absence of explicit information to the contrary. Consider a modified version of the above example: "Mary stirred the coffee". In this instance, comprehension would follow the same process as above, except that the Instrument Role would not be filled by explicit information from the text but instantiated by default. We would assume, based on information associated with the verb, that Mary used a "spoon" to "stir the coffee". Like schemas and scripts, it is the assumption that default values are automatically taken that accounts for the process of elaborative inferencing. It is generally assumed that all the roles (and their default values) associated with a verb become active when the verb is read.

3.4.1 Verb Roles and Discourse Integration

The previous discussion illustrated how verb-based roles and their associated default values can assist comprehension at the sentence level. However the influence of the verb may operate outwith the sentence. Verb-based information may also assist integration across sentences boundaries. Consider:

(13) MARY STIRRED HER COFFEE.
THE SPOON WAS MADE OF PLASTIC.

(14) THE GARDENER DUG A HOLE.
THE SPADE HAD A LONG WOODEN HANDLE.

Assume that both verbs assign the roles of Agent, Object and Instrument to participants in the event they denote. However, the instrument is not assigned within the sentence, instead it occurs in a subsequent sentence. It is suggested, that this unfilled Instrument Role can assist the integration of the instrument in the subsequent sentence by functioning as an antecedent for the reference to the instrument. This use of verb-based roles is analogous to the use of script-based antecedents (section 3.2.1a) and similar to Carlson & Tanenhaus' concept of "open roles".

3.4.2 Verb Roles and Inference: Default Values

Despite the default filling of verb roles being well motivated; the empirical evidence for the routine encoding of verb entailed roles is mixed (McKoon & Ratcliff, 1992). A detailed discussion of the empirical data is presented in Chapter Six but a brief discussion of some pertinent issues is given below.

Recall that the major argument against the routine instantiation of default values is the range of inferences that it would produce. The problem is especially relevant to large scale schema structures. The more extensive and detailed the knowledge base the greater the number of Roles and associated default values that could be taken, hence the greater number of inferences that can be made. However, it may be slightly easier to examine inferences associated with verbs as they seem to support a more restricted set. Unfortunately, even here, the empirical support is mixed.

Corbett & Doshier (1978), Doshier & Corbett (1982) in a series of priming studies investigated the encoding of verb-related roles (Agents, Patients and most extensively Instruments) and failed to find any solid evidence that verb-based concepts are automatically encoded during comprehension. Such findings are inconsistent with schema-based accounts of comprehension.

Doshier & Corbett (1982) argued that although the empirical evidence only offers limited support for the encoding of case-filling inferences, empirical studies provide no information regarding the activation of default values. Default values may have been activated but not included in the memory representation because they were not critical to the gist of the material. Such a view raises the need to distinguish between the activation of default values and the actual instantiation of these default values. Mauner et al. (1995) suggest that an implicit instrument may always be activated when the verb is read, but not always instantiated. If this is so, we need to examine the conditions determining instantiation. Evidence (Garrod et al, 1991) suggests that context may be important factor in determining the degree of elaborative processing. However, the introduction of contextual information sometimes makes it difficult to differentiate between a verb-based instrument inference and a more general script-based inference. Is the default value derived from lexical or contextual information?

3.4.3 Verb Meaning and Comprehension

The empirical work of Just & Carpenter (1978) was one of the earliest attempts to investigate if verb-based information, specifically verb meaning, can assist comprehension and whether this influence operates outwith the sentence. They investigated whether lexical items can give rise to inferences that link sentences. Consider the verb "murder" which entails an Agent, a Recipient, and an Instrument Role. It was shown that these entailed roles can be used to integrate subsequent sentences which mention these items.

Just & Carpenter (1978) examined How and When a reader infers the relation between a verb and its entailments. They hypothesised that such a relation should take a certain amount of time to compute, and that this time may be influenced by the lexical relationship between the verb and its associated concepts. The closer the relationship, the easier and quicker the process. They

compared the time taken to process a reference to an entailment by comparing reading time for the concept (killer) in sentences such as:

(15) Direct Relationship

THE MILLIONAIRE WAS MURDERED ON A DARK AND STORMY NIGHT.
THE KILLER LEFT NO CLUES FOR THE POLICE TO TRACE.

(16) Indirect Relationship

THE MILLIONAIRE DIED ON A DARK AND STORMY NIGHT.
THE KILLER LEFT NO CLUES FOR THE POLICE TO TRACE.

Whereas the relationship between "murder" and "killer" is direct in example (15), it is less direct in example (16). If someone dies, it does not necessarily mean that a killer is involved. Thus, if one sentence refers to someone dying and the next sentence refers to a killer, it might take more time to infer the relationship. As expected, it took longer to process a reference to an agent (the killer) after "die" that does not entail a killer, than it did after "murder" which does make the entailment.

There are two possible explanations for the timing of this verb-based inference process. One possible explanation is that integration is the result of forward inferencing. Schank (1973) proposed that all the cases associated with the verb become available when the verb is read. If a lexical item (in the above example, "killer") then refers to a previously unspecified case (Agent) then it can easily be integrated because the case is already specified in the representation. For example, after reading a sentences containing "murder", it would be easy to integrate "killer" as the representation of "murder" already contains the concept "killer". In contrast, following the verb "die" additional inferential processing would be required to integrate "killer". Alternatively, Case relations may only be represented when required, when the referent is mentioned. Unfortunately, Just & Carpenter's method does not allow us to determine the timing of the inference process and hence evaluate these alternative explanations. However, the empirical work presented in later Chapters permits a more detailed examination of the availability of verb-based information.

3.5 Instrument Inferences

3.5.1 Instrument Inferences: Scripts or Verb-Schemata?

The distinction between verb-based and script-based information is similar to the distinction that is drawn between lexical and contextual knowledge. Instrument inferences are generally thought to be closely associated with verbs, and the previous discussion has shown how lexical structure can assist the process of reference resolution. The question is whether all instrument inferences are verb-based. If this is the case, we would expect the empirical data to be conclusive rather than offering only weak support for their encoding. Other factors must influence their encoding. Lucas et al. (1990) demonstrated that instrument inferences are more likely to be drawn if there is a strong biasing context. If instrument inferences are verb-based why does context influence their encoding?

Consider the influence of context: does it modify (constrain content) or establish an Instrument Role. Assume a basic verb schema for "cut" consisting of three roles: Agent, Object, and Instrument; with the Instrument Role being optional in the sense that it does not have to be explicitly mentioned in the text, as it is easily inferred by default. The default value for the instrument associated with the basic verb schema for "cut" would be "knife". In the context "cut cake", the most likely default instrument is consistent with the verb schema default: "knife". In contrast, the most likely default in the context "at the hairdresser/cut hair" would be "scissors". This contrasts with the default value of the verb schemata which is "knife". This example illustrates how default information can be supplied by the context. The question is whether the context establishes the Instrument Role (script-based role) or only constrains the nature of the default value of the verb schema.

Context appears to differentially influence the content of the Instrument Roles associated with different verbs. In some cases, the content of the Instrument Role seems more connected to the context (script-based) than the verb. Consider how contextual restrictions can influence the nature of a role filler. First consider "Garrod & Sanford verbs", here the instruments are associated with the Verb alone i.e. "drive" implies the use of a "vehicle". In contrast, for so-called "general verbs" the instrument is associated with a verb+object pair, rather than the verb. For example the general verb "hit", "bats" are associated with "hitting a ball" rather than just "hitting". These verb-object pairs vary according to the context in which they are used. Therefore, context can restrict the nature of an instrument because

only certain instruments will be used to perform certain actions in specific contexts. Take for example, the verb "spread": the instruments used to perform various acts of "spreading" will vary according to the situation in which they are performed i. e., to "spread butter" you would use a "knife"; but to "spread cement" you would normally use a "trowel".

This differs from the way in which context can modify an instrument associated with a Garrod & Sanford Verb. Let us again examine the verb "drive" which implies the use of a "vehicle". Although the exact nature of the vehicle can be mediated by context i. e. in the context of a farmer carrying out farm work the type of vehicle used is most likely to be a tractor; this possibility is highly unlikely in the context of a chauffeur conducting his duties. So although the type of vehicle may vary as a function of the context of use, the actual nature of the instrument itself remains constant: a vehicle of some description will always be used.

These examples illustrate that it is not easy to disentangle the source: verb-based or script-based information, responsible for establishing and providing the content of an Instrument Role. The issue seems clearer when the verb default and contextual information are consistent, but problems arise when the verb default is inconsistent with contextual constraints. However, this clash is interesting as it highlights how context can influence a possible default value. The question remains, whether context is constraining the default value of an existing verb-based role or creating a new contextually defined Role. To illustrate this point consider the verb "write". Assume that the default instrument associated with the verb "write" is "pen". If the verb is used in a consistent context, "write letter" then there is no conflict between the contextual and lexical default values. However, if the verb is used in the context "write blackboard" then the contextual and lexical default values conflict "chalk" rather than "pen". The experimental results (cf. Chapter 8) suggest that if the lexical based default information is consistent with the contextual default then the instrument is more rapidly integrated compared to examples where there is a conflict between lexical and contextual information. In addition, the results suggest that the preferred instrument of a verb (the value thought to be the basic verb schema default instrument) is initially preferred until contextual information shows it to be inappropriate. These results suggest that lexical default information is rapidly available and assists the processing of a reference to the instrument before contextually appropriate default information.

Roles and the associated constraints on their fillers are an excellent medium with which to represent default information because roles can be derived from both lexical and contextual information and constraints on their fillers can come from either, or both of, these sources. The use of a single mechanism provides a possible explanation of the interaction of lexical and contextual information during discourse processing.

3.5.2 Instrument Inference: Meaning or Interpretation

Asking whether instrument inferences are verb-based or script-based raises the distinction between meaning and interpretation. Even if instrument inferences are verb-based we still need to distinguish between verb meaning and verb interpretation: the interpretation of the verb may be guided by context. If instrument inferences are purely verb-based why and how can context influence their encoding? The fact that they are open to contextual influence tends to suggest that they are a product of interpretation. It is interesting to note that the degree of contextual influence depends on whether the instrument is based on the verb or a verb+object pair. The contrast between the influence of context on a Garrod & Sanford verb and the influence of context on a General verb illustrates this fact. In the first instance, the context constrains the nature of the instrument, in the second it is the object of the verb that determines the nature of the instrument.

Does context influence word meaning; or does the meaning remain fixed and only the interpretation differ? Does the use of a different instrument constitute a difference in meaning (examples 19, 20, 21). It is interesting to note that there is a continuity in these uses of cut, although our conception of the events and the instruments used is different. Would it be accurate to say it was a different meaning; is it just simply a different interpretation of the same event? We interpret the verb in context, so perhaps content of the instrument role is determined by context but the actual role itself is provided by the verb. To decide, the plausibility of a lexically based explanation must be considered. Consider the distinction between Meaning and Interpretation and how it may explain the different intuitions of the events described and how they differ depending on the nature of the object of "cut".

(19) BILL CUT THE GRASS.

(20) BILL CUT TOM'S HAIR.

(21) BILL CUT THE CAKE.

Is the use of "cut" in the above examples ambiguous? However, "cut" is not ambiguous like "bank"; all its occurrences seem to involve "a common semantic content" which includes the notion of physical separation by means of the pressure of some more or less sharp instrument. Yet despite this, the sort of thing that constitutes cutting the grass is different from our ideas about cutting cake. Not, even on standard linguistic tests for ambiguity (conjunction reduction) as in example 22, suggest it is ambiguous or even a different sense.

(22) BILL CUT THE GRASS, TOM'S HAIR, AND THE CAKE.

This contrasts with the failure of conjunction reduction in examples of the figurative or idiomatic use of "cut".

(23) THE PRESIDENT OF THE MULTINATIONAL COMPANY CUT THE SALARIES OF ALL THE EMPLOYEES BY FIVE PERCENT.

(24) BILL CAN'T CUT MUSTARD.

(25) * THE PRESIDENT OF THE MULTINATIONAL COMPANY CUT THE SALARIES OF ALL THE EMPLOYEES AND CAN'T CUT MUSTARD.

(26) * BILL CUT THE GRASS, THE CAKE, AND THE SALARIES OF ALL THE EMPLOYEES.

The difference between meaning and interpretation can also be applied at the sentence level by distinguishing between "Literal meaning" and "Utterance Meaning". The Literal meaning of a sentence is the basic linguistic interpretation regardless of context, and the utterance meaning includes elaborations on this basic meaning using contextual and general knowledge. Such a distinction may be acceptable in theory, but we need to ask what constitutes understanding: literal meaning or utterance meaning?

Perhaps "cut" is Vague, with the context of the rest of the sentence allowing the reader to infer what is meant, even though the meaning was not precisely expressed by the literal meaning of the sentence. This appears to be supported by the existence of more precise verbs ("mow", "stab", "slice", "trim") that would more exactly express what the speaker meant. Consider example 19 (Bill cut the grass) again. If there is a difference between less precise literal sentence meanings and more precise intended meaning, then this example would be expressed by:

(27) Literal Meaning

BILL MADE A SEPARATION OF THE GRASS USING A MORE OR LESS SHARP INSTRUMENT.

(28) Utterance meaning

BILL MOWED THE GRASS.

Although the vagueness explanation is plausible it has limitations. Firstly, it suggests we should be able to understand sentences like "Bill cut the coffee". Although we may understand each of the words, it is not possible to understand the sentence because we do not know the truth conditions that they determine: don't know what it means "to cut coffee" without using context. The sentence alone does not allow us to determine the truth conditions. Secondly, it allows scope for idiosyncratic interpretations of meaning such as stabbing the grass with a knife in attempt to cut it. Lastly, in order to understand "cut" we would need to move from a common literal meaning of "cut" through a process of unconscious inferences to different speaker meanings. This whole notion of vagueness involves a process of inference from the general to a specific case. It suggests that we would have a very general meaning and then refine it. Although this does have some credibility, it contains the assumption that we would understand "Bill cut the grass" without any context as meaning "Bill made a separation of the grass using a more or less sharp instrument" and then by a series of steps in an inference involving assumptions about the context derive "Bill mowed the grass". It seems psychologically implausible to assume that we learn the meaning of "cut" by learning its paraphrase and ignoring the common everyday use. If someone told you that "Bill made a separation of the grass using a more or less sharp instrument" you would wonder what they were talking about; in contrast you would have no such difficulty with "Bill cut the grass".

The problem with a basic, context free definition of meaning is that it can become too vague, and lose the ability to express fine distinctions within a sense. It

removes any linguistic basis on which to differentiate sense and all richness and particularity in understanding must be explained in terms of world knowledge.

Despite these differences, the verb "cut" still retains its continuity of meaning in all these events: separation using a sharp instrument. The problem is to explain all the extra information about the manner and circumstance of "cutting" that springs immediately to mind when reading these different examples. The traditional solution is to distinguish between Meaning (lexical knowledge) and Interpretation (contextual knowledge), with "Meaning" being the core meaning of the verb regardless of context and the "Interpretation" being the elaborated, contextually appropriate meaning of the word.

It seems that the difference between these uses of cut may not lie in any ambiguity of a semantic kind, but rather in terms of our understanding (interpretation) against a background of information about how nature works and how culture works. It is possible to understand the sentence "Bill cut the grass" differently from "Bill cut the cake", not because of any ambiguity or vagueness in the original but because we know a lot of things about grass and a lot of things about cakes. The knowledge that "cutting grass" is a different sort of business than "cutting cakes" is part of this larger system of knowledge.

Normal reading of these sentences goes beyond that expressed by the words alone. Our understanding (interpretation) will include the instrument by which the cutting is done. The verb "cut" is used in the same general sense in all these sentences- separate into parts using a sharp object, yet it is unlikely that this all there is to meaning of "cut". If it was, then cutting the cake with a lawnmower; or cutting the lawn with a knife would be equally acceptable. Sentence meaning is interpretation. A complete understanding can not be achieved unless it is assessed relative to the context in which it occurs. Even if sentences do have literal meaning, when it comes to understanding discourse we want understanding to be relative to context. When it comes to instruments the final interpretation is relative to context.

3.5.3 Implicit Instruments and Variable Binding

Implicit instruments, like all other implicit information may be treated as variables (roles) which can accept as a value, any reference that satisfies their associated constraints. Differences in satisfying these constraints may explain the

acceptability or unacceptability of the occurrence of instruments and verbs. Differences in the degree of satisfaction of these constraints may explain why certain verbs initially retain a preference for a particular instrument even the presence of a strong biasing context and why some instruments are more stereotypical than others ("scissors vs razor blade" example 3. 1. 2c).

For instance, the Instrument role associated with the verb "drive" will only accept references that satisfy the constraints on a motor vehicle:

(29) KEITH DROVE TO LONDON.

THE CAR/ THE LAND-DROVER/ THE BUS/ THE MOTORCYCLE

(30) KEITH DROVE TO LONDON.

* THE AEROPLANE/ THE BICYCLE/

In contrast the verb "travel" does not impose such restrictive constraints on the method of transport:

(31) KEITH TRAVELLED TO LONDON.

THE CAR/ THE LAND-DROVER/ THE BUS/ THE MOTORCYCLE/
THE AEROPLANE/ THE BICYCLE/ THE TRAIN

By representing implicit entities as variables with the appropriate constraints it is possible for implicitly introduced information to assist subsequent processing in a principled contextually appropriate manner.

Despite the obvious advantages that can be derived from implicit information it is important that the representation of explicit and implicit information remain distinct. The need for such a distinction is shown by differences in the accessibility of explicit and implicit information for reference. One of the most important is that implicitly introduced information does not support a subsequent pronominal reference. Compare:

(32) KEITH TOOK HIS CAR TO LONDON OVERNIGHT.

IT HAD RECENTLY BEEN OVERHAULED.

(33) KEITH DROVE TO LONDON OVERNIGHT.

* IT HAD RECENTLY BEEN OVERHAULED.

It is also difficult to understand indirect attribution statements about an entity previously implied rather than explicitly introduced. Consider,

(34) KEITH TOOK HIS CAR TO LONDON OVERNIGHT.
THE ENGINE HAD RECENTLY BEEN OVERHAULED.

(35) KEITH DROVE TO LONDON OVERNIGHT.
* THE ENGINE HAD RECENTLY BEEN OVERHAULED.

In order to fully understand example 35 it is necessary to make the following bridging inference- driving implies travelling in a vehicle (role filler); a vehicle requires an engine; this engine serves as antecedent to "the engine" in the discourse. The fact that the representation of drive contains the role "Vehicle" is of little assistance because "the engine" does not satisfy the constraints associated with this role. Instead, it is necessary to generate some antecedent that both maps into the variable "Vehicle" and which can act as a suitable antecedent for "the engine".

If the filling of roles is based on satisfying the associated constraints, and if this matching process takes a proportionate amount of time, then some terms would be a better and quicker fit than others. If a reference perfectly matches the variable specifications it may be integrated faster than one that does not. Such a proposal may explain why the preferred instrument of a verb is easier to integrate than a non-preferred instrument. Perhaps, preferred instruments match the associated variable constraints better than the non-preferred instruments. Consider the preferred and non-preferred instruments associated with the verb "write"- "pen" and "chalk". If a variable matching perspective is taken, then "pen" would be regarded as being integrated faster because it is most consistent with the constraints associated with the instrument role despite the fact that in the context of "writing on a blackboard" "chalk" is the most appropriate instrument. Such a proposal suggests that verb-based information may initially take priority over contextual information during discourse integration.

A constraint satisfaction approach suggests that certain verbs may place stricter constraints on their associated variables than others. This offers an other perspective on the origin of instrument roles. Constraints being derived from the verb (verb-based constraints) or from the context (script-based constraints) with lexical constraints coming into play first and contextual constraints later.

3.6 Advantages of a Role-based Explanation

The examples presented in this chapter illustrate the benefits that can be derived by using the concept of Roles to represent information associated with language. Attention has focused on the advantages of viewing text understanding as a process of role mapping. One of the major advantages of roles is their ability to remain unbound and hence assist integration not only of information within a sentence but within a discourse. The examples discussed in this chapter also illustrate how verbs and larger scale knowledge structure (Scripts) and the roles they provide can assist integration at both the sentence and discourse level.

Roles can represent a diverse range of information in a structured format. They can be used to represent language information at all levels: lexical semantics to discourse. Their very nature (variables) and the associated constraints on their binding allows them to represent any kind of information in a consistent manner. It is interesting to note that role-based accounts have been used to capture the underlying intuitions that we have about events and their participants whether they be expressed in terms of thematic roles or more general script-based concepts.

Roles have the additional advantage that they can accept default values. The ability to inherit default information has enormous implications for their use as a means of representing implicit information in a discourse representation where so much of the information intended to be conveyed is implied rather than explicitly stated. The use of default values is most obvious with respect to elaborative inferencing.

The use of roles to represent the information conveyed by verbs highlights that Verb-based information is crucial to the process of comprehension and any detailed investigation of discourse must consider the way in which a verb and its associated information can guide the process of interpretation. Roles (variables) and their associated default values can easily represent information associated with verbs and how this information can assist discourse integration. Role-based explanations have the added advantage that they allow us to use the same means to represent both lexical and contextual information. One of the most important aspects of roles, whether they be script-based or verb-based, is their ability to accept default values. The instantiation of roles with their default values is assumed to underlie the process of elaborative inferencing. Despite the usefulness of roles, their origin is not always clear: the problem of determining the origin and

content of a role was discussed with respect to instrument inferences. Despite this problem, roles and differences in the nature of constraints on their possible values offers an interesting perspective on the acceptability of instruments by verbs and why some instruments seem more stereotypical than others for certain actions.

It is important to remember that linguistic accounts have been posited to explain, at the level of syntax and semantics, the same conceptual notions (agency, instrumentality, causality etc.) that have been captured by roles in Psychological accounts such as Scripts, Schemas and Frames. The important function of verbs and their associated information has been discussed within the Linguistic literature and these proposals have influenced recent Psycholinguistic theories (Carlson & Tanenhaus, 1988) which propose that verbs and their associated roles can guide comprehension processes and assist the construction of a full discourse representation. The idea of verb related roles assisting discourse integration is also present in current computational accounts of text comprehension. Whittmore et al (1991) for example, allow both verb-based and context-based information in the form of expected adjuncts to assist the process of reference resolution. A detailed discussion of the Linguistic concept of Roles is given in the following chapter.

Chapter Four

The Linguistic Concept of Roles

4.1 Linguistic Conceptions of Roles

Linguists have used Roles (thematic roles) as a means to represent how events and their participants are expressed in the syntax of the sentence that describes the event. Despite the controversy over their nature and grammatical status, Linguistic conceptions of Roles have had a significant impact on Psycholinguistic accounts of language processing.

Psycholinguistic interest in thematic roles has focused first on their syntactic (Stowe, 1989) and now on their discourse function. Carlson & Tanenhaus (1988) should be credited with focusing our attention on the possible discourse benefits that can be derived from thematic roles, specifically their concept of "open roles". Carlson & Tanenhaus (1988) extensively discuss the concept of implicit thematic roles and propose that thematic roles not assigned to an argument within a sentence can remain as "open roles" (unfilled roles) within the discourse model and assist the integration of a subsequent definite noun phrase that fills such a role.

In this Chapter deficiencies associated with thematic role accounts are discussed with respect to Instruments. Within the empirical framework of Psycholinguistics, instrument inferences are generally regarded as "case-filling inferences". Just as verbs of movement typically co-occur with adjuncts denoting a location, verbs of action typically co-occur with instruments (instrumental adjuncts). A thematic role frame-work has difficulty explaining how instrument roles can assist discourse integration because an Instrument thematic role is not assigned. Thematic roles are assigned on a strict syntactic basis and since instruments are generally optional, rather than necessary, complements they are not assigned a thematic role. The problems that thematic role accounts have in explaining the possible discourse benefits that can be derived from implicit instruments highlights the need for a broadening of the concept of thematic roles when applied within a Psycholinguistic framework. The notion of a more conceptually based role, a Discourse Role, and how these Roles can assist integration by acting as antecedent sites for reference is outlined.

4.1.1 Cases and Thematic Roles

The concept of Thematic roles was first discussed by Fillmore (1968) under the title of "Cases". Many of his proposals are still recognisable in contemporary discussions of thematic roles. Most notably, Fillmore's proposal of what Carlson & Tanenhaus (1988) term "thematic ambiguity".

Fillmore motivated his use of Cases as follows: "case-structure descriptions of words and sentences offered a level of linguistic organisation at which universal properties of lexical structure and clause organisation were to be found, and, moreover, that such descriptions were in some sense intuitively relateable to the ways people thought about the experiences and events that they were able to express in the sentences of their languages" (Fillmore, 1977, P. 62).

From this, we can see that Fillmore regarded Cases as a means of capturing our intuitions about events, together with the actions and the participants involved in them. Fillmore proposed that these intuitive judgements could be expressed in terms of the semantic relations that hold between predicates and their arguments. He used Cases as a general means of expressing these relations. He regarded Cases as abstractions:

"what we need are abstractions from these specific role descriptions (*roles played by specific arguments in specific events*), abstractions that allow us to recognise that certain elementary role notions recur in many situations" (Fillmore, 1971, P. 376).

For Fillmore, Cases served a role identifying function, with each individual Case identifying the role played by the argument (assigned that case) in the event described by the verb. By using cases in this way, he hoped to bridge the gap between syntax and semantics. Cases express how the syntactic arguments of a verb are involved in the event described by the verb. Cases were thought to capture syntactically relevant aspects of meaning. This bridging function of Cases was thought to be, and still remains, their main source of appeal. It is interesting to note the similarity between Fillmore's notion of Case as a means to bridge the gap between syntax and semantics and Carlson & Tanenhaus's view that thematic roles can bridge across syntactic, semantic and discourse levels of representation. It is this possible integrative function of thematic roles that makes the concept so appealing.

Fillmore assumed that Case information was contained in the lexical representation of the verb. A verb's lexical entry contains "frame features" which specify the "case frames" (types of arguments and the cases they can accept) with which a verb can occur. This is similar to Chomsky's sub-categorisation information in that it accounts for syntactic co-occurrence, but unlike Chomsky, Fillmore did not assume that Case information was the only information contained in a lexical entry.

Fillmore proposed the following six Cases and definitions:

i) Agentive

The case of the typically animate perceived instigator of the action identified by the verb.

ii) Instrumental

The case of the inanimate force or object causally involved in the action state identified by the verb.

iii) Dative

The case of the animate being affected by the state or action identified by the verb.

iv) Factitive

The case of the object or being resulting from the action or state identified by the verb, or understood as a part of the meaning of the verb.

v) Locative

The case which identifies the location or spatial orientation of the state or action identified by the verb.

vi) Objective

The semantically most neutral case, the case of anything representable by a noun whose role in the action or state identified by the verb is identified by the semantic interpretation of the verb itself: conceivably the concept should be limited to things which are affected by the action state identified by the verb.

4.1.2 The Instrumental Case

Fillmore used the Instrument Case to account for the syntactic co-occurrence of verbs and inanimate subjects as well as instrumental adjuncts.

He discusses the verb "open" to illustrate his view of the instrumental case.

(1) JOHN OPENED THE DOOR.

Agent

(2) THE KEY OPENED THE DOOR.

Instrument

(3) JOHN OPENED THE DOOR WITH THE KEY.

Agent

Instrument

He uses the acceptable occurrence of both "John" and "the key" in the same sentence with the verb ("open") playing their respective roles to justify the need for both an Agentive and Instrumental Case.

Fillmore's account is unique in that he assigns an Instrument role to instrumental adjuncts. Other theories only assign the Instrument case to an inanimate subject (2) because the Agent role is not applicable, and not to an instrumental adjunct (3). As a result, they fail to capture the concept of instrumentality.

Fillmore's ideas about how to capture our underlying intuitions about events have had far reaching implications in both Linguistics and Psychology. His concept of Case has been refined and applied to various aspects of language processing but its biggest impact has been to motivate the empirical study of Instrument inferences, with Instrument inferences being generally regarded as case-filling inferences (McKoon & Ratcliff, 1992).

Unlike, syntactic-based views, Psychological studies of Case are closer to Fillmore's original goal of examining and explaining our intuitive notions of events and their participants. Although an instrument may not be necessary for a syntactically well-formed description of the event of "cutting a cake", it is unarguably part of our understanding of such an event. As subsequent discussion will show, it is the reliance on syntax to constrain the range of thematic roles that renders them unable to account for our intuitions about the involvement

of instruments in events. Such a criticism is not so serious for theories that regard thematic roles as syntactic or semantic in nature, but is serious for current views (i.e. Carlson & Tanenhaus) which view thematic roles as conceptual entities.

4.1.3 Government & Binding Theory (GB)

The concept of Thematic roles was widely discussed in the linguistic literature by Chomsky (1981). He formalised Fillmore's notion of "Case" and demonstrated how "theta-roles" may serve as the basis for a grammatical theory. Chomsky regarded theta-roles as the sole component in a verb's lexical representation. These theta-roles were viewed as the syntactic primitives from which syntactic structure is derived. By placing restrictions on role assignment (roles assigned on syntactic basis): a verb must assign a theta-role to all its subcategorised arguments and the subject of the sentence; and imposing the constraint of thematic uniqueness (no verb can assign the same theta-role to two of its arguments). Chomsky attempted to account for the grammatical structure of language and the syntactic co-occurrence of verbs and arguments.

Chomsky's work has been very influential and many of his ideas have been incorporated into current views of thematic roles. For example, Carlson & Tanenhaus accept his constraints and only assign thematic roles on a strict syntactic basis (only subject and arguments assigned a role, and the same role cannot be assigned to more than one argument). However, the emphasis he places on them as a syntactic entity as we shall see, is generally questioned, and not widely accepted.

4.1.4 Criticisms of Thematic Roles

The concept of Thematic roles (in some form or other) has been used to explain a wide variety of linguistic phenomena ranging from the generation of grammar (Chomsky, 1981), to the integration of elements in a discourse model (Carlson & Tanenhaus, 1988). These uses are far removed from Fillmore's initial attempt to capture our intuitions about events and their participants.

Despite their wide spread use, there is immense controversy in the linguistic literature concerning their nature and grammatical significance. At present, there is no widely accepted set of roles, a classification system (hierarchy) or definitions.

This general lack of clarity and precision makes it very difficult for claims concerning their nature or range of application to be validated.

Various perspectives have been taken on thematic roles. At one extreme, they have been viewed as elements playing a crucial role within the grammar of language (Chomsky, 1981); at the other extreme, Ladusaw and Dowty (1988) view thematic roles as generalisations over entailments of verb meaning and are therefore devoid of any special significance in either linguistic or semantic theory. The majority of theorists, particularly those within Psycholinguistics, adopt a more intermediate stance and regard thematic roles as semantic or conceptual elements. Carlson & Tanenhaus (1988), for example, regard thematic roles as a semantic or conceptual phenomena whose main function is to relate arguments of a verb to the meaning of the verb in semantic interpretation. However, the conceptual status of thematic roles is by no means established. Thematic roles need not be viewed as conceptual primitives. Jackendoff (1987) identifies thematic roles with certain conceptual configurations. For example, the notion of agency is identified with the conceptual element functioning as the first argument of the concept of causation. Such an approach permits a fine-grain analysis of the relationship between arguments and events. (see section 4. 5. 3 for a more detailed discussion).

4.2 The Nature of Thematic Roles

What is the exact nature of Thematic Roles and how does it relate to their function? As we can see, one of the major question that arises with respect to thematic roles is whether they should be characterised as a syntactic, a semantic, or a conceptual phenomenon. A comprehensive discussion of the nature of thematic roles is given by Carlson (1984) in which he justifies assigning thematic roles an intermediate status between syntax and semantics.

4.2.1 Carlson's View

Carlson (1984) argues that thematic roles should not be regarded as a syntactic entity (from a structuralist perspective) because they are not required to account for the formal structure of sentences. Even in GB, where they play a fundamental part, there is nothing of significance in the syntax that is dependent on which thematic role an NP is assigned. All that matters, is that a role is assigned (theta-

criterion). Hence, thematic roles should not be regarded as elements of syntax necessary to account for the form of language.

Nor does he assume that thematic roles are purely semantic (on a model-theoretic definition) in nature. Although thematic roles may be important in determining the truth-conditions of sentences. For example, the truth of "John was smoking" depends on whether the subject ("John") is assigned the role of Theme or Agent. They have certain properties that cannot be explained using the usual assumptions concerning the nature of model-theoretic interpretation: language constrained by the nature of world.

The constraint of thematic uniqueness (no verb seems able to assign the same thematic role to two or more of its arguments) can not be explained in terms of structural constraints (Barwise & Perry, 1983). Structural constraints are used to limit our interpretations of language because the way the physical world is constructed, is thought to constrain our interpretation of language. For example, kissing entails touching. Thematic uniqueness is difficult to explain in terms of structural constraints. Carlson provides the following example: "John stouched Bill". He takes "stouched" as designating an event in which both the subject and the object get touched. However, there are no verbs like "stouched" which assign the role of Theme to both their subject and object, despite the fact that there is no reason to expect that such events do not, or cannot occur. We are just not able to describe them in this way. Therefore, the constraint of thematic uniqueness can not be explained in terms of the nature of reality because nothing in reality precludes relations between elements of an event that play the same role. Carlson suggests that the constraint of thematic uniqueness is therefore a property of events, and not a property of the verb, or reality.

It seems that thematic roles can neither be explained on purely syntactic or semantic grounds. This may be due to their relationship with events rather the world. Such a relationship would give them some kind of conceptual status. It is interesting to remember that Fillmore perceived Case relations as "abstractions" that captured widely recognisable relations that hold between a verb and its associated arguments in the event they describe. Cases were labels for relations that attempted to characterise the part arguments play in our representation of events. This is similar to Carlson's view, " ...thematic roles can be looked upon as functions which map individuals to sets of events, the events in which that individual participates in that particular way" (Carlson, 1984, P. 268).

From this perspective, thematic roles are regarded as conceptual in nature, since they describe involvement in events.

4.2.2 Dowty's View

The status of thematic roles within linguistics has been most strongly criticised by Dowty. He questions their theoretical significance and suggests they should be regarded as labels for clusters of verb entailments and presuppositions, and therefore not assigned any grammatical significance. He discusses the problems with identifying and defining a comprehensive set of roles and proposes "proto-roles" as a possible means to identify Agent and Patient roles.

Dowty (1991) proposed "cluster definitions" of Roles in which thematic role type is assigned on the basis of having the largest number of basic proto-thematic-role properties. For instance, the role of Agent would be assigned to the argument possessing the most "agent-like" properties (including volition, sentience, and "causes an event", and movement) and the role of Patient to that having the most "patient-like" properties (including change of state, incremental theme, and causally affected by the event). He doesn't assume that these properties and their respective values (\pm) define what the labels Agent or Patient mean, they only help to characterise them and, perhaps more importantly, characterise them with respect to the verbs with which the roles are associated. This is important as different verbs will have differing numbers of positive and negative values for their Agent and Patient properties (e.g. some will have volition + and cause +, others will not).

Dowty is right to question the status of thematic roles and he should be credited with highlighting a number of their problems. However, his proposed "proto-roles" are only an attempt to identify rather than define thematic roles and the cluster definitions he proposes do not have much conceptual appeal.

4.3 The Advantages and Disadvantages of Thematic Roles

Despite their unresolved status, the concept of thematic roles has exerted a powerful influence on current Linguistic and Psycholinguistic theory. Psycholinguistic interest in thematic roles has focused first on their syntactic function and now on their possible discourse benefits. The question is why has

such an imprecise concept been so widely applied? The usefulness of thematic roles in language processing is expressed by the following quote:

"Thematic roles are of particular interest in the study of sentence processing as they cut across aspects of representation that are typically considered distinct from one another. On the one hand, thematic roles are aspects of conceptual representation. Events and modes of participating in events are arguably conceptual notions. It is also common place to assume that events and their participants are elements of a discourse structure. More locally, thematic roles are closely tied to the syntactic structure of a sentence, as only modes of participation that are realised as syntactic complements of a verb are associated with thematic roles. Thematic roles, then, provide a form of representation with access to concepts and meaning, and elements of discourse structure that map directly on to syntactic form. This property of roles suggests that they should be useful to the comprehension system in co-ordinating different types of information. In addition, the way that the comprehension system exploits the information supplied by thematic roles may provide interesting insights into its architecture" (Tanenhaus, Carlson & Trueswell, 1990, P. 213).

In most cases, the controversy over their linguistic status is acknowledged and then despite this (or perhaps because of this) general assumptions are made. The main assumption concerns their nature. As discussed earlier, it is their assumed nature (their underlying intuition) that makes them so appealing. They offer a relatively simple way to bridge the gap between syntax, semantics, and discourse levels of representation. Although, the concept of thematic roles has been used to explain so many things (thematic hierarchies and antecedent assignment, parsing, processing of unbounded dependencies) it may not actually be thematic roles that were intended. Rather it may be their underlying nature that is being used. As a result, the concept of thematic roles has been over-generalised in an attempt to explain a range of data which they were never intended to explain.

By focusing on Thematic roles, even Carlson & Tanenhaus' implicit roles, we have restricted our view of how lexical information may be involved in language processing. Although implicit roles have focused attention on the possible benefits of implicit information; the concept of implicit thematic roles has focused attention only on semantic information that is syntactically relevant and resulted in the neglect of information contained in the verb but not expressed in the syntax.

Although thematic roles have been used to explain various lexical-based phenomenon they should not be regarded as a lexical theory. Such an assumption, probably derived from Chomsky's proposal that theta-roles were the sole information in a verbs lexical entry. It should be remembered that thematic roles were posited to account for the syntactic co-occurrence of a verb and its arguments; not as a theory of lexical semantics. They can only ever express syntactically relevant aspects of meaning. The preoccupation with establishing a well-defined set of thematic roles that can adequately account for syntactic phenomena has distracted attention away from the important role that information conveyed by the verb can play in language comprehension.

Perhaps, now that emphasis has shifted towards the integrative function that thematic roles can play, more attention will be paid to the integrative benefits that can be derived from concepts inherent to the meaning of the verbs, and not just from their possible implicit syntactic arguments. To their credit, Carlson & Tanenhaus have acknowledged that "verb core meaning" may assist integration. However, subsequent discussion will show that their proposals are insufficient to explain the range of benefits that can be derived from verb-based information.

4.4 Thematic Roles and Discourse

Carlson & Tanenhaus (1988), Tanenhaus & Carlson (1989), should be credited with focusing our attention on the possible discourse benefits that can be derived from thematic roles. Given their importance, it is to a detailed discussion of their proposals that we now turn.

Carlson & Tanenhaus view thematic roles as a "semantic or conceptual phenomena whose main function is to relate "arguments" of a verb to the meaning of the verb in semantic interpretation" (Carlson & Tanenhaus, 1988, P. 266).

However, they assign these semantic or conceptual entities on syntactic grounds. They adopt the standard linguistic view (derived from Chomsky, 1981) that only syntactic arguments of a verb are assigned a thematic role, i.e. the subject of the sentence, and the subcategorised phrases in the VP, which are sisters of, and governed by the verb. Therefore, no adverbial modifiers or adjuncts are assigned a thematic role. These constituents, generally PPs, are not subcategorised phrases and therefore not assigned thematic roles. Instead the lexical meaning of the

prepositions themselves are assumed to relate the prepositional object to the meaning of the verb phrase. As we shall see, such a view has difficulty explaining the existence of implicit roles derived from verbs that can optionally be used with an instrumental prepositional phrase.

Carlson & Tanenhaus's view about thematic roles are based on the following representational assumptions. They assume that verb meaning is composed of two elements: core meaning and thematic roles. It is further assumed that the sets of thematic roles associated with the verb are, in turn, related to corresponding syntactic configurations in the verb's sub-categorisation information. Finally, and most importantly for the current discussion, not all roles need to be assigned within the sentence; and roles which are not assigned can remain open ("open roles") and assist in the integration of definite noun phrases in subsequent sentences.

Thematic roles are appealing from a psycholinguistic perspective as they seem to have access to aspects of representations conventionally regarded as being distinct. They are standardly conceptualised as being conceptual or semantic in nature, while retaining the ability to be mapped directly onto syntactic form. Given their diverse nature Carlson & Tanenhaus (1988) propose that they may be used to co-ordinate aspects of different representations during comprehension. More specifically, they mediate between syntax, a discourse model, and world knowledge. This is possible because thematic roles can be regarded as representing the conceptual aspects of the event denoted by verbs, these conceptual events and their associated participants are assumed to be included in a discourse model; the same thematic roles can also be mapped onto the syntactic structure of the sentence used to describe the event.

4.4.1 Open Thematic Roles and Discourse Integration

Carlson & Tanenhaus (1988) demonstrated how thematic information can influence the process of discourse integration. It was shown that the time spent reading a sentence was influenced by the availability of a thematic role for the noun phrase at the beginning of that sentence.

(i) Bill hurried to unload the car.
The suitcases were heavy. (Target)

(ii) Bill hurried to catch his plane.
The suitcases were heavy. (Target)

The reading times for a target sentence following sentences containing verbs which provided a thematic role that could be filled by the subsequent NP (i) were faster than targets following sentences that contained no such role. For example in sentence (i) the verb "unload" assigns the role Theme which is not assigned to an argument in that particular sentence, therefore it remains an "open role". This role can be filled by the first NP in the target sentence ("The suitcases"). In contrast, sentences like (ii) provide no open thematic role and the NP must therefore be integrated inferentially, hence the longer reading time.

Carlson & Tanenhaus concluded that thematic role information was being used to establish local coherence in the discourse. Active thematic roles that are not assigned to an argument remain as "open roles" in the discourse model. A subsequent NP that fills such a role will then be easier to integrate into the discourse model than an NP that does not fill such a role.

4.4.2 The Concept of Open Roles

"Open thematic roles" are possible because the same thematic grid can be associated with different subcategorisations of a verb. Take for example, the verb "load".

(4) JOHN LOADED THE TRUCK WITH WOOD
Agent Location Theme

(5) JOHN LOADED THE TRUCK.
Agent Location

It is assumed, in example (5), that there is an open THEME role: whatever was loaded into truck.

It is important to remember that "open thematic roles" are only one example of the implicit information that can be associated with verbs. There are numerous examples where it is possible for a verb to leave some argument unspecified: Agentless passives, ditransitive verbs used transitively, Null Complement anaphora. It is possible that information about all types of implicit arguments, and not only implicit thematic roles, may assist discourse integration (cf. section 4.5.2 for a detailed discussion).

By representing open thematic roles as unspecified entities in the conceptual representation of the discourse (discourse model) open roles, like anaphors and presuppositions can help create local discourse coherence by functioning as antecedents for definite NPs. This method of integration (role filling) does not seem to require a resource demanding inference. Although they fail to say how such roles are filled Carlson & Tanenhaus do say "filling such a role does not have to rely wholly upon general inferential processing" (Carlson & Tanenhaus, 1988, P. 278).

Carlson & Tanenhaus seem to distinguish between two processes: role filling and inference. Such a distinction is similar to that discussed by Garrod (1985) who distinguishes between logical and non-logical (model-based) inferences and regards model-based inferences as being less demanding than logical inference. Model-based information, like role filling may assist processing by reducing the need for complex, time-consuming bridging inferences.

4.4.3 Carlson & Tanenhaus's Treatment of Instrumentals

One of the most controversial issues concerning thematic roles is that of identifying a comprehensive set of roles. Possibly, the most widely debated issue is the assignment of an Instrument Role. Only Fillmore assigns an Instrument Case.

The instrumental case has provoked great controversy because although it seems intuitively part of our representation of the event, an instrument is not always present in the syntax; as instrumental PPs are optional arguments. Instrumentals are modifiers rather than complements, and consequently not included in the verbs subcategorisation frame, therefore not assigned a thematic role. So, although thematic roles attempt to capture our intuitions about actions they are assigned on syntactic grounds and only express aspects that are syntactically necessary. The disadvantages of relying on syntax to capture important aspects of our representation of events has particularly important consequences with respect to instrumentals.

4.4.3.1 The Case for an Instrument Case

Instrumentality can be expressed in two ways, neither of which can be captured by current conception of thematic roles. Instrumentality can be conveyed in a prepositional phrase headed by "with" as in "cut with a knife" or be inherent in the meaning of verbs. For example, "drive" and "knife", which not only specifies the use of an instrument but also the nature of the instrument: a "vehicle" or a "knife", respectively. Neither mode of expression can be captured by thematic roles because thematic roles are only assigned to arguments not prepositional adjuncts nor can they be used to express concepts inherent in the meaning of the verb outwith those expressed in the syntax. Given these restrictions, do thematic roles really fulfil their purpose and capture our intuitions about events?

As outlined earlier, Carlson & Tanenhaus regard instrumental adjuncts as being outwith the thematic domain of the verb. They accept that their decision not to assign an instrument role is controversial and they use a variety of linguistic tests to justify their decision. Their strongest defence is based on adjunct-argument alternation. Although some instrumentals show adjunct-argument alternation it is not that common. There are some examples which allow "with phrases", but

not instrumental subjects. The existence of such counter-examples, is used to justify their decision not to assign an instrument role.

In the examples below, the role of instrument is only assigned because a thematic role must be assigned to the subject of the verb. The role of Instrument rather than Agent must be assigned because the subject lacks animacy, a necessary condition for Agency.

(6) JOHN SLICED THE SALAMI WITH THE RAZOR-SHARP KNIFE.

Agent

Theme

PP Adjunct

(7) THE RAZOR-SHARP KNIFE SLICED THE SALAMI WITH EASE.

Instrument

Theme

Counter-Examples

(8) JOHN ATE THE SALAMI WITH A FORK.

(8') * JOHN'S FORK ATE THE SALAMI.

(9) FRED READ THE TELEPHONE BOOK WITH A MAGNIFYING GLASS.

(9') * THE MAGNIFYING GLASS READ THE PHONE BOOK.

However these counter-examples are not without their problems. The verbs used generally require an animate subject. Since the majority of instrumentals occur with action verbs and since action verbs generally require an animate subject, the linguistic test of argument-alternation does not seem particularly suitable. Secondly, examples (10) below which does show alternation highlights an important feature of instrumentals. In this example, a prepositional phrase, "with ease", is included which makes the sentence more acceptable Compare:

(10) THE RAZOR-SHARP KNIFE SLICED THE SALAMI WITH EASE.

(10') THE RAZOR-SHARP KNIFE SLICED THE SALAMI.

Perhaps, we need to justify focusing attention on the instrument in the absence of an agent to manipulate the instrument. Instruments are generally manipulated by

an agent to accomplish some action. Even when instruments are used in subject position there is still the intuition of Agentive manipulation. So when an Instrument is used in subject position, it must be so for a reason i.e. performed the task "with ease".

Tanenhaus & Carlson (1989) further justify their decision of not assigning an instrument role by offering an intuitive test for the presence of an open role: is something else a necessary participant in the situation playing that role. They regard necessary participation as a requirement for implications arising from open roles. Consider, John running to catch a plane, he is most likely to be at or near an airport. However, it is possible that there is no airport, in spite of the fact that such situations usually do involve airports. They assign "open roles" on necessary rather than pragmatic grounds. Since necessary participation is a condition for the presence of an open role and because so many instruments are not necessary, only likely, they are not assigned a role. An interesting point to remember is that we normally interpret text with respect to what is usual (scripts capture pragmatic, stereotypical instances), as opposed to what is necessary, hence default instruments, and in the above example the location of an airport, would generally be assumed in the absence of explicit information to the contrary. It is interesting to note that such intuitions are not captured by Thematic roles, but can easily be expressed by conceptual roles.

The fact that they don't acknowledge an open thematic role with respect to examples such as "John sliced the salami" and don't view "knife" as a necessary participant, implies we need some other way to capture instrumentality. It is difficult to imagine "cutting something" without an instrument. Therefore, shouldn't a full representation of "a cutting event" contain an instrument?

4.4.3.2 The Acceptability of Implicit Instruments

It is important to consider why instrumentals are not always realised and why their implicitness is so acceptable.

Perhaps the answer lies in recognising the concept of inherent instrumentality. If the instrument is inherent to the meaning of the verb then there is no need for it to be explicitly mentioned unless we want to bring it into focus at that particular time. Unfortunately, studying thematic roles has directed attention to syntactically relevant aspects of verb meaning and distracted interest from

concepts that are inherent in the meaning of verbs. Just because they are not realised syntactically does not make them any less important, they are an integral part of meaning and their importance should be addressed.

A similar explanation may be applied to contextually derived instruments. Why explicitly mention something if it is not particularly salient to the topic at hand. Such an explanation of the acceptability of implicit instruments has a Functional appeal. By simply saying "John sliced the meat" it is possible to omit the instrument because all the information conveyed by the omitted complement can be conveyed by the verb. Such an economical mode of expression is useful when the implicit arguments are not particularly important to the discourse. Since they are not explicitly mentioned, they do not shift attention away from the topic of the discourse. However, expression of an argument brings it to the foreground where it can then serve to control the topic of the discourse. Therefore, by not imposing strong correspondences between concepts and their syntactic realisations, language allows the speaker or writer to strike the desired balance between the amount of information conveyed, its importance to the discourse as a whole, and the complexity of the forms with which it is conveyed.

4.4.3.3 The Concept of Core Meaning

Carlson & Tanenhaus (1988) appreciate that implicit roles are not the only means of integration. They acknowledge the traditional use of inferencing to establish coherence and, in addition, propose that verb "core meaning" may assist integration.

" We are not suggesting that thematic roles are the only mechanism for discourse integration effects for definite NPs, by any means. It is well known that definite NPs can be used felicitously in part-whole situations.... Verb core meanings as well may lead to ease of integration, even in the absence of thematic roles.the verb *perform*, which on our analysis does not provide a thematic role for an audience. Still the core meaning of the verb would involve saying something about a performance being intended for an audience (even if one does not show up). Thus the ease of integrating a discourse like *The schoolboys performed the play. The audience was wildly enthusiastic.* We see open roles as but one road to discourse integration." (Carlson & Tanenhaus, 1988, P. 281).

Tanenhaus & Carlson (1989) regard the meaning of a verb as being composed of two components: core meaning (sense) and a thematic grid. Core meaning is the component of verb meaning that is independent of thematic assignments and suggest that core meaning may be used to integrate some instruments into a discourse model.

" By our criteria, none of these verbs has Instrument on their grids Thus, we claim that in such cases as *John sliced the salami* there is no open Instrument role. This does not mean, however, that the core meaning of the verb itself does not entail, or strongly imply, the presence of an instrument; entailed participation is a necessary but not sufficient condition for the presence of a thematic role" (Carlson & Tanenhaus, 1988, P. 272).

It is important to note that entailed participation relates to an event, whereas thematic roles relate to syntax. Entailed participation should be accounted for because it is an essential part of our representation of the event. The fact that information about entailed participation is used during comprehension is shown by Garrod & Sanford (1982).

Garrod & Sanford (1982) demonstrated that subjects experienced no more difficulty in processing a sentence containing a reference to an implied entity than to one which was explicit if the implied entity was entailed by the verb. They compared reading time for sentences such as

(11) MARY PUT THE CLOTHES ON THE BABY.
THE CLOTHES WERE MADE OF PINK WOOL. (Target sentence)

(12) MARY DRESSED THE BABY.
THE CLOTHES WERE MADE OF PINK WOOL. (Target sentence)

Since "dress" entails "clothes" there is no advantage in explicitly mentioning "clothes".

However, despite the advantages that can be derived from core meaning Carlson & Tanenhaus (1988) do not assume that core meaning is involved in the integration of all instruments.

"*John wrote a letter* introduces just *John* and the *letter*, and no entity playing the role of an instrument (such as pen), even if an instrument is conceptually judged to be a necessary participant in such actions: such entities would have to be introduced inferentially" (Carlson & Tanenhaus, 1988, P. 272).

Why do they assume that core meaning assists in "perform", and "slice" but not with "write" where inference processes are thought to be used. They discuss a difference between instruments being entailed or strongly implied but offer no means of differentiating between the two. They may differentiate between "slice" and "write" because they see "slice" as logically entailing its instrument whereas the instrument for "write" are pragmatic. Since the instrument is pragmatic and therefore provided by the context the core meaning of the verb can not provide the information and the instrument would have be inferred.

Carlson & Tanenhaus discussion of "core meaning" is rather vague. Even in cases where core meaning is thought to assist integration they fail to explain how "core meaning" can assist integration. Except that, like role filling, "one does not have to rely wholly upon general inferential processing of the type usually required to integrate information into a single scheme". (Carlson & Tanenhaus, 1988, P. 278).

The results presented later in this thesis illustrate that under certain circumstances instruments do not have to be introduced inferentially and that some form of information is available to assist the integration of the instrument. As Carlson & Tanenhaus suggested "core meaning" may not be involved in the integration of all instruments, but the range of instruments that it does assist seems larger than they suggested. It is proposed that some form of Discourse Role may assist the integration of these instruments.

4.4.3.4 Concluding Remarks on Carlson & Tanenhaus' Proposals

It would seem that Carlson & Tanenhaus' proposals about thematic roles, even implicit roles, are not adequate to explain our intuitions concerning instrumentality. Although they acknowledge that implicit roles are not the only means to assist discourse integration, and recognise the role of core meaning; this account is insufficient as it allows no scope for the influence of context. Even their distinction between a sense and thematic ambiguity is of little use with respect to "general verbs". There is no ambiguity of sense nor is there any thematic ambiguity as they do not assign a thematic instrument role. Even if they did, it

would be of minimal assistance in explaining the influence of context. The results presented later in this thesis suggest that information above and beyond that captured by their syntax-based roles assists in the creation of discourse coherence.

Traditional views of thematic roles fail to capture concepts inherent in the meaning of verbs. If the "appeal" of roles is their ability to capture meaning or account for the participants in the event denoted, then they should reflect inherent concepts. It appears that processing advantages can be derived from concepts inherent in the meaning of verbs and not just from syntactically realised aspects of meaning. We need to address all aspects of meaning not only those which are syntactically relevant. Given the important role of verbs, it is essential that the ways in which they can assist integration are investigated. Carlson & Tanenhaus outline three main methods of discourse integration: role filling, core meaning, and inference. All these methods need to be evaluated.

Reliance on syntax-based definitions of Roles restricts their value. It is a paradox in the sense that it is their reliance on syntax to constrain their scope that constrains their ability to account for aspects of language which they are conceptually well suited to explain.

Carlson & Tanenhaus discuss the discourse benefits that can be derived from thematic roles, particularly implicit thematic roles, yet they try to account for discourse processing within a framework bound by syntactic constraints. If we are examining discourse should we not be dealing with concepts that operate at a discourse/conceptual level. Our interpretation of discourse, even verbs, extends far beyond the syntax of the sentence, so shouldn't the roles we assign elements within that representation not also extend beyond syntax.

4.5 Broader Conceptions of Thematic Roles

Problems with the theoretical status of Thematic roles and the need to account for a range of information outwith that expressed by syntax has lead to the expansion of the concept of Thematic Roles. The concept has been extended both in Linguistics and Psycholinguistics. Recent work by Mauner, Carlson & Tanenhaus (1995) has suggested that a wider range of implicit information associated with verbs may be routinely encoded during comprehension and that once encoded this information can assist the process of discourse integration. Within Linguistics, the work of Jackendoff (1990) offers a different perspective on

thematic roles: they are discussed within the wider framework of conceptual knowledge. Firstly, the work of Mauner et al. will be discussed. It will be shown that even although their proposals extend the work of Carlson & Tanenhaus, they still fail to recognise the full range of benefits that can be derived from implicit information. Secondly, Jackendoff's proposals will be examined and how his notions are being used by contemporary computational linguistic attempts to represent discourse processing.

4.5.1 Implicit Arguments

Mauner, Carlson & Tanenhaus (Mauner et al. 1995) discuss the benefits that can be derived from the encoding of implicit semantic arguments. Like Carlson & Tanenhaus (1988), they assume that this implicit semantic information is provided by the "implicit arguments" of verbs. However, unlike Carlson & Tanenhaus (1988), Mauner et al. do not restrict the set of implicit arguments to those assigned thematic roles. Their proposals are similar to that of Carlson & Tanenhaus' concept of "open roles", except the scope of implicit arguments is not constrained by syntax. They focus on implicit semantic rather than implicit syntactic arguments. Mauner et al. offer a three fold classification system for implicit arguments and show how this may explain the contradictory evidence regarding the encoding of implicit instruments.

The implicit semantic information associated with verbs is a highly plausible candidate for immediate encoding. As outlined earlier (cf. Chapter 3) verbs play an important role in both the organisation of a sentence and the discourse. Evidence for the encoding of implicit thematic roles suggests that the encoding of this implicit information incurs little computational cost; hence it is assumed that implicit semantic information can be encoded without the need for a resource demanding inference. We shall see how this implicit semantic information may provide discourse benefits similar to those provided by implicit syntactic arguments (thematic roles): assist integration by acting as antecedents for subsequent reference. Mauner et al. investigated the time course of the encoding of this implicit semantic information and whether its encoding demands a resource demanding inference.

4.5.1.1 Evidence for the Encoding of Implicit Semantic Arguments

Mauner et al. (1995) empirically tested the proposal that unspecified arguments of verbs would be encoded during comprehension. Specifically, they investigated whether an implicit Agent associated with a short passive would be automatically encoded. Unlike full passives, Agentless passives do not contain an explicit "by-phrase" that specifies the subject of the verb. Nevertheless, there is a strong intuition that the interpretation of the sentence includes an understood or an implicit agent (in example 14 below, the person responsible for sinking the ship). In contrast, the intransitive version (15) does not support such an intuition, despite having the same propositional content.

(13) Full Passive: THE SHIP WAS SUNK BY THE CAPTAIN.

(14) Agentless (short) Passive: THE SHIP WAS SUNK.

(15) Intransitive: THE SHIP SANK.

The reading time of full passives, short passives, intransitives, and active sentences (see Table 4. 1 for example materials) were compared using word-by-word presentation and a secondary task of indicating when the sentence stopped making sense as an index of processing difficulty associated with the sentences. The time course of the encoding of a possible implicit agent was assessed by exploiting properties of "rationale clauses". Rationale clauses are adverbial infinitive modifiers that carry a connotation of purpose, and like all infinitive clauses, rationale clauses have an understood subject which must be associated with the noun in the preceding context. Rationale clauses also require the contextual element that is associated with its understood subject to be capable of volitional action i.e., be Agentive. Hence they are an ideal means to probe for the encoding of an implicit agent. If subjects encode an implicit Agent as part of their representation of a short passive, then this implicit argument should provide a contextually appropriate antecedent for the understood subject of a rationale clause. In contrast, if a rationale clause is preceded by an intransitive, then no contextually appropriate antecedent will be available, hence comprehension will be difficult.

Active

The contestant spun the game show's wheel to win a prize and lots of cash.

Rationale clause preceded by full passive

The game show's wheel was spun by the contestant to win a prize and lots of cash.

Rationale clause preceded by short passive

The game show's wheel was spun to win a prize and lots of cash.

Rationale clause preceded by intransitive

The game show's wheel spun to win a prize and lots of cash.

Table 4. 1 Example of Materials used by Mauner et al. (1995)

The results suggest that rationale clauses following short passives which contain no explicit agent are no more difficult to understand than those following a full passive or an active which do provide an explicit Agent that can act as the subject of the rationale clause. Subjects, however, experienced great difficulty (longer reading times) with the intransitive condition where an Agentive subject was neither explicit or supported by an implicit argument.

It was concluded that the encoding of implicit Agents in short passives takes place rapidly and that it does not involve a resource demanding inference. While subjects could have inferred the presence of an Agent in the intransitive cases, it appears they either did not, or this inference was not constructed automatically and hence a time consuming bridging inference was required. In contrast, the encoding of implicit arguments does not seem to require processing resources beyond that needed to encode explicit information and certainly not the resources needed for the assumed bridging inference.

The fact that unspecified arguments can be encoded during comprehension has implications concerning the encoding of implicit instruments. Mauner et al. classify implicit arguments depending on the degree of contextual support they

require, and show that implicit instruments and methodologies used to assess their encoding may underestimate the extent of their encoding.

4.5.1.2 Types of Implicit Arguments

Syntactic and semantic information may remain implicit because verbs can occur with arguments which are not realised if context can provide their content. The extent to which a verb relies on the context to supply its arguments can vary. Mauner et al. propose that it is this variability that explains the contradictory results concerning the immediate encoding of implicit instruments.

The occurrence of optional arguments has been widely discussed and various types of implicit arguments have been identified. Mauner et al. offer a three fold classification for implicit arguments: obligatory anaphoric, non-obligatorily anaphoric, and optionally anaphoric arguments.

1) Obligatory Anaphoric Implicit Arguments

Perhaps the most well-known example is that of "Null Complement Anaphora" (Hankamer & Sag, 1976), where argument roles provided by the verb can function as anaphors if they are not associated with an actual constituent in the sentence. Consider the verb "remind" which can occur with both a noun phrase and an infinitival complement as in example 16 below.

(16) JOHN REMINDED BILL TO GO TO THE BANK.

However, the infinitival complement can remain implicit (example 17) if the context can supply the information.

(17) BILL NEARLY FORGOT TO GET SOME MONEY FROM THE BANK
FOR OUR TRIP.
FORTUNATELY, JOHN REMINDED HIM (*OF IT*).

In example 17, the implicit complement ("what John reminded Bill to do") behaves like a pronoun in that it refers to information introduced by the prior context. The implicit argument can function in an anaphoric fashion, hence the name Null complement anaphora, and integrate the sentence with the context. In fact, Hankamer & Sag (1976) suggest the implicit argument functions like the pronoun

"it". The implicit argument is thought to behave like a pronoun because it takes its interpretation (refers back to explicit information) from the prior context. The implicit argument must take its interpretation from earlier explicit information as Pronouns must have explicit antecedents. Therefore the implicit argument is obligatory anaphoric. As you can see, sentence 18 is unacceptable if presented alone.

(18) * FORTUNATELY, JOHN REMINDED HIM.

Experimental evidence seems to confirm the linguistic intuition that omitted arguments may function as pronouns. McKoon & Ratcliff (1989) using speeded recognition ("priming") to probes from contexts (e.g. desk) when they specify an implicit location in a sentence such as "He cleared the papers off".

2) Non-obligatorily Anaphoric Implicit Arguments

In the case of "remind" the infinitival complement can only remain implicit because the discourse provides the missing information. However, not all implicit arguments need to take their interpretation from the prior discourse context (i. e. must be anaphoric). Consider the verb "donate" which can occur either with (19) or without (20) its recipient PP complement.

(19) JOHN DONATED FIVE DOLLARS TO THE UNITED WAY.
PP complement

(20) THE UNITED WAY ASKED JOHN FOR A CONTRIBUTION.
JOHN DONATED FIVE DOLLARS.

In example 20, the PP complement can remain implicit because the context provides a clear recipient, "the united way". The implicit complement behaves in a similar way to that of "remind" discussed earlier.

However unlike "remind", the verb "donate" allows an implicit PP complement in the absence of a context that supplies an antecedent.

(21) HARDLY ANYONE KNOWS THAT JOHN DONATES THOUSANDS OF
POUNDS EACH YEAR.

Intuitively, there is an implicit recipient, someone or something must have received the donation. However, it remains unspecified by the context. Mauner et al. regard such examples as illustrating the non-anaphoric nature of some implicit complements. They are non-anaphoric in that they do not require context to supply their content; instead the implicit argument can remain unspecified.

The linguistic literature has also noted the distinction between implicit arguments that need to be specified by context and those that do not. Fillmore (1986) has suggested that context-dependent anaphors are like definite NPs in that they refer to entities already introduced in the discourse, whereas context-independent implicit arguments are more like indefinites, in that they may introduce entities into a discourse but not, themselves, be referred to. Given this, it would seem that there are some implicit arguments whose content can remain unspecified but still become part of the reader's representation of the sentence.

3) Optionally Anaphoric Implicit Arguments

Some action verbs can optionally be used with an instrumental prepositional phrase. For example:

(22) JOHN CUT THE STEAK WITH A KNIFE.

The question is whether an instrument argument is encoded while reading

(23) JOHN CUT THE STEAK.

The empirical data concerning the encoding of implicit instruments is contradictory. Mauner et al. attempt to resolve this conflict by assuming that implicit instruments are optionally anaphoric.

Recall that an obligatorily anaphoric argument must take its interpretation from the context. Mauner et al. demonstrated that unspecified arguments (arguments with no content) are encoded during comprehension. Therefore, an optionally anaphoric argument may or may not use context to provide its content.

Such a proposal has two important implications. Firstly, it suggests that instrument inferences should be sensitive to contextual factors. Secondly, it has important implications for the type of methods used to assess their encoding.

Contextual and methodological factors are the two most widely investigated reasons for the conflicting results concerning the encoding of instrument inferences. First let's consider methodological issues concerning the encoding of instruments.

If their proposal is correct and unspecified implicit arguments are encoded; then priming tasks may not be sensitive enough to assess the encoding of instruments. Priming tasks may underestimate the degree of inferencing, if the inferred information is unspecified. If the inferred information is uninstantiated then priming only reflects if, or when, the information that is encoded becomes specific enough to prime a particular concept. Such a view contrasts with Keenan et al. (1990) who suggest that priming tasks may overestimate the amount of information that is encoded because the presentation of the probe itself may encourage the inference.

Results from numerous priming studies suggest that instrument priming only occurs when the context introduces a likely instrument: McKoon & Ratcliff (1983); Lucas, Tanenhaus & Carlson (1990). In the absence of context, either priming does not occur: McKoon & Ratcliff (1981); Lucas, Tanenhaus & Carlson (1990) or is delayed, Swinney & Osterhout (1990).

Maurer et al. attempt to unify these conflicting findings by proposing that implicit instruments are optionally anaphoric and that priming only occurs when a specific instrument becomes active enough to reach threshold. Therefore, an implicit instrument may always be encoded following a verb like "cut" but may not always be instantiated. The instantiation of an implicit instrument will depend on the information that is available in the context. The fact that instruments are optionally anaphoric and therefore may or may not take their interpretation from context explains the mixed results regarding instrument inferences with respect to the use of context. Maurer et al. propose that implicit instruments are always encoded, but not always instantiated; with instantiation depending on contextual factors. Such a proposal is consistent with the need for a strong constraining context (cf. Chapter 6) and the need to investigate the constraints on the instantiation of these implicit instrument arguments.

The routine encoding of implicit arguments has important implications for discourse integration. Recall how the encoding of an implicit agent assisted the processing of a subsequent reference and how implicit thematic roles can assist the processing of subsequent NPs that are consistent with such a role. However,

Mauner et al. fail to discuss the full range of discourse benefits that can be derived from the encoding of implicit arguments.

4.5.2 Advantages of the Encoding of Implicit Arguments

Consider the implicit Agent argument associated with a short passive, the implicit Agent acts as the understood subject of a rationale clause the implicit argument is not functioning in an anaphoric way (similar to the complement in remind). Instead the implicit argument seems to act as an antecedent for a subsequent reference- acts as subject of the rationale clause. The fact that implicit arguments can support subsequent reference is not clearly shown by Mauner et als' examples because rationale clauses allow their subjects to remain implicit. To illustrate, consider another example of a short passive:

- (24) THE SHIP WAS SUNK CLOSE TO THE REEF.
THE EXPLOSIVES WERE IN THE HOLD.

In this example, the definite reference to "the explosives" is assumed to fill the Agent Role and therefore to be responsible for sinking the ship. It is assumed that the explosives have been placed in the ship in order to sink it. This explanation is similar to Carlson & Tanenhaus proposals concerning "open roles".

The ability of implicit arguments to support subsequent reference can be further illustrated with reference to earlier examples of non-obligatory anaphoric arguments. It is interesting to note that obligatory anaphoric arguments can not support subsequent reference.

Recall the earlier discussion of "donate"

- (25) THE UNITED WAY ASKED JOHN FOR A CONTRIBUTION.
JOHN DONATED FIVE HUNDRED POUNDS .

It was noted that the recipient could remain implicit because it could be derived from context. Example 26 illustrates that the argument could remain implicit even in the absence of context.

- (26) HARDLY ANYONE KNOWS THAT JOHN DONATES THOUSANDS
OF DOLLARS EACH YEAR.

Mauner et al. did not discuss how the implicit recipient argument of the verb can assist the integration of subsequent text by acting as possible antecedents for subsequent references to a possible recipient role. Consider examples 27 and 28 below.

(27) JOHN DONATED FIVE HUNDRED POUNDS.
THE CHARITY WAS VERY GRATEFUL.

(28) HARDLY ANYONE KNOWS THAT JOHN DONATES THOUSANDS
OF DOLLARS EACH YEAR.
THE CHARITY FUNDS RESEARCH ON GENETIC DISORDERS.

In both these examples the implicit recipient argument is acting as the antecedent for the noun phrase ("the charity") which identifies or in Mauner et al.'s terms instantiates the implicitly encoded recipient argument of the verb "donate". It is not only the recipient argument that can support subsequent reference, but also what he donated. In example 29, it is "money".

(29) JOHN OFTEN DONATES TO CHARITY.
THE MONEY IS TAX DEDUCTIBLE.

The nature of the implicit argument can vary according to context. For instance,

(30) JOHN OFTEN DONATED TO THE OXFAM SHOP.
THE BOOKS AND RECORDS ALWAYS SOLD QUICKLY.

The implicit instruments associated with verbs can also behave in a similar fashion:

(31) JOHN CUT THE STEAK.
THE KNIFE WAS VERY SHARP.

As do instruments implied by verb meaning:

(32) KEITH DROVE TO LONDON.
THE CAR BROKE DOWN HALFWAY.

(33) THE WOMAN WAS MURDERED NEAR THE ENTRANCE TO THE PARK.
THE KILLER PROBABLY HID IN THE BUSHES.

These examples illustrate the integrative benefits that can be derived by the immediate encoding of implicit arguments. It is exactly this integrative function that Carlson & Tanenhaus regard as the main advantage of implicit thematic roles. Open roles in discourse models assist integration by functioning as antecedents for subsequent referents. The question then becomes one of investigating the constraints on their encoding and instantiation. The constraints on the encoding of one the most controversial implicit arguments, implicit instruments are investigated in subsequent chapters.

4.5.3 Jackendoff's Conceptual Semantics

Jackendoff (1983, 1990) offers a broader perspective on Thematic roles. The notion of thematic roles as a means to capture the relationship between syntactic arguments and the role they play in events is discussed within his more general framework of "Conceptual Semantics". Although a detailed discussion of his proposals is outwith the scope of this thesis (cf. Jackendoff, 1983, 1990) a brief discussion of some proposals; especially those that offer a solution to the traditional problems associated with thematic roles will be presented.

Since Jackendoff's approach is set within a broader conceptual framework, it avoids many of the problems associated with traditional syntax-based accounts. Most notably it successfully captures the intuition of agentive manipulation associated with Instrumentals. Jackendoff's account of thematic roles captures the fine detail of how semantic arguments relate to other event participants, and hence provides a rich representation of events. First Jackendoff's general conceptual framework will be outlined, then a more detailed discussion of his view of thematic roles, particularly his treatment of instrumentals.

4.5.3.1 Elements of Conceptual Structure

Jackendoff's primary objective is to specify the components involved in "Conceptual Semantics". He attempts to formally specify the form of knowledge generally described as "concepts", "ideas", or "thoughts" and explain how such knowledge is expressed in the syntax of natural language. He attempts to characterise the mental resources that underlie the representation and acquisition of human knowledge and experience of the world. For him, the central motivation of a theory of conceptual knowledge parallels that of generative

syntactic theory: specification of the innate units and principles of organisation that make human lexical and sentential concepts possible and learnable given the realistic constraints on linguistic and non-linguistic experience. Conceptual Semantics is concerned with the form of the internal representations that constitute conceptual structure and its relations with syntactic, and phonological levels of representation. Syntactic structure is related to conceptual structure by a series of rules with every content-bearing phrasal constituent of a sentence (S, NP, AP, PP, etc.) corresponding to a conceptual constituent of some major category. Consider the different levels for the following sentence:

(34) JOHN RAN INTO THE ROOM

(34') Syntactic structure:

[S [NP John] [VP ran [PP into [NP the room]]]]

(34'') Conceptual Structure

[Event GO ([Thing John], Path TO ([Place in ([Thing room])]])))]

Jackendoff adopts a decompositional stance and identifies a range of conceptual primitives that constitute the basic building blocks of conceptual structure. He demonstrates how these primitives are related to syntax and combine to form a coherent semantic representations of a sentence. Jackendoff (1983) identifies the following conceptual categories Thing (or Object), Event, State, Action, Place, Path, Property, and Amount. Each of these primitives can be elaborated into a function-argument relation. Fig. 4. 1 illustrates how these conceptual categories can be elaborated by means of specialised formation rules.

A. [PLACE] -> [Place PLACE-FUNCTION ([THING])]

B. [EVENT] ->

[Event GO ([THING], [Path])]
[Event GO ([STAY], [PLACE])]

C. [EVENT] ->

Event	CAUSE	<table border="1" style="display: inline-table;"> <tr> <td>THING</td> </tr> <tr> <td>EVENT</td> </tr> </table>	THING	EVENT	,	[EVENT]
THING						
EVENT						

Fig. 4.1 Examples of Conceptual Categories and their Elaboration Rules

Rule A states that a conceptual constituent belonging to the category Place can be elaborated as a Place-function plus an argument that belongs to a category Thing. The argument can serve as a spatial reference point, where the Place-function defines a region. For example, in the expression "under the table", "the table" designates a reference object and "under" expresses a Place function that maps the region into the region beneath it.

Rule B states that a constituent of a category Event can be elaborated as either of the two Event-functions GO or STAY, each of which takes two arguments. The arguments of GO, which denotes motion along a path, are the Thing in motion, and the Path it traverses. This is illustrated by the sentences "Bill went to New York". In contrast the arguments of STAY denote stasis over a period of time and are the Thing standing and its location as in "Bill stayed in the kitchen" with "Bill" being the Thing standing and "Kitchen" being the location.

Rule C elaborates an Event as the Event-function Cause plus two arguments. The first argument, if a thing is Agent; if an Event is Cause. The second argument, an event, is the Effect.

Initially, Jackendoff treated these functions as conceptual primitives, however "Stay" may be composed of some durational form of BE. The actual set of primitives and hence the process of conceptual decomposition is not yet complete. However, it does go some way towards a formal description of conceptual structure.

Jackendoff (1990) regards thematic roles as part of conceptual rather than syntactic structure. Thematic Roles are defined over the conceptual representation. For instance, the thematic role of Theme is generally defined as the object in motion or being located. This can structurally be defined as the first argument in example B in Fig 4. 1 above. Source, the object from which the motion proceeds, appears structurally as the argument of the Path-function FROM. It is important to note that Source is not a direct argument of the Event-function but is embedded within the Path-constituent. Similarly Goal (the object to which motion proceeds) is the argument of the path-function TO. Agent is the first argument of the event-function CAUSE. Experiencer presumably is an argument of a yet undefined State-function dealing with mental states. From these examples, it is clear that Jackendoff regards thematic roles as instances of specific structural configurations in conceptual structure with thematic role names simply being convenient labels for particularly prominent configurations of functions and arguments.

In support for his proposal that thematic roles are general terms for specific configurations of conceptual primitives and their arguments he appeals to the existence of numerous types of arguments not assigned a thematic role but whose relationship is captured by Conceptual Semantics. Consider, "John passed the house" which is expressed as "John went by the house". BY is an elaboration of the Path-function VIA. This function is contained in the conceptual representation for the verb Pass, just as TO is included in ENTER. The direct object of "Pass" is understood as the argument of this Path function, it is neither source, Goal, or Theme in the traditional sense. Similarly the direct objects of "jump" in "John jumped the gorge", and "approach" in "John approached Harry" incorporate the conceptual structures OVER/ACROSS and TOWARD respectively. Although there is no standard name for the thematic roles of these direct objects, their conceptual roles are perfectly well-defined and fall out from the general account of Path-functions.

Jackendoff's account provides a fine-grain analysis of events and as such illustrates the generalities and imprecision of traditional thematic role accounts. Finally, consider the transitive use of the verb "climb" in "John climbed the

mountain". In this sentence it is not the "mountain" that is the goal, but the top of the mountain. This intuition is not captured by traditional accounts but it can easily be expressed by Conceptual semantics. The conceptual structure for the verb "climb" embeds its NP argument in the structure:

[Path TO ([Place TOP-OF([Thing]))].

There is Goal both intuitively and formally, but it is a location on the Thing denoted by the direct object (in this instance a mountain), not the Thing itself. We would not want to invent a thematic role for the object of "climb" and this can be avoided by treating thematic roles as structural positions in conceptual configurations. Jackendoff's account does not treat thematic roles as semantic primitives but rather as relational notions defined structurally over conceptual structure. Such a view gives them a status comparable to the syntactic notions of Subject and Object.

Since thematic roles are part of the wider framework of conceptual semantics and are simply a system of structural relations within this conceptual structure the constraints on their number and type are provided by the constraints on the range of conceptual functions necessary to express the meanings of verbs and prepositions rather than being constrained by syntax.

Jackendoff's conception of Thematic roles does not allow a "default" thematic role that can be assigned in the absence of a more suitable role. Some accounts (Fillmore, 1968 neutral Objective case; and Gruber's (1965) Theme) of thematic roles have taken Theme or Patient as their default. Within Jackendoff's framework an NP must correspond to a specific argument position in conceptual structure and therefore must have a specific thematic role. Therefore, Theme has a specific structural definition and cannot be assigned as default. Since thematic role assignment is based on an argument's position in conceptual structure there is no need for a default role.

4.5.3.2 Jackendoff's Treatment of Instrumentals

Jackendoff offers a detailed account of instrumentals which captures the concept of agentive manipulation of an instrument which is lost by traditional accounts. It is possible to capture this notion because Jackendoff uses such a detailed level of analysis to specify the content of an event. The general characteristics of an

instrument are: it plays a role in the means by which the Actor accomplishes the action, the Actor acts on the instrument, and the instrument acts on the patient. More subtly, it is the fact that the Actor acts on the Instrument that results in the Instrument acting on the patient. It is generally left to pragmatics to determine exactly how the Actor uses the Instrument and exactly what the Instrument does to the patient. Consider the following examples, in which the subject is Actor and the Object is patient. The general characteristic of an instrument are encoded by assigning the Instrument NP role within a "means expression" that modifies the core sentence.

(35) PHIL OPENED THE DOOR WITH A KEY

CS+ ([Phil], {INCH [BE ([door], [open])]])

AFF- ([Phil], [door])

CS + ([Phil], [AFF- ([key], [door])])

[BY AFF- ([Phil], [key])]

(36) SAM BROKE THE WINDOW WITH A HAMMER.

CS+ ([Sam], [GOcomp+ ([window], [TO []])])

AFF- ([Sam], [window])

CS + ([Sam], [AFF- ([hammer],
[window])])

[BY AFF- ([Sam], [hammer])]

In these structures BY is the function that turns Events into "means modifiers". The Event in turn is a causative relation. For instance, the "means expression" says that Phil, acting on the key, caused the key to act on the door, without saying anymore about what the particular actions were. That is, the instrument is stipulated as an intermediary in the Actor's action. On such an analysis, the role Instrument, like other thematic roles, is defined structurally: it is a conceptual constituent that appears in a "means expression".

In conclusion, Jackendoff proposals offer an interesting account of conceptual structure and its relation to syntax. His account avoids many of the traditional problems associated with thematic roles because he regards roles as a conceptual phenomena. For him roles are simply, prominent structural configuration of functions and arguments within a more general conceptual structure. As a result they are constrained by conceptual structures and not syntax, hence they allow a more detailed description of events. It is this detailed representation of the structure of events that allows the agentive manipulation of instruments to be expressed.

4.5.4 Computational Uses of Roles: Discourse Roles

This brief discussion of a Computational Linguistic implementation of Roles is intended to highlight the growing recognition of the discourse benefits that can be gained by recognising the contribution of implicit arguments to the creation of discourse coherence, rather than provide a detailed discussion of the system's implementation.

Perhaps the broadest perspective on thematic roles is the concept of a "discourse role" (Whittemore et al., 1991). Their main goal was to design a knowledge base for storing event and state lexical semantic information. The knowledge base is part of a larger natural language understanding retrieval project in the medical domain. The input to the system is in the form of patient discharge summaries and the system goal is to "understand" and comment on the best possible treatment and prognosis for the patient. As a result they need to represent information in sufficient detail to provide an adequate representation of the events described and to reason about its implications.

In order to create a complete representation of an event we need knowledge about events and their expected participants. Such information allows the prediction of arguments and their underlying properties. If this information is associated with the verbs in the discourse then it is possible to use this information to incrementally build event representations as the discourse progresses. Therefore, we need to represent events in enough detail to allow us to reason about their implications. A rich representation of events is achieved by including both explicit and implicit arguments. The traditional way to represent the relationship between events and their participants has been to assign thematic roles. Whittemore et al. based their roles and analysis of the event on those used

by Jackendoff (cf. earlier discussion of Jackendoff and Whittemore et al for more a more detailed discussion).

It is suggested that the relationship between events and their participants should be represented at the level of discourse. A syntax-based representation is insufficient to provide an adequate description of the event. Representation of an event requires Event (discourse roles) rather than syntax-based roles. Events due to their nature are not conveyed by single sentences. Information about the event or related events is distributed across the discourse. Hence, syntax-based accounts are inadequate as they cannot create links across sentence boundaries.

A rich representation of an event at the conceptual level allows reference into the internal structure of the event which can contribute to the creation of discourse coherence: individual elements of an events internal structure can behave anaphorically. Recall, earlier examples of verbs like "drive" and "sew" where conceptual level information about the event denoted assist the creation of coherence.

4.6 Concluding Remarks on The Linguistic Concept of Roles

This chapter has focused on the linguistic concept of Roles, specifically that of Thematic Roles. The problems with thematic roles becomes most apparent when they are applied within a psycholinguistic theory. The most influential is that of Carlson & Tanenhaus (1988) and their proposals concerning "open thematic roles" and discourse integration. It was noted how a psycholinguistic theory based on the traditional syntax-constrained view of thematic roles is insufficient to explain the range of discourse benefits that can be derived from implicit information. These deficiencies are particularly prominent with respect to Instrumentals. Instrumentality can be expressed in two ways: inherent to the meaning of verbs, or expressed by an instrumental adjunct (PP headed by "with"). Neither of which these can be captured by thematic roles.

Although Carlson & Tanenhaus acknowledge that open roles are not the only means to assist discourse integration, and therefore admit the possibility of inferences being derived from the "core meaning" of the verb their proposals are rather vague as they offer no basis on which to determine whether an instrument will be integrated through "core meaning" or via general inferences processes. The following chapters empirically examine the use of verb "core meaning" in

discourse integration and establish the boundary conditions on the use of verb-based information during integration.

The problems associated with the traditional concept of thematic roles are being addressed within linguistics (Dowty, 1991; Jackendoff, 1990) and they offer an interesting perspective on way in which information associated with events and their participants may influence our representation and processing of language.

Within Psycholinguistics, recent studies have also extended the concept of thematic roles. The work of Mauner et al. (1995) suggests that implicit semantic as well as implicit syntactic information may be routinely encoded during comprehension and be immediately available to assist discourse integration. The availability of implicit semantic information is investigated in subsequent chapters, specifically information associated with implicit instruments and the extent to which this information can support subsequent reference and assist the creation of discourse coherence.

Chapter Five

Verbs and Discourse Coherence

A Verbs and Discourse Coherence

5A.1 Verbs and Discourse Integration

The primary objective of this chapter is to empirically assess the use of verb-based information during discourse processing. Specifically, can verb-based information assist the establishment of discourse coherence. The general availability of verb-based information and specific constraints on its immediate availability were assessed in two eye tracking experiments.

The previous discussion (Chapters 3 & 4) outlined the important contribution of verbs and verb-based information to comprehension. Therefore, it is not surprising that verb-based information may influence inference processes and contribute to the creation of discourse coherence. Evidence suggests that verb-based information in the form of either implicit thematic roles or implicit arguments can assist the process of discourse integration (Carlson & Tanenhaus 1988; Mauner et al., 1995). The issue addressed here, is whether verb-based information about instruments is immediately available and assists the establishment of discourse coherence. Can a Verb introduce a referent into the discourse model that can function as an antecedent for subsequent reference? For instance, will reading the verb "dress" (1 below) result in a discourse role for "clothes" being established in the developing discourse model of the text? If such an instrument role is established, will it function as an antecedent for a later mention of "the clothes"? Thereby enabling the reference to be integrated into the discourse model without the need for a time consuming bridging inference. The question is How, When, and under What circumstances such an "Instrument Discourse Role" is established.

- (1) MARY DRESSED THE BABY
THE CLOTHES WERE MADE OF PINK WOOL.
- (2) MARY PUT THE CLOTHES ON THE BABY.
THE CLOTHES WERE MADE OF PINK WOOL.

Assume that the verb "dress" entails the transfer of "clothes", and that some conception of transferring clothes is a necessary part of the meaning of the verb. Garrod & Sanford (1982) proposed that this information is also part of the working representation (equivalent to a scenario) associated with the verb. They

demonstrated that a subsequent reference to "the clothes" is dealt with just as quickly regardless of whether its antecedent is introduced directly (2) or indirectly by the verb "dress" (1). These results support the use of verb-based information in the establishment of discourse coherence. In contrast, the findings of Singer (1979) suggest that verb-based information does not assist discourse integration. Given such conflicting data, it was felt necessary to replicate the experiments of Garrod & Sanford (1982) and Singer (1979) using a more sensitive methodology and thereby accurately assess the contribution of verb-based information to the process of discourse integration

5A.1.1 Verbs, Instruments, and The Discourse Representation

The Instrument Roles associated with Verbs are an ideal means to investigate the availability of verb-based information during discourse processing. On the one hand instruments are closely related, if not part of, the verb's meaning. On the other, the establishment of an Instrument Role in a conceptual level representation is ultimately the product of interpretation. The ease with which a reference to an Instrument is resolved indicates the availability of such verb-based information. In addition, the fact that the content of these instrument roles can be mediated by context, permits the time course of contextual effects during discourse processing to be examined (cf. Chapters 6 & 8 for a detailed discussion).

Lucas, Tanenhaus & Carlson (1990) demonstrated that instrument inferencing involves access to a discourse level representation i.e., making an Instrument Inference requires accessing an element in a discourse model. The fact that inferring an instrument requires access to a discourse model illustrates why instrument inferences are an ideal means to investigate the use of verb-based information during integration. They are an example of verb-based information that is closely linked to a conceptual representation.

Lucas et al. (1990) exploited the differential sensitivity of Lexical Decision and Naming tasks to surface and discourse levels of representation. Initially, it was assumed that both Lexical Decision and Naming tasks provided similar information about word recognition (Meyer & Schvaneveldt, 1976). However, recent evidence (Seidenberg, Waters, Sanders, & Langer, 1984) suggests that Lexical Decisions, but not Naming responses, are facilitated by syntactic relationships between words, backward associations (target-to-prime associations) and changes in the proportion of related and unrelated items. Lexical decisions

are also affected by a number of factors related to the meaning of the word: number of dictionary meanings, likelihood that the target will be given as a response to a category name. In contrast, Naming seems relatively insensitive to these factors (Chumbley & Balota, 1984; Balota & Chumbley, 1984).

Forster (1979) suggested that a simple strategy of matching the orthographic characteristics of the visually presented word with an internal representation may be time-consuming and inaccurate, causing Lexical Decision targets to undergo post-access checks for error. Forster argues that an effective error-checking mechanism would involve a different format from the one involved in the initial match. In a typical lexical decision task, this means using message level processes to integrate the target with its context. Successful integration supports Yes decisions, failures support No decisions.

In contrast, Naming does not require a conscious Yes/No decision. Instead, it requires accessing procedural knowledge directly related to the lexical representation of the word. Knowing whether or not a word makes sense in context is unlikely to facilitate this process. This may explain why Naming is not very sensitive to contextual integration effects. Although there is little disagreement that lexical decision is more sensitive to such effects than naming, the difference in the two tasks is not absolute (cf. Norris, 1987). Nonetheless, the generalisation that Lexical Decision is more sensitive than Naming to post lexical decision processes seems to hold across most studies.

Forster's proposals suggest that Naming is primarily sensitive to lexical processes and Lexical Decision is sensitive to both lexical and post lexical processes. Lexical decisions seem to be the result of cognitive processes that cut across levels of representation; whereas Naming seems primarily sensitive to representations of lexical form. Therefore, a different pattern of responses on both tasks may indicate which level of representation is being accessed. If integration requires changing the activation level of either the lexical form associated with the relevant discourse element in a linguistic level of representation then this should be tapped by both Naming and Lexical Decisions measures. However, if integration involves changes in activation at the discourse level such a change will only be reflected in Lexical Decision responses and not Naming which is thought to be less sensitive to discourse level processes than lexical decisions.

The results of Lucas et al. (1990), evidence for instrument inferencing only with Lexical Decisions and not Naming, suggest that instrument inferences require

access to a discourse level of representation. The question is How lexically based information about instruments can influence the discourse level representation. It is proposed that verb-based information assists integration by establishing a 'Discourse Role' that supports subsequent reference (recall example 1). Such a proposal is consistent with Instrument-based information being available at the discourse level of representation, and Carlson & Tanenhaus' proposal that verb-based role information can assist the creation of discourse coherence.

There is one important difference between the materials used by Lucas et al. (1990) and the materials used in the experiments presented later in this chapter. Lucas et al. only found evidence for instruments being inferred in context. They found no evidence that instruments were inferred in response to single sentences such as

(3) HE SWEPT THE FLOOR EVERY WEEK ON SATURDAY

but did find evidence of priming in the contexts condition such as

(4) THERE WAS A BROOM IN THE CLOSET.
JOHN SWEPT THE FLOOR EVERY WEEK ON SATURDAY.

Under such "context conditions", explicit mention of the instrument that was later implied by the verb, a discourse referent is established by the earlier mention of the instrument, which is later accessed to assist the inference process. This assumption suggests that the inference was not made in the "no context conditions" because there was no explicit antecedent to establish a discourse level representation to support the inference. However, subjects may have failed to make the inference not because there was no antecedent in the discourse model to support it, but rather because the verb was not restrictive enough to constrain the inference. In this view, the instrument was not inferred in the absence of an explicit antecedent because the verb could not support the inference; rather than there being no explicit antecedent to establish a role in the discourse model.

It is predicted that an instrument inference will be made in the absence of an explicit antecedent if there is sufficient verb-based information to support the encoding of the implicit instrument. Such a proposal assumes that reading the verb will result in a discourse role being established that can function as an antecedent for subsequent reference. This is consistent with Lucas et al.s' findings that instrument inferencing requires access to a discourse level of representation.

It is interesting to note that Lucas et al. (1990) do acknowledge that it may not be necessary for an instrument to be explicitly mentioned in the previous discourse "but only that something in the context constrain the situation such that an appropriate discourse model would include the inference" (P. 623). The important point is that the nature of the instrument must be constrained. It is proposed that a "restrictive verb" imposes strong constraints, and that these constraints should result in an antecedent role being established in the developing discourse model.

Lucas et al. (1990) criticise reading time measures for not being sensitive enough to differentiate the levels of representation that are accessed during processing. However, a reference to an instrument with an implicit antecedent i.e., a reference to "clothes" following the verb "dress" can only be resolved by reference to a conceptual level of representation; as there is no information present in the surface form representation (an explicit antecedent) to assist the process. This contrasts with the explicit introduction of an antecedent where the instrument reference can be resolved with reference to either the surface or discourse level representation.

It is proposed that verb-based information will assist the establishment of an Instrument Discourse Role that will support subsequent reference without the need for time-consuming bridging processes. However, not all verbs support discourse integration processes. In fact, the empirical data on instrument inferencing is mixed and suggests that an instrument will not always be encoded (McKoon & Ratcliff, 1992). The issue is further complicated by the fact that the different methods used to study Instrument inferencing also produce conflicting results (Keenan, Potts, & Golding, 1990; cf. Chapter 6 for a detailed discussion). Such contradictory findings highlight the need to investigate the conditions where verb-based information about instruments is available to assist comprehension.

5A.2 The Availability of Verb-based Information

As mentioned earlier, the empirical data on the encoding of instrument inferences is mixed. One of the most surprising findings are the conflicting results of Garrod & Sanford (1982) and Singer (1979) who using what appeared to be similar materials and method, obtained different results. Their results have been replicated by Cotter (1984) who ruled out a methodological explanation for the discrepancy, and attributed differences in the ability to immediately support

instrument inferencing to the lexical structure of the verb. Before evaluating Cotter's proposals let's examine the original studies of Garrod & Sanford (1982) and Singer (1979).

5A. 2. 1 Evidence For The Use of Verb-based Information in Integration

Garrod & Sanford (1982) discuss the advantages of the immediate use of verb-based information during comprehension. They illustrate how verb-based information can contribute to the establishment of discourse coherence by facilitating the process of anaphoric reference. A definite noun phrase requires an antecedent. In most cases the antecedent is explicit:

- (5) MARY CUT THE STEAK WITH A KNIFE.
THE KNIFE WAS VERY SHARP.

In other cases the relationship is not so direct.

- (6) MARY SEWED HER NEW DRESS.
THE NEEDLE WAS TOO LARGE FOR THE DELICATE WORK.

In example (6), there is no explicit noun phrase to function as an antecedent for "the needle". Instead, the sentences seem to be connected by the verb "sewed" which implies the use of a "needle". It is possible to integrate these two sentences, without the need for complex bridging processes, by using information conveyed by the verb.

Garrod & Sanford (1982) investigated the availability of such verb-based information using the self paced reading paradigm. Using Haviland & Clark's (1974) rationale that the drawing of bridging inferences takes a measurable amount of time compared to a baseline (no inference) control. They compared sentence reading time for target sentences with either explicit or implicit antecedents (see Table 5A. 1). If the information that "drive" involves the use of "a vehicle" is available when the sentence is read then, the referential link between "drive" and "car" will be made before the reference ("the car") is encountered. However, if this information is not available when the reference is encountered then, a bridging inference must be made to establish the connection. This bridging process would be reflected in longer reading times for a target sentence with an implicit antecedent. However, no difference in the reading time would be

expected for the target sentences if the verb immediately provides information that can assist the process of reference resolution.

As expected, there was no difference in the reading times of a target sentence with either an explicit or implicit antecedent. Garrod & Sanford concluded that information derived from the verb must immediately be available to assist the process of reference resolution.

Explicit Antecedent

Keith was giving a lecture in London.
He was taking the car there overnight.
The car had recently been overhauled. (Target)

Question: Did Keith go to London by car/train? (Yes/No)

Implicit Antecedent

Keith was giving a lecture in London.
He was driving there overnight.
The car had recently been overhauled. (Target)

Question: Did Keith go to London by car/train? (Yes/No)

Table 5A. 1 Example of Materials used by Garrod & Sanford (1982)

Garrod & Sanford's conclusion concerning the immediate availability of verb-based information may be questioned because sentence reading was used as an indicator of the time taken to resolve the anaphoric noun phrase it contained. Hence, it is difficult to precisely establish the timing of the resolution process. Is the reference resolved as soon as it is encountered, or is resolution delayed until the entire sentence is read? Question response times suggest that the information is immediately available and immediately used to resolve the reference. Accurately answering the question relies on the inference having been made. If the inference was made while answering the question we would expect to see an increase in the question response times for the unstated antecedent. Since no such difference was apparent, it is assumed that verb-based information is immediately available and can be used to assist discourse integration.

5A. 2. 2 Evidence Against The Use of Verb-based Information in Integration

Singer in a series of studies (1979a, 1979b, 1980) investigated the encoding of Case filling inferences (agents, patients, and instruments). He found that strongly implied case-fillers were not routinely inferred during comprehension. People needed more time to verify, recognise, and understand sentences expressing the implications of antecedent material than sentences expressing ideas that were explicitly stated.

Singer (1979) compared the reading time of the Target sentence under three conditions (see Table 5A.2) using Haviland & Clark’s bridging rationale. The reading time for a target sentence containing a reference to either a direct or implied antecedent was compared. A control condition was also included: "a shovel" does not specify the existence of any particular shovel, therefore additional processing would be expected to reconcile the target with its antecedent. Therefore, control latencies were expected to be longer than those with a direct antecedent. If not, the advantage for an explicitly mentioned antecedent may be due solely to lexical repetition rather than information derived from the Verb.

Explicit Antecedent

The boy cleared the snow with a shovel.
The shovel was heavy. (Target sentence)

Implicit Antecedent

The boy cleared the snow from the stairs.
The shovel was heavy. (Target sentence)

Control

The boy hated working with a shovel.
The shovel was heavy. (Target sentence)

Table 5A. 2 Example of Materials used by Singer (1979)

As predicted, subjects took longer to read a target sentence that referred to an implied rather than an explicit antecedent. The fact that reading times for the

control condition were intermediate between those for the explicit and implicit antecedent conditions suggests that the faster reading times for the explicit condition were not simply due to lexical overlap with an explicitly introduced antecedent. Singer's results suggest, contrary to Garrod & Sanford (1982), that there is a distinct advantage to having an explicit antecedent, and that verb-based information about instruments does not assist discourse integration.

5A.3 The Importance of Verb Meaning in Instrument Inferencing

There are some important differences in the materials used by Singer (1979) and Garrod & Sanford (1982). Unlike the materials used by Garrod & Sanford, the Instruments used by Singer were implied by action descriptions, "clear the snow" rather than implied by the verb, "drive". This difference is highlighted if we examine the selection procedures used. Garrod & Sanford used a strict selection criteria for their verbs: subjects were asked to produce brief descriptions of verbs based on examples such as "carve: use a knife to slice meat". This was to ensure that the verb strongly implied, or preferably required, the existence of the instrument. In contrast, Singer selected verbs and instruments on the basis of a questionnaire task which contained verb phrases and asked for instruments to be provided. Consequently, the instruments used by Singer were associated with a verb phrase rather than the verb alone. The distinction between an instrument being implied by a verb rather than an action description (verb phrase) is very important. If the instrument is not strongly implied by the verb, then the information may not become available when the verb is read (cf. Chapter 7 for a detailed discussion of the role of association). The possibility of differences between the verbs used by Garrod & Sanford (1982) and Singer (1979) was assessed by Cotter (1984).

5A.3.1 Cotter's Replication

Cotter (1984) examined possible reasons for the discrepant results of Garrod & Sanford (1982) and Singer (1979) and ruled out methodological factors as an explanation. Instead, Cotter attributed the disparity to differences in the materials used. There are two main points of interest in Cotter's discussion: the first being her replication of the results of Garrod & Sanford (1982) and Singer (1979); the second, the Dictionary Exercise and Questionnaire tasks used to compare the two

sets of verbs. Firstly, Cotter’s replication will be examined, then a detailed discussion of the proposed explanation of the differential support for instrument inferencing provided by the two sets of verbs will be presented.

Garrod & Sanford Materials

INTRO: Patrick went to see his old granny in Belfast.

Alternative antecedents:

STATED: He caught the new boat from Stranraer.

UNSTATED: He sailed in the morning from Stranraer.

PLEONASTIC STATED: He sailed on the new boat from Stranraer.

TEST: The boat was fast and fairly frequent.

QUESTION: Did Patrick go by aeroplane?

Singer Materials

INTRO: The boy was helping his mother.

Alternative antecedents:

STATED: He cleared the snow with a shovel.

UNSTATED: He cleared the snow from the stairs.

OVERLAP: He hated working with a shovel.

TEST: The shovel was heavy.

QUESTION: Did the boy use a broom?

Table 5A. 3 Example of Materials used by Cotter (1984)

Cotter corrected for methodological differences between the two studies. There were slight differences in the method and instructions: Garrod & Sanford (1982) used sentence triplets and questions, whereas Singer (1979) used sentence couplets and no questions. Singer also instructed his subjects to read for understanding. However, the most important difference lies in the nature of the

materials used. Garrod & Sanford did not use the verb in the explicit antecedent condition; instead a paraphrase of the verb together with an explicit mention of the instrument was used (see Table 5A. 1). Garrod & Sanford (1982) regarded the use of the verb and its instrument as pleonastic (using more words than necessary to express the meaning). In contrast, Singer's explicit antecedent condition mentioned the verb and instrument (see Table 5A. 2). The implicit antecedent conditions also differed: Singer included a location element, Garrod & Sanford did not. The location element may have acted as a distracter and reduced inferences from the verb by supporting inferences of its own, which in turn increased reading times.

To control for lexical priming effects, Cotter included an "overlap condition" in the Singer replication in which the instrument was mentioned prior to the test sentence, but not mentioned with the verb (see Table 5A. 3). Such an overlap condition was included to test Garnham's (1982) proposal that stated conditions gain their advantage (faster reading time) as a result of lexical priming. The Garrod & Sanford experiment was also expanded to include a "pleonastic condition" to assess the proposal that the use of a Garrod & Sanford Verb and Instrument together was pleonastic. Longer reading times for the target sentence would be expected if the pleonastic sentence was more difficult to understand.

Cotter replicated both the results of Garrod & Sanford (1982), and Singer (1979). In addition, the results suggest that the advantage (faster reading time) of a stated antecedent with Singer verbs was not solely due to lexical priming (there was no difference between the unstated and overlap conditions). The results also indicate that the co-occurrence of a Garrod & Sanford verb and instrument is not pleonastic.

5A.3.2 Cotter's Explanation: Relatedness and Association

Cotter's replication excludes a methodological explanation for the discrepant results of Garrod & Sanford (1982), and Singer (1979). Instead, she proposes that some verbs may support instrument inferences more than others. Cotter located the source of these verb differences using a Questionnaire task and a Dictionary Exercise. There was no difference between the two sets of verbs on an Instrument generation questionnaire, but differences were apparent in a Dictionary Exercise.

Cotter referenced both sets of verbs in the Oxford English Dictionary (1933) to check how often the instrument was cited as part of the dictionary definition of the verb. Definitions were assigned to one of four categories: instrument mentioned in definition, verb can be a noun that implies target instrument (i. e., "dress" implies "clothes", category that includes instrument ("vehicle" includes "car")), and no instrument mentioned. The results indicate that Garrod & Sanford Verbs are more likely to mention Instruments in their dictionary definition than Singer Verbs.

The interesting point is that there was no difference between the two sets of verbs on an instrument generation task. Cotter presented subjects with lists of verb phrases (not the verb alone) and subjects were asked to provide three instruments used to perform the task. The results demonstrate that subjects produced instruments associated with the different Verb sets with equal ease and frequency. Cotter suggests that although the instrument generation task shows no difference in association between verbs and their instruments, there may be differences in the strength of this association. If the association is strong i. e., when the instrument is part of the meaning of the verb; then inferences are expected to be automatic and apparent in both reading and questionnaire tasks. However, if the association is weak, as with Singer Verbs, inferences are expected in a questionnaire task where there are no time pressures but not on-line, in a reading task.

Cotter assessed the possible difference in association strength between verbs and instruments in a word recognition task. If Garrod & Sanford Verbs' and Instruments are more highly associated than Singer Verbs and Instruments then the Instruments associated with Garrod & Sanford Verbs should be more accessible and hence recognised faster than those of Singer verbs. The results of the word recognition task support the idea that Garrod & Sanford Verbs more strongly imply their Instruments than Singer Verbs.

Cotter's proposal that Garrod & Sanford Verbs more strongly imply their instruments was further supported by another reading time study. If reading a verb strongly suggests the use of a particular instrument then the presentation of an unexpected instrument should produce an increase in the reading time for this 'inappropriate instrument'. However, if the verb does not strongly imply an instrument, then the presentation of an inappropriate instrument should produce no increase in reading time. Cotter predicted that if Garrod & Sanford Verbs strongly imply their instruments, then the introduction of an unexpected

instrument should produce an increase in reading time. Such an increase in reading time is not expected for Singer Verbs as they don't strongly imply their instruments. Therefore, the introduction of an inappropriate instrument should cause minimal disruption. As expected, the introduction of an inappropriate instrument produced an increase in reading time for Garrod & Sanford verbs, but not for Singer verbs; suggesting that Garrod & Sanford Verbs strongly imply the use of a particular instrument.

On the basis of the experimental results, the questionnaire task, and the Dictionary Exercise, Cotter proposed that differences in the ability to generate instrument inferences were attributable to differences in the lexical structure of the verbs involved. Furthermore, these differences would only be manifested under time pressure: in on-line, but not off line, tasks. The results of the Dictionary Exercise suggest that Instruments for Garrod & Sanford Verbs are more inherent to the meaning of the verb than Singer Instruments. Hence, Garrod & Sanford instruments were thought to be related to the verb, and Singer Instruments only associated with the verb.

Such a distinction between semantic relatedness and semantic association becomes clear if we examine the representational structure of the verb. Gentner's (1981) Central Components Model views the representation of a verb in semantic memory as determining the pattern of inferences that are activated when it is read. The central part of a verb's representation contains semantically related components. Inferences would initially be made from the verb's "central components". Other components may be associated with the verb, but not related. A word may have many associations but the set of associations that form an essential part of the representation are limited. So if inferences derived from a verb's 'central components' are more likely to be made on-line then we would expect instruments that are part of the meaning of the verb to be inferred as the verb is read. Such is the case with Garrod & Sanford Verbs and Instruments. However, if the instrument is only associated with, rather than related to, the verb, as is the case with Singer verbs, it is unlikely that the inference will be made when the verb is read, but it is likely that the inference will be made when there is no time pressure.

Cotter's proposals highlight the important role that lexically-based information can play in discourse integration. It also demonstrates that these verb-based benefits may only be provided by specific verbs under a limited set of circumstances. The question then is how verb-based information assists

processing and contributes to the creation of discourse coherence? Most theories assume that lexical structure can assist comprehension and contribute to the creation of discourse coherence via a decomposed representational structure.

5A.4 Lexical Decomposition and Comprehension

Like Cotter, Garrod & Sanford (1982) explained the influence of lexical information on comprehension processes within a decomposition-based framework. This extended representation can assist the process of reference resolution because the bridging information needed to resolve the reference is contained in the decomposed representation. Recall the earlier discussion of "sew" (example 6), a decomposed representation of the verb "sew" would contain information about a needle, thread, the agent who performs the act of sewing, and the object that is being sewed. Such information is thought to be immediately accessible from the verbs decomposed representation and used to resolve the reference to "the needle".

In accordance with the majority of work on conceptual representations, compositional accounts represent the content of the lexical entry by means of variables (cf. Chapter 3 for a detailed discussion). These variables can accept any item that satisfies their associated constraints as a value. For instance, the Instrument Role associated with the verb "drive" will accept all references that satisfy the constraints of a vehicle. By representing implicit entities as variables (roles) it is possible for implicitly introduced information to assist subsequent processing.

There are numerous compositional accounts of meaning (Katz, 1972; Miller & Johnson-Laird, 1976; Rumelhart et al. 1977), but it is possible to identify three main types of elements that generally occur: primitives describing actions or states (Schank & Abelson (1977) "ACTS") such as "ATRANS" which is used to represent the transfer of an abstract relationship such as possession, ownership, or control; Logical primitives, e.g. negation; and lastly, entities necessarily entailed in the descriptions of actions or states, e.g., moving a foot is entailed by "kick", or "driving" entails the use of a vehicle of some description.

Componential analysis has been successfully used in A.I. to implement text understanding packages. The psychological issue, from the perspective of

language comprehension, is whether a sentence is automatically represented in a decomposed form or whether decomposition only occurs when necessary. There are two main issues that must be addressed in the evaluation of decompositional theories: Structural considerations that refer to the actual content of the decomposed representation, and Temporal considerations concerning the actual time course of the decomposition process.

Initially, empirical studies were based on the assumption that words are decomposed into their meaning components during comprehension and the process of building a semantic representation is proportionally related to the complexity of the words it contains. However, evidence suggests that such a proposal is too simplistic. In general, there is little evidence to suggest that complex verbs take any longer to process than simple verbs (Fodor et al. 1975; Kintsch, 1974).

With respect to structural aspects the mostly widely discussed topic is the "Connectedness/ Complexity" issue. Initially, it was assumed that the more complex a word, the more processing it would require (the more components, the more processing, therefore the greater the memory load). Although complexity effects can be explained by decomposition they are not necessarily a consequence of decomposition: meaning components may be processed in parallel, without any increase in processing load for complex words as compared to less complex words. An alternative view of decomposition is that rather than counting the number of primitives contained in the decomposed representation (Complexity, Kintsch 1974) we should examine the way these primitives are connected (Connectivity Hypothesis, Gentner 1981). Gentner regards the semantic structure of verbs as frames for sentence representation and predicts that the memory strength between nouns in a sentence is dependent on the number of underlying sub-predicates that connect the nouns.

Reading time measures have generally been used to assess the time course of the decomposition process. Kintsch (1974), and Carpenter & Just (1977) found no reading time difference between complex and simple verbs and used this to argue against decomposition at encoding. It was assumed that decomposition takes time and this should be reflected in the reading time, the more complex the decomposition, the longer it is assumed to take. Such a view assumes that verb meaning takes time to decompose. However, decomposed verb meanings may be stored as modules in memory. Consequently, retrieval of the information would not be dependent on the complexity of the representation as it is only the module

that needs to be retrieved. If this is the case, reading time data cannot be used to identify the timing of the compositional process.

Memory techniques have been extensively used to evaluate the Connectedness and Complexity debate. Kintsch (1974) reasoned that reading time would be longer, and memory would be poorer for sentences containing propositionally complex verbs. For example, "John is accused of stealing" with the verb "accused" assumed to decompose into "someone says that John is guilty of stealing" being more difficult to process than sentences containing simpler verbs such as "guilty" in "John is guilty of stealing". The problem with this view is that it assumes complexity interferes with retrieval.

In contrast, Gentner (1981) argues that what is important at retrieval is not how many propositions the decomposed structure contains but how well the elements are connected. Some verb decomposition's may be complex, but not well connected. Gentner used cued recall to demonstrate that sentences with highly connected structures were better recalled than those with less connected structures. Gentner claimed that decomposition does occur when sentences are read and that Kintsch failed to find evidence for decomposition because the materials he used confounded complexity with connectedness.

Some evidence suggests that verification time bears some relationship to the content of the decomposed representation. This is especially true for logical primitives like "not". Carpenter & Just (1975) demonstrated that subjects treat "forget" like "not remember" and the inherently negative, and thus more complex verb "forget" takes longer to process in a verification task. Such evidence supports the notion of decomposition at encoding, at least for logical operators. Despite this, verification time can not be equated with reading time in general.

Garrod & Sanford (1982) propose that the issues of timing and content of a decomposed structure are inter-related. First let's examine some of the problems associated with decomposition depth alone, before discussing its relationship to the time course of the decomposition process.

It is very difficult to define the depth to which a verb may be decomposed. Just how detailed should the decomposed representation be. This issue also applies to the semantic primitives that are included in the decomposed representation. How much information should a basic primitive convey. For example the "MOVE" primitive that is used to define "punch" could contain information specifying the nature of the movement. But in doing so, it would become less primitive. There

seems to be trade-off between the baseness of description and attention to the amount of detail that is needed to adequately represent the meaning of the verb. This issue of decomposition depth in relation to comprehension is illustrated by instrumental verbs. Consider the following:

- (7) KEITH DROVE TO LONDON.
- (7') THE CAR BROKE DOWN HALFWAY.
- (7'') THE PORCHE BROKE DOWN HALF WAY.

There seems to be no difficulty in comprehending either continuation (7') or (7''). It is possible that the reference to "the car" is easily resolved because the decomposed representation of the verb "drive" contains a role slot for a vehicle. (7'') poses the problem of defining the nature of the role slot. It seems highly unlikely that a representation of "porche" is included in a decomposed representation of the verb "drive". The information that a "Porche" is a type of car must be derived from our general knowledge. It seems that it is possible to speculate on the boundaries of a decomposition representation but not possible to set them.

In example (7) reading the verb "drive" should produce a representation that has a car or a vehicle default. If it doesn't have 'porche', then extra inferential processing should have to occur when the reference to porch is encountered, more than when a reference to "the car" is encountered. The use of variables and their associated constraints provides a possible solution to this problem. If the vehicle role has the appropriate constraints, then it will accept any value that fulfils these requirements. In (7) both "car" and 'porche" meet these specifications. Variables seem to be an excellent way to represent implicit information (cf. Chapter 3).

Despite their problems, decompositional accounts remain popular. One reason is that they can not only be used to represent elements of lexical structure but also illustrate how a lexical representation can assist the process of comprehension. The use of primitives is appealing because they can capture the family resemblance between verbs. For example, all verbs of motion contain the same primitive. Decompositional accounts also capture the fact that many verbs are elaborations of others: "buy" and "sell" can be regarded as elaborations of "give" and 'take", with their meaning being captured by the addition of more primitives.

Information contained in the decomposed lexical structure can also assist processing at the discourse level. It may be used to resolve ambiguity in pronoun resolution. Consider ,

(8) MARY GAVE A CLOCK TO JACQUELINE.

(8') SHE SAID SHE WOULD KEEP THE CLOCK IN HER OFFICE.

Technically the pronoun "she" in 8' is ambiguous with either "Mary" or "Jacqueline" being possible antecedents. However, the pronoun is generally not interpreted as ambiguous and there is no difficulty assigning "Jacqueline" as its antecedent. It is assumed that information conveyed by the decomposed structure of the verb "give" allows us to determine the referent of the pronoun. We know that "giving" involves transfer of possession, hence only Jacqueline is a suitable antecedent, as it is only "Jacqueline" that can determine where the clock should be kept.

Finally, a decomposed lexical structure can contribute to creation of discourse coherence by assisting the process of reference resolution. Recall the earlier 'sew example' where a decomposed representation of the verb "sew" is assumed to contain a needle. This information can then function as an antecedent for a subsequent reference to 'the needle'.

A decomposition-based framework in which verbs refer to complex events containing particular roles provides a way in which verb meaning can assist comprehension. Since only elements central to the verb's meaning are included in a decomposed representation then we have some way of determining whether verb-based is available to assist comprehension. Evidence suggest that the semantic content of a verb not only influences the process of instrument inferencing, but also assists in the encoding of other types of elaborative inferences.

5A. 5 Verb Restrictions and Elaborative Inference

O'Brien, Schank, Myers & Rayner (1988) demonstrated that the nature of the context influenced the process of elaborative inferencing (instantiation of a category member). By varying the amount of contextual support they demonstrated that an elaborative inference would only be drawn when the text contained characteristics that virtually eliminated the possibility of it being disconfirmed. Once these constraints were relaxed, there was no evidence for the on-line encoding of the elaborative inference.

The most important aspect of their study, for the current discussion, is how the nature of the context was constrained. The restrictive nature of the context was manipulated, on most occasions, by using a restrictive verb (see Table 5A. 4).

Restrictive Context with Explicit Antecedent

All the mugger wanted was to steal the woman's money. But when she screamed, he stabbed her with his knife in an attempt to quieten her down. [He looked to see if anyone had seen him.] He threw the knife into the bushes, took her money, and ran away.

Restrictive Context with Implicit Antecedent

All the mugger wanted was to steal the woman's money. But when she screamed, he stabbed her with his weapon in an attempt to quieten her down. [He looked to see if anyone had seen him.] He threw the knife into the bushes, took her money, and ran away.

Non-restrictive Context with Explicit Antecedent

All the mugger wanted was to steal the woman's money. But when she screamed, he assaulted her with his knife in an attempt to quieten her down. [He looked to see if anyone had seen him.] He threw the knife into the bushes, took her money, and ran away.

Non-restrictive Context with Implicit Antecedent

All the mugger wanted was to steal the woman's money. But when she screamed, he assaulted her with his weapon in an attempt to quieten her down. [He looked to see if anyone had seen him.] He threw the knife into the bushes, took her money, and ran away.

Table 5A. 4 Example of Materials used by O'Brien et al. (1988)

In the restrictive context, the nature of a possible weapon could be either be constrained "stabbed with a weapon", or unconstrained "assaulted with a weapon". In addition, the method of antecedent introduction was manipulated: it could either be explicit ("knife") or implied ("weapon"). The results show that subjects had no difficulty interpreting the target noun, "knife" in either of the explicit contexts as the target has an explicit antecedent, nor did they have problems processing the target in the implicit restrictive context because the nature of the weapon was constrained by the verb, "stab". However, subjects experienced difficulty integrating the target, "knife" in the implicit non-restrictive context, "assault with weapon", as they had no means to constrain the nature of the weapon. Hence, they were unlikely to infer that "a knife" was used.

It should be noted that in order to rule out any influence of physical effects (explicitly presented concepts may have an advantage in the close paragraphs because the physical pattern may still be available in memory to facilitate the word identification process) a distance manipulation was included. The distance between the antecedent and the anaphor was varied with an intervening sentence (included in square brackets in table 5A. 4) occurring between the anaphor and its antecedent in the "distant condition" this sentence was omitted in the "close condition". No effect of distance was found, suggesting that the faster reading times were due to the facilitative influence of verb-based information at the discourse level and not to faster word identification processes. The results of O'Brien et al (1988) are important as they illustrate how verb-based information can assist the process of discourse integration.

Garrod, O'Brien, Morris, & Rayner (1990) closely examined the results of O'Brien et al. (1988) and found the process of elaborative inferencing is more complex than O'Brien et al's results suggest. Garrod et al. (1990) identified problems with O'Brien's materials and on the basis of a re-analysis and subsequent experiment demonstrated that the effect of a restrictive context (in this case a restrictive verb) was only apparent for anaphoric materials. It seems that context is only used to further define a referent if the reference is anaphoric.

Garrod et al. (1990) tested their anaphoric prediction by focusing on the key area of interest: the contrast between the explicit and implicit introduction of an antecedent in a restrictive context. The anaphoric nature of the target noun phrase was systematically manipulated by placing a definite or indefinite article in front of the target noun (materials used were similar to those of O'Brien, except the anaphoric nature of the target was manipulated). As predicted, the results

confirmed that a restrictive verb could assist the resolution of an anaphoric reference. For the non-anaphoric controls, a restrictive verb provided little assistance. As expected, the longest reading time was produced by the implicit non-anaphoric condition: it had no explicit antecedent nor could it benefit from the restrictive effect of the verb. The results of Garrod et al. (1990) suggest that the benefits provided by a role restricting verb only have processing consequences when this information is called upon to resolve a subsequent anaphoric reference. Their results provided yet another illustration of the use of verb-based information in comprehension.

5A.6 Verbs and Discourse Roles

Given the results of Garrod & Sanford (1982) and Cotter (1984) the benefits that can be derived from a restrictive verb such as "stab" may be more extensive than Garrod et al. suggest. Verb-based information should do more than simply further define a referent ("stab" constrains the type of weapon to "knife") it should be capable of establishing a discourse role. Reading the verb "stab" should result in a discourse role for an instrument (with its content being constrained to most strongly prefer "knife") being established. This discourse role can then assist the integration of a subsequent reference to the instrument without the need for complex bridging inferences. Consider this modified example of their material:

- (9) THE MUGGER STABBED HIS VICTIM BEFORE STEALING HIS WALLET AND BRIEFCASE. WHEN THE VICTIM BEGAN TO SCREAM; THE MUGGER THREW THE KNIFE INTO THE BUSHES AND RAN AWAY.

The use of verb-based information to assist integration is consistent with the views of Carlson & Tanenhaus (1988). Although they propose that the verb-based information is in the form of Thematic roles, they do acknowledge that Verb meaning ("core meaning") may assist discourse integration. The proposal that Verbs establish Discourse Roles is one possible way this could occur. It is the ability of verbs to establish discourse roles that assist discourse integration that is investigated in section B of this Chapter and in subsequent chapters.

5. B Verbs and Discourse Coherence: An Empirical Evaluation

5B.1 Assessing the Availability of Verb-based Information

The aim of the two experiments presented in this chapter was to evaluate the availability of verb-based information during discourse processing. Cotter's (1984) proposals suggest that verb-based information may not always be available to assist integration. The problem, then, is to determine the boundary conditions on the availability of verb-based information. Cotter suggested that verb-based information can only support integration if the required information is part of the lexical structure of the verb. If the information is only associated with the verb, it would not be immediately available and therefore unable to assist the integration process. The two experiments discussed in this chapter, and in subsequent chapters, investigate the range of conditions where verb-based information will assist integration.

It was felt necessary to replicate Cotter's results using a more sensitive methodology and thereby obtain more detailed information concerning the availability of verb-based information and its influence on integrative processing. Cotter used sentence reading time as an indication of the time taken to process the reference it contained. The studies discussed below use eye movements to monitor the time course of text processing.

Cotter's proposal that only information central to the meaning of a verb would influence integration was tested by replicating the results of Garrod & Sanford (1982), and Singer (1979). If Cotter's prediction is accurate, and "related" information is immediately available, then we should expect no advantage (difference in reading time) of having an explicitly rather than an implicitly introduced antecedent for a reference following a Garrod & Sanford Verb. However, we would expect longer reading times for Singer verbs as the verb-based instrument information should not be available to assist the resolution of a reference with an implicit antecedent. This prediction is supported by the data, and indicates that verb-based information, under certain conditions, will assist the process of reference resolution and contribute to the creation of discourse coherence.

5B.1.1 Eye Tracking: A More Sensitive Methodology

Eye movements were monitored to assess the time course of processing. The monitoring of eye movements appears to be the most secure method of establishing the time course of processing under normal reading conditions. It is possible to tell which sections of the text are being fixated and re-fixated, and for how long, at any given moment in time (Rayner et al, 1992; Rayner & Pollatsek, 1987). This contrasts with sentence reading time, where the reading time for a complete sentence is used to indicate the time taken to process an individual word it contains.

For successful comprehension readers must integrate current information with earlier information. Eye movement studies have provided important information about the timing of integrative processes, most notably the timing of antecedent search processes which are manifested as longer fixation times and regressions. For example, Ehrlich & Rayner (1983) studied the time course of Pronoun resolution. Their results indicate that the antecedent search process is initiated while a reader is fixating the pronoun, but may not be completed until one or two fixations following the pronoun. Duffy & Rayner (1989) investigated the timing of the resolution processes for Definite Noun Phrases. For explicit antecedents the search was strongly localised on the target noun (referent), and there was no evidence of major spill over effects.

A range of data, sentence and clause wrap-up effects (Just & Carpenter, 1978), antecedent search (Ferreira & Clifton, 1987), illustrates that eye movements can provide accurate information about high level comprehension processes. The data suggests that the fixation time on a target word, in the light of an earlier higher order manipulation, can provide information about higher order processes. It seems that discourse integration effects are manifested in specific eye fixations in particular regions. The rationale is similar to that of Haviland & Clark's (1974) bridging inference proposals for sentence reading time. If fixation time on the target region varies, it is most likely attributable to the fact that readers will have integrated information obtained earlier in the text, which allows them to process the target word more efficiently, or with more difficulty if they have not integrated the prior information.

Recently, eye movements have been used to study the time course of elaborative inferencing. The critical difference between the process of elaborative inference and antecedent search is that elaborative inferencing requires information to be

generated on-line that has not been explicitly stated. If elaborative information (generated from the verb) is immediately available then this information will be available to support the integration of subsequent text. As discussed earlier in this chapter, O'Brien et al. (1988) and Garrod et al. (1990) used eye movement data to demonstrate the on-line encoding of elaborative inferences. Also, Just & Carpenter (1978) used eye tracking to investigate the use of verb-based information in comprehension (cf. Chapter 3). They demonstrated that the information entailed by lexical items like "murder": Agent, Recipient, and Instrument, can be used to integrate subsequent references to these entailments.

As outlined earlier, eye movements can reflect higher order processing and these effects may be localised to specific areas of the text. Due to the fine grain analysis eye movement data allows, it is possible to check if the difficulty associated with processing a word influences the time taken to process subsequent words. In short, the difficulty may "spill-over" onto subsequent words. Inhoff & Rayner (1986) and Rayner & Duffy (1986) found that the difficulty associated with a target word can not only influence the amount of time spent reading that word but it may also produce longer reading times on following words, i.e., difficulty spills over onto following words.

This discussion illustrates that eye movement data can provide detailed information about language processing. The empirical data shows that the fixation time on individual words can be influenced by higher order processes. The fine grain level analysis that eye movement data allows can provide information about integrative processes- antecedent search, and elaborative inferences. Since we can examine the reading time on individual words rather than the reading time on a entire sentence we can precisely locate the locus of difficulty and see if the difficulty associated with processing a particular word influences the time spent processing subsequent words (spill over effects). A precise method is essential when investigating the availability of verb-based information about instruments; since the empirical data is mixed and seems dependent on the method used (Keenan et al., 1990).

5B.2 Experiment One: Replication of Garrod & Sanford (1982)

5B.2.1 Rationale

As outlined earlier, the majority of studies used to evaluate the use of verb meaning in inferencing and discourse integration, used self-paced reading time to assess processing difficulty. It was felt necessary to replicate, and in the light of new evidence from Garrod et al. (1990), expand these experiments using a more sensitive methodology.

Garrod & Sanford's original study was extended to test the proposal made by Garrod et al. (1990) that verb-based (role) information would only have processing consequences when the role information is required to resolve an anaphoric reference. This suggestion is also consistent with a prediction derived from the Sanford & Garrod (1981) Focus Framework: only definite descriptions will access role based antecedents. Garrod & Sanford's original study only contained an anaphoric reference to the instrument, there was no non-anaphoric control. Therefore, an non-anaphoric reference to the instrument was included.

Despite this modification, the basic rationale remained the same. Compared the reading time for a target instrument with either an explicit or implied (by a role identifying verb) antecedent. In addition, the reference could either be anaphoric or non-anaphoric. The anaphoric nature of the target instrument was systematically manipulated by having either a definite or an indefinite determiner preceding the instrument.

The rationale is based on the work of Haviland & Clark (1974) who demonstrated that comprehension time for a sentence was partly dependent on the reader's ability to recover antecedents for the definite anaphors it contains. The indirect introduction of an antecedent increases reading times, because additional processing is thought to be required to make the necessary anaphoric connection. Given this, an anaphoric reference to an instrument should receive a longer fixation time if its antecedent has been implicitly, rather than explicitly introduced. It is assumed that additional processing is required to make the inference that this instrument, was the one used to carry out the previously mentioned action.

If, as predicted, a role identifying verb can introduce a role based discourse referent which can facilitate the comprehension of a subsequent anaphor there should be no difference in the fixation time for an anaphor with either an explicit or an implicit antecedent. However, such role derived benefits should only be apparent with anaphoric materials. Definite Noun phrases take their interpretation from the context, therefore they require an antecedent in the discourse model. Such an antecedent can either be introduced directly (as in the explicit condition) or established by a role inducing verb (implicit condition).

It was predicted that if verb-based information is immediately available to support integrative processes then there should be no difference in the reading times of the target instrument following an explicit or implicit antecedent. However, this verb-based information should only be used to assist the processing of an anaphoric reference. Hence, subjects should experience difficulty integrating a non anaphoric reference following an implicit antecedent (implicit non-anaphoric condition). This difficulty should be reflected in an increased reading time on this region.

5B.2.2 Method

5B.2.2.1 Materials

The 16¹ Garrod & Sanford verbs used by Cotter (1984) were used to generate the stimulus materials (see Appendix 1). The stimulus passages all conformed to a standard format. Each had an introductory sentence that established the context for interpretation. The second sentence introduced the Target Instrument either explicitly ("took his car") or implicitly via the verb ("drive"). The third sentence contained the Target Instrument which referred either anaphorically or non-anaphorically to the instrument introduced in the previous sentence. The forth, and final, sentence was simply a concluding sentence to make the passage more coherent.

The explicit introduction of the antecedent followed the method used by Garrod & Sanford (1982) in that it did not contain the actual verb. Instead, the verb is

¹ The verb "kiss" included in the experimental materials of both Garrod & Sanford (1982) and Cotter (1984) was not included in the final analysis; since the implied instrument ("lips") is a body-part rather than a tool instrument. The work of Doshier & Corbett (1982) suggests that body-part instruments may differ from tool instruments .

paraphrased and the instrument mentioned. The passages used are slightly longer than those of Garrod & Sanford (1982) or Cotter (1984). This was to ensure that subjects processed the text as a short discourse rather than single sentences. An example material in all conditions is given below:

Explicit Anaphoric

David had to attend an important meeting in town. He hated taking his car to London as the roads were so busy. He wished he had taken a friend's advice and left the car at home. If he didn't find a parking space soon he would be late for his appointment. Did David travel to London by train?

Explicit Non-anaphoric

David had to attend an important meeting in town. He hated taking his car to London as the roads were so busy. He wished he had taken a friend's advice and left a car at home. If he didn't find a parking space soon he would be late for his appointment. Did David travel to London by train?

Implicit Anaphoric

David had to attend an important meeting in town. He hated driving in London as the roads were so busy. He wished he had taken a friend's advice and left the car at home. If he didn't find a parking space soon he would be late for his appointment. Did David travel to London by train?

Implicit Non Anaphoric

David had to attend an important meeting in town. He hated driving in London as the roads were so busy. He wished he had taken a friend's advice and left a car at home. If he didn't find a parking space soon he would be late for his appointment. Did David travel to London by train?

5B.2.2.2 Subjects

24 students from the University of Glasgow participated in the experiment. All were native speakers of English. Some subjects had previously participated in other eye tracking studies. Each subject was paid £5.

5B.2.2.3 Design

A within subjects design was used. Four experimental list of materials were compiled for presentation, with each set containing 4 passages in each of the four experimental conditions. This meant that each passage in each condition was read by 6 subjects. The stimuli were presented along with 63 filler items of a similar format, in a fixed random order.

5B.2.2.4 Procedure

When a subject arrived a brief explanation of the purpose of the experiment and the procedure involved was given. They were informed that the purpose of the experiment was to investigate eye movements that occurred during reading and were instructed to read the passages as they would normally read a piece of text. They were told they would be expected to accurately answer a Yes/No question after some of the passages.

In order to eliminate head movements, subjects were restrained by a chin rest and forehead restraints. When the subjects were comfortably seated the eye tracking system was set-up and calibrated for each individual subject. The set-up and calibration procedure took on average five minutes.

On successful completion of the calibration phase subjects were prompted to begin the reading phase of the experiment by the following message "press pace key to commence reading phase" appearing on the viewing screen. Doing so, would result in a fixation point ("+") appearing in the upper left hand corner of the screen. When this point was fixated the stimulus material was displayed. This fixation point coincided with the first letter of the displayed text. After reading the passage of text the subject pressed the 'pace key' to remove the passage from the screen. Then, they were either presented with a question which the subject answered Yes or No via the key pad, or prompted (as before) to begin the next trial. A question was presented on half of the trials. No feedback was given on the question responses as they were only included to motivate the subject and encourage comprehension.

Subjects were given a rest interval after every 19 trials. There were 3 such break periods, and the eye tracking system was re-calibrated after each one. Subjects usually completed the experiment in 40 minutes.

5B. 2. 2. 5 Apparatus

Eye movements were monitored by a Stanford Research Institute Dual Purkinje Generation 5.5 Eye Tracking System made by Forward Technologies under license to S.R.I. The eye-tracker has an angular resolution of 10' arc. Viewing was binocular with eye location being recorded from the right eye. The eye tracking system was interfaced with a Vanilla 386 computer which controlled the presentation of stimuli and recorded the output from the eye tracking system. The experimental stimuli were presented on a VDU which also interfaced with the Vanilla. The VDU was located at a distance of 70 cm and the material spanned 6-8 lines, with a maximum of 65 characters per line.

The position of a subject's eye was sampled every millisecond and analysed using software that continuously monitored the output in order to establish the sequence of eye fixations, and their start and finish times to the nearest millisecond. Hence, a continuous record of eye movements, fixation position, and fixation duration was obtained.

5B. 2. 3 Analysis

5B. 2. 3. 1 Processing of Individual Data Files

Following the experiment, the eye movement records for each subject were analysed to determine which line of text the subject was reading. This involved a small degree of judgement as subjects' eyes could land between two lines of text, and slight head movements sometimes cause small systematic changes in the recording of fixation location. In the majority of cases there was little difficulty in determining which line was being fixated.

The data was then processed by an automatic procedure that pooled short contiguous fixations. All fixations of less than 80 ms on characters only separated by one other character were treated as a single fixation, as were fixations of less than 40 ms within 3 characters.

5B. 2. 3. 2 Data Replacement

Prior to any statistical analysis the data was corrected for outliers that lay more than 2.5 standard deviations above the condition mean for each region. These outlying scores were replaced with the 2.5 standard deviation value for the appropriate region. Less than 2% of the data was replaced by this procedure.

5B. 2. 4 Regions and Measures

5B. 2. 4. 1 Regions

There were two main regions selected for analysis: the Target Instrument (noun) and the Post Target region. The Post Target region was defined as the two words following the Target Instrument. The post-target region was examined to probe for any spill-over and discourse integration effects (Inhoff & Rayner, 1986).

All data is cited in milliseconds per character. Such a transformation corrects for differences in the number of characters in a region. Since all regions across conditions are matched for length there is no need to be concerned that this transform will systematically distort the data in a way that could undermine the conclusions as discussed by Trueswell, Tanenhaus & Garnsey (1994).

5B. 2. 4. 2 Measures

The eye movement data was examined using a number of measures:

i) First Pass Reading Time (abbreviated to FP Reading Time)

Defined as the sum of all the fixations occurring within a region before the eye leaves the region, either to the right or to the left. Such a definition means that if the eye fixated a point beyond the end of the region before landing in the region for the first time, then the first-pass time for that region would be zero.

ii) Total Reading Time (abbreviated to Total Time)

Defined as the sum of all fixations in a region including all regressions back to that region.

iii) Regressive Eye Movements (abbreviated to Regressions)

Defined as any leftward movement that began at the right-most point the subject had fixated and crossed a region boundary. Regressive eye movements within a region were ignored.

Regressive eye movements, especially large regressive movements, can indicate processing difficulty (Rayner & Pollatsek, 1989). Thus, differences between conditions in the number of regressions they evoke may provide an indication of processing difficulty.

As with Reading Time, two types of Regressive Eye Movements were examined:

(a) First Pass Regressions

Defined as regressive eye movements which occur following a First Pass fixation in the region.

First Pass regressions are thought to reflect early effects of processing- word recognition processes etc. (Rayner & Pollatsek, 1989).

(b) Total Time Regressions

Defined as the total number of regressive eye movements from the region; includes both First Pass regressions in addition to any subsequent regressions following a re-fixation in the region.

Total Time Regressions are thought to reflect secondary analysis of the region and provide a global measure of processing difficulty.

5B. 2. 5 Results

5B. 2. 5. 1 Noun Region

First Pass Reading Times

Condition	FP Reading Time	Standard Error
Explicit Anaphoric	26.416	2.956
Explicit Non-Anaphoric	26.959	2.303
Implicit Anaphoric	26.380	2.501
Implicit Non-Anaphoric	29.244	2.897

Table 5B. 1 Mean First Pass Reading Times (ms/pc) and Standard Errors By Condition For Target Instrument

A 2 (explicitness) x 2 (anaphoricness) repeated measures ANOVA calculated on First Pass subject and item reading time means revealed no significant main effects or interactions (all Fs < 1).

Although statistical analysis revealed no reliable effects the pattern of results is as expected: the implicit non-anaphoric condition receives the longest reading time, suggesting that subjects found this most difficult. Also, as expected, there is no apparent difference between the explicit and implicit anaphoric conditions suggesting that there is no advantage to be gained by explicitly introducing the antecedent for a subsequent anaphoric reference to an instrument associated with a Garrod & Sanford Verb.

Further evidence for the difficulty associated with the implicit non-anaphoric target is provided by the pattern of regressive eye movements. Regressions are regarded as indicating integrative processing and research has shown that the number of regressions is generally related to text difficulty (Rayner & Pollatsek, 1989).

First Pass Regressions from Target Instrument to All Prior Text

Condition	First Pass Regressions	Standard Error
Explicit Anaphoric	.126	.037
Explicit Non-Anaphoric	.104	.035
Implicit Anaphoric	.103	.031
Implicit Non-Anaphoric	.157	.038

Table 5B. 2 Mean Number of First Pass Regressions From Target Instrument to All Prior Text and Standard Errors By Condition

A 2 (explicitness) × 2 (anaphoricness) repeated measures ANOVA calculated on First Pass subject and item Regression means revealed no significant main effects (all $F_s < 1$) and a trend towards interaction ($F_1 (1,23) = 1.449, p = .241, MSe = .024$; $F_2 (1,14) = 1.803, p = .2008, MSe = .008$).

Although the results fail to reach statistical significance, the overall pattern of results is as expected. There is a trends towards an interaction with the greatest number of regressions being evoked by the implicit non-anaphoric condition.

Although statistical analysis of the First Pass reading time and regression data shows no significant effects, the pattern of results is consistent with the experimental predictions. Suggesting that there is no advantage in having an explicit antecedent for an anaphoric reference to an instrument implied by a Garrod & Sanford Verb.

Total Reading Time

Condition	Total Reading Time	Standard Error
Explicit Anaphoric	28.439	3.246
Explicit Non-Anaphoric	31.550	2.529
Implicit Anaphoric	30.519	3.225
Implicit Non-Anaphoric	36.351	3.377

Table 5B. 3 Mean Total Reading Times (ms/pc) And Standard Errors By Condition For Target Instrument

A 2 (explicitness) x 2 (anaphoricness) repeated measures ANOVA calculated on Total subject and item Reading Time means revealed no significant main effects (explicitness: $F_1(1,23) = 1.656, p = .2109, MSe = 171.516$; $F_2(1,14) < 1$; anaphoricness $F_1(1,23) = 2.04, p = .1666, MSe = 235.190$; $F_2(1,14) = 3.026, p = .1039, MSe = 91.552$) or interaction ($F_s < 1$).

Although statistical analysis revealed no reliable effects, the pattern of results is as predicted: with the target instrument in the implicit non-anaphoric condition receiving the longest reading time. The difficulty associated with the implicit non-anaphoric condition is also manifested in the pattern of Total Time Regressions.

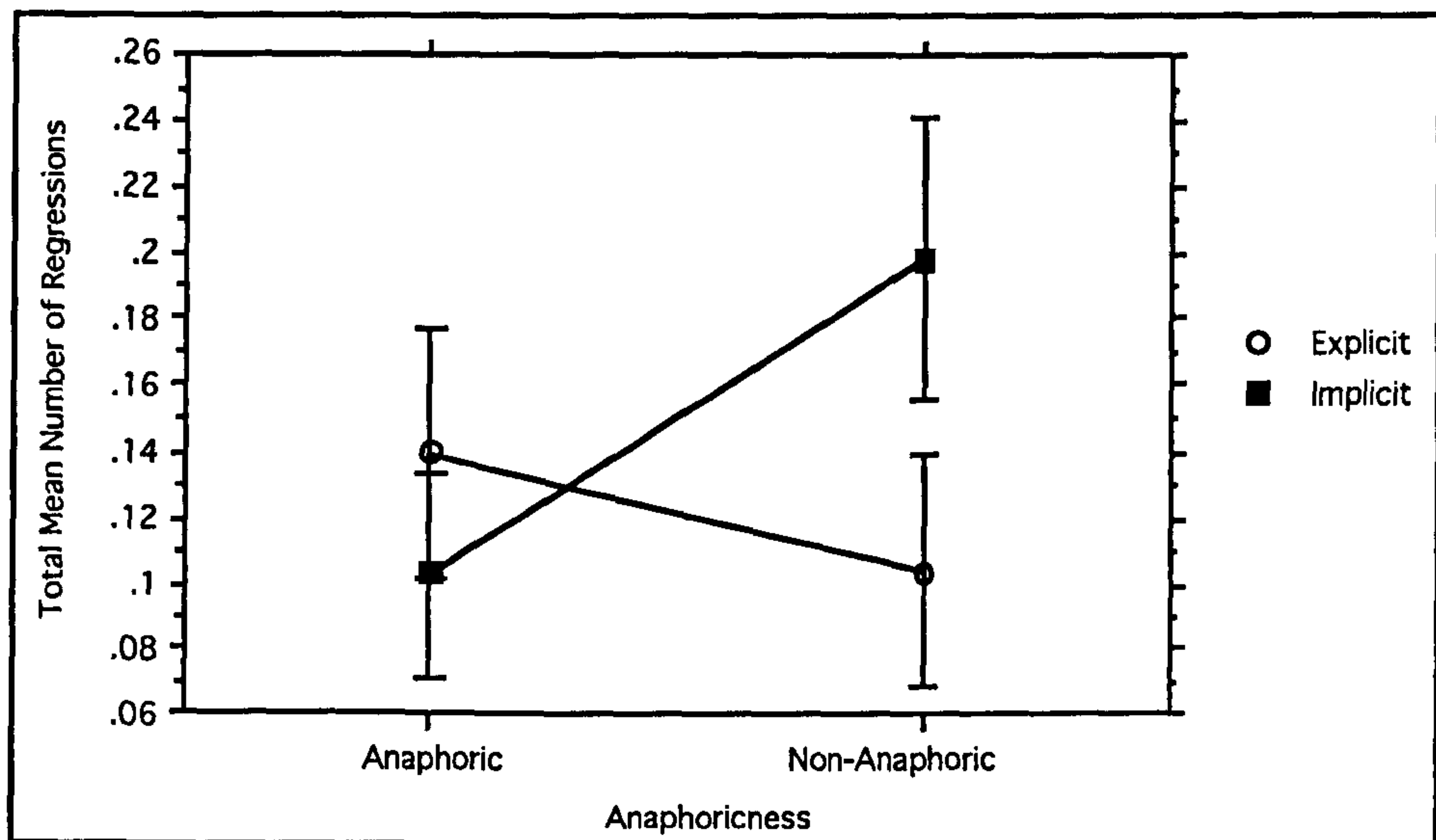
Total Time Regressions from Target Instrument to All Prior Text

Fig. 5.1 Mean Number of Total Time Regressions From Target Instrument to All Prior Text and Standard Errors By Condition

A 2 (explicitness) \times 2 (anaphoricity) repeated measures ANOVA calculated on the Total number of subject and item regression means revealed no significant main effects ($F_s < 1$) and a Significant Interaction between Explicitness and Anaphoricity: $F_1(1,23) = 5.16, p < .04, MSe = .02$; $F_2(1,14) = 5.187, p < .04, MSe = .008$.

Planned means comparisons revealed the interaction was due to a significant difference between the number of regressions evoked by the explicit non-anaphoric condition compared to that of the implicit non-anaphoric condition: $F_1(1,23) = 5.342, p < .04, MSe = .107$; $F_2(1,14) = 4.906, p < .05, MSe = .04$, with the implicit non-anaphoric target producing the most regressions. There was also a significant difference in the number of regressions from the implicit anaphoric condition compared to that from the implicit non-anaphoric condition: $F_1(1,23) = 5.503, p < .03, MSe = .11$; $F_2(1,14) = 5.512, p < .04, MSe = .045$, with the implicit non-anaphoric condition producing most regressions. This pattern of regressions is consistent with the reading time results, suggesting that a non-anaphoric reference to an implied instrument is the most difficult to resolve.

The results from the Noun Region (both Reading Time and Regression data) support the experimental predictions. Firstly, a non-anaphoric reference to an implied instrument (control condition) produced the longest reading time, suggesting it was the most difficult to integrate into the discourse. The apparent lack of difficulty (no difference in the reading times for the explicit and implicit anaphoric conditions) for the implicit anaphoric condition suggests that verb-based information is available to assist the integration process. In contrast, in line with Garrod et al. (1990) findings, such verb-based information will not facilitate the integration of a non-anaphoric reference, hence the difficulty (long reading times) produced by the implicit non-anaphoric condition.

5B.2.5.2 Spill Over Effects

As outlined earlier, difficulty associated with processing a word may "spill over" onto subsequent words. If processing difficulty spills over, or if the Target is not being integrated when it is read, then we would expect longer reading times on words subsequent to the Target.

It was predicted, that the difficulty associated with the implicit non-anaphoric target may spill over. The fact that there is no difference between the explicit and implicit anaphoric conditions may be due to the implicit condition not yet being integrated, rather than the use of verb-based information to assist its integration. If this is the case, we would expect a difference to be apparent on subsequent words. To assess this possibility, the fixation time on the two words following the target was examined. A two word region following the target was examined because in most instances there was a preposition following the target noun. Since prepositions are short, they may be skipped (low fixation probability).

First Pass Reading Times on Post-Target Region

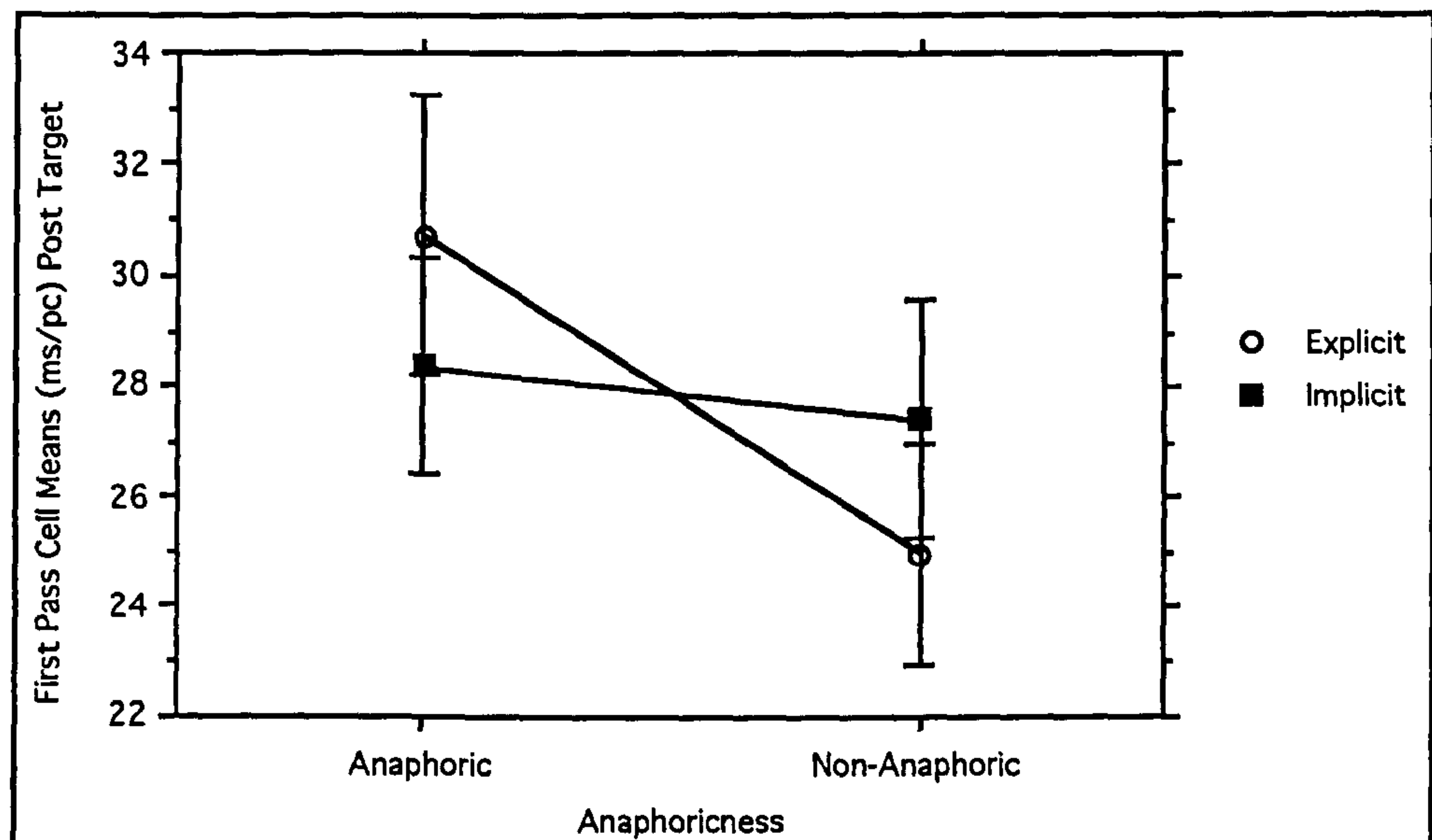


Fig 5B. 2 Mean First-Pass Reading Times (ms/pc) and Standard Errors By Condition For the Post-Target Region

A 2 (explicitness) x 2 (anaphoricness) repeated measures ANOVA calculated on First-Pass subject and item Reading Time means revealed no significant main effects of explicitness (both $F_s < 1$), a marginal effect for anaphoricness:

$F_1(1, 23) = 2.921$, $p = .1009$, $MSe = 92.311$, $F_2(1, 14) = 3.917$, $p < .07$, $MSe = 30.653$ and a marginal interaction: $F_1(1, 23) = 1.781$, $p = .1951$, $MSe = 78.132$, $F_2(1, 14) = 3.376$, $p < .09$, $MSe = 21.689$.

The First Pass reading times on the Post-Target region follow a different pattern than the First Pass reading time on the Noun region. The longest fixation time is for the explicit anaphoric condition, closely followed by the implicit anaphoric condition. The interesting finding is that there is no difference between the explicit and implicit anaphoric conditions. Another point to note, are the relatively faster reading times for the non-anaphoric conditions.

Total Reading Time on Post-Target Region

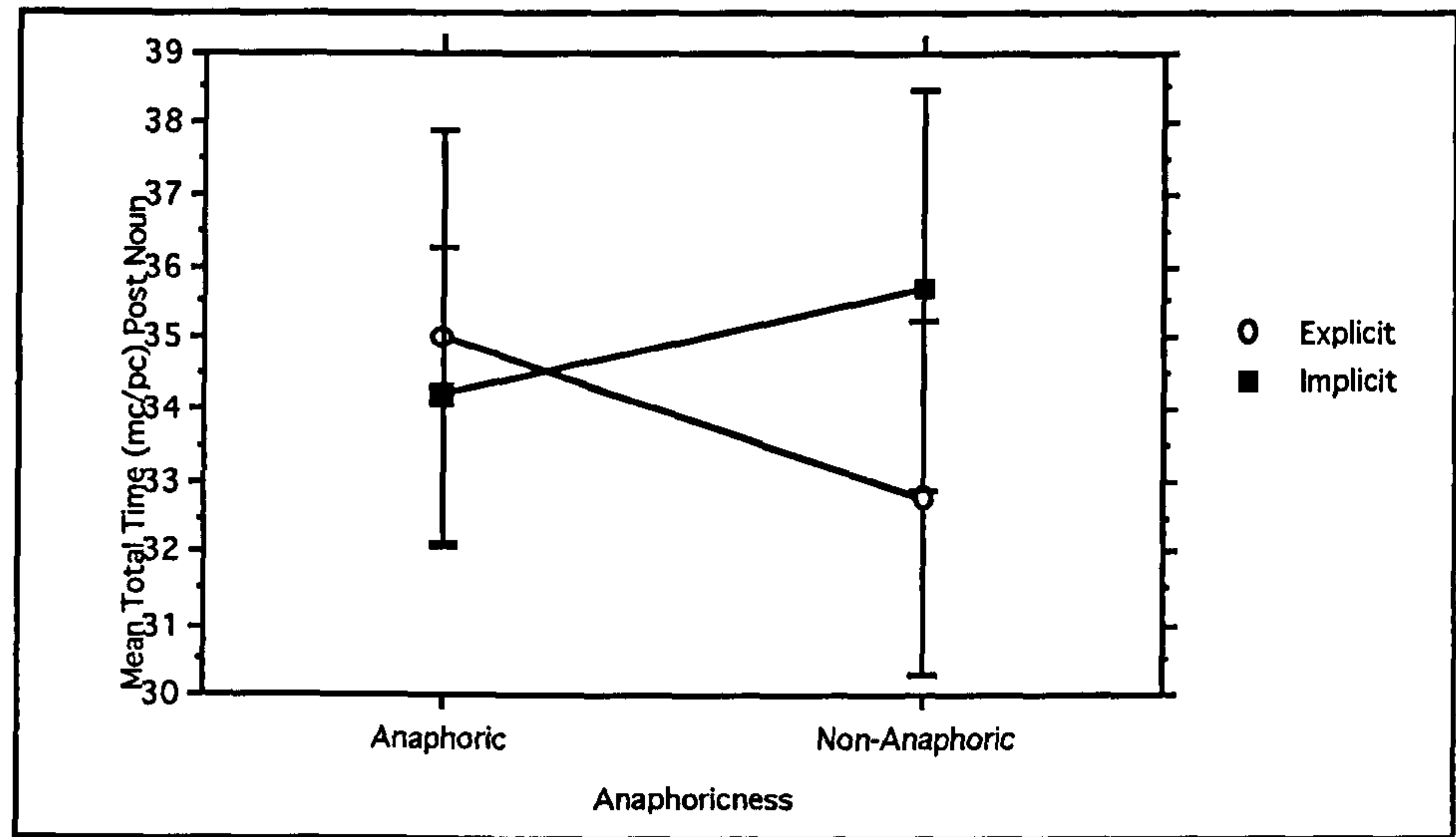


Fig 5B. 3 Mean Total Reading Times (ms/pc) And Standard Errors By Condition on the Post-Target Region

A 2 (explicitness) x 2 (anaphoricness) repeated measures ANOVA calculated on Total subject and item reading time means revealed no significant main effects (explicitness both $F_s < 1$, anaphoricness $F_1 < 1$, $F_2 (1,14) = 2.817$, $p = .9958$, $MSe = 52.543$); and a non-significant interaction ($F_1 (1, 23) < 1$; $F_2 (1,14) = 1.503$, $p = .2405$, $MSe = 50.433$).

The implicit non-anaphoric condition is still causing the most processing difficulty. Again, it is important to note that there is no difference in the reading time for the explicit and implicit anaphoric targets. The fact that there is no spill-over associated with the implicit anaphoric target is very important. It may be argued that there was no difference between the explicit and implicit anaphoric targets because the target instrument was not integrated when the instrument was encountered. However, since there is no difference in the pattern of spill over effects (both show a comparable increase) we can be sure that both targets are being processed with equal ease, and that any difficulty produced by anaphoric reference with an implicit antecedent does not spill over onto subsequent text.

As expected, the biggest difference in the means (though not significant) is between the non-anaphoric targets with the difficulty produced by the implicit non-anaphoric target spilling over onto subsequent words.

The results of the Post Noun region are consistent with those obtained from the Noun region. They suggest that subjects still experience difficulty processing the implicit non-anaphoric condition. This interpretation is consistent with the regression data.

Regressions from Post-Target Region to Target Region

First Pass Regressions from Post-Target Region to Target Region

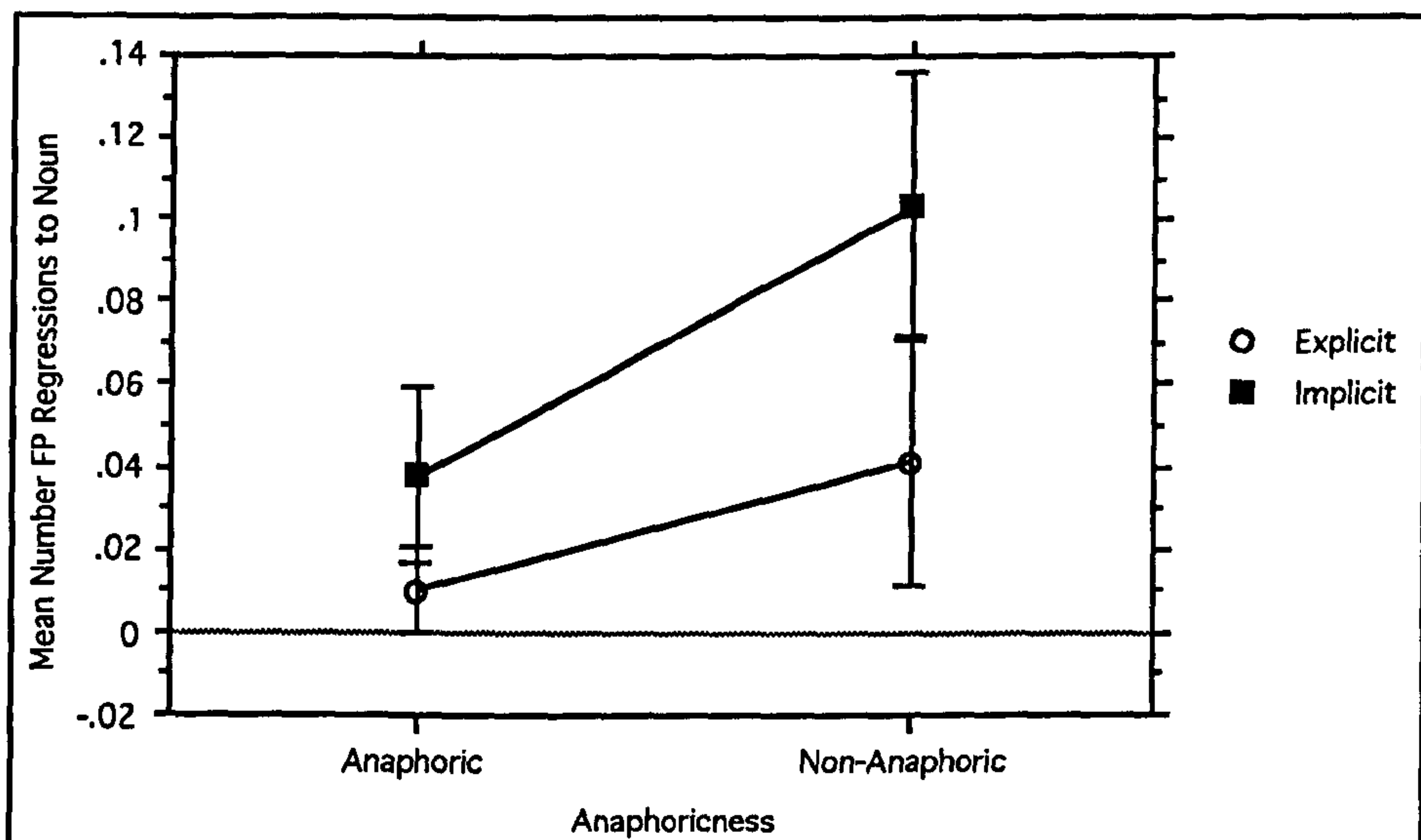


Fig 5B. 4 Mean First Pass Regression From the Post-Target Region to the Target Instrument and Standard Errors By Condition

A 2 (explicitness) \times 2 (anaphoricness) repeated measures ANOVA calculated on First Pass subject and item Regression means revealed marginal main effects of explicitness: $F_1(1,23) = 2.029$, $p = .1677$, $MSe = .024$; $F_2(1,14) = 10.682$, $p < .006$, $MSe = .033$, and anaphoricness: $F_1(1,23) = 5.825$, $p < .03$, $MSe = .01$; $F_2(1,14) = 3.21$, $p = .0948$, $MSe = .009$, and a non significant interaction: ($F_1(1,23) < 1$; $F_2(1,14) = 1.085$, $p = .3153$, $MSe = .007$).

The First Pass Regression data is consistent with the experimental predictions: most regressions from the implicit non-anaphoric condition, suggesting it was the most difficult to integrate.

Total Time Regressions from Post-Target Region to Target Region

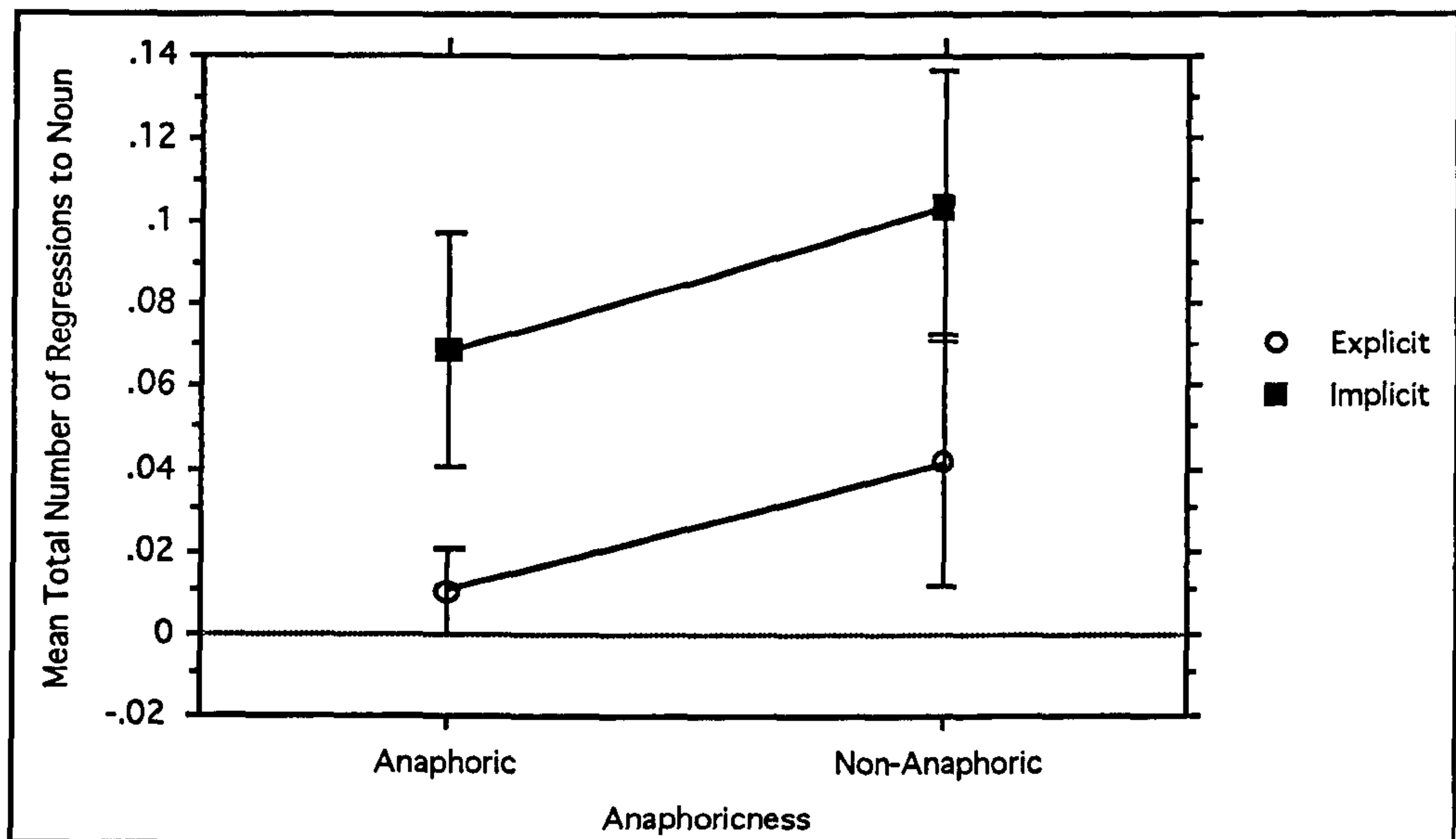


Fig. 5. 2 Mean Number of Total Regressions And Standard Errors By Condition from Post-Target Region

A 2 (explicitness) x 2 (anaphoricness) repeated measures ANOVA calculated on Total subject and item Regression means revealed a significant main effect of explicitness: $F_1(1,23) = 3.464$ $p < .08$, $MSe = .025$; $F_2(1,14) = 23.349$, $p < .0004$, $MSe = .003$. No effect for anaphoricness ($F_1(1,23) = 1.887$ $p = .18.27$, $MSe = .014$; $F_2(1,11) < 1$); and a non-significant interaction (both $F_s < 1$).

The pattern of Total Regressions from the Post-Target Region to the Target Instrument indicates that most regressions are evoked by a reference (both anaphoric and non-anaphoric) that has an implicit antecedent. The Implicit non-anaphoric reference produced the most regressions suggesting it is the most difficult to integrate. However, there was an increase in the number of regressions associated with the implicit anaphoric condition. It is important to note that this higher number of regressions to the target Instrument in the implicit anaphoric condition did not increase the total fixation time on either the

Instrument or the Post-Target Region to a level that was significantly different from those obtained for explicit anaphoric targets.

The Reading Time and Regression data for the Post Target Region is consistent with the experimental predictions, in that the implicit anaphoric target does not produce a significant increase in fixation time suggesting that a definite reference with an implicit antecedent can easily be resolved if the integration process is supported by verb-based information.

5B.2.5.3 Discussion of Results

It was predicted that if verb-based information is immediately available to support integrative processes then there should be no difference in the reading times of a reference to a Target Instrument with an explicit or implicit antecedent. However, this verb-based information should only be used to assist the processing of an anaphoric reference. Hence, subjects should experience difficulty integrating a non anaphoric reference with an implicit antecedent (implicit non-anaphoric condition).

The results, no difference in the reading times of the Target Instrument (or the post target region) with either an explicitly or implicitly introduced antecedent, support the experimental predictions that verb-based information can assist the integration process. The fact that such verb-based information assists the integration process is supported by the longer reading times for the implicit non-anaphoric targets where verb-based information is not available to assist the integration process. The results are also consistent with the findings of Garrod et al. (1990) who demonstrated that the discourse benefits from a role-restricting verb would only be apparent with anaphoric materials. This is because the verb supports a discourse role that can function as an antecedent for subsequent reference. Such a discourse role would be of little assistance in resolving a non-anaphoric reference which does not require an antecedent. Although the non-anaphoric contrast fails to reach significance, the trend is consistent with this prediction as subjects experience most difficulty resolving an indefinite reference to an instrument with an implied antecedent. The small number of materials may have reduced the likelihood of this result reaching significance.

The surprising finding was the difference in the number of regressions from the Post Target Region back to the Target Instrument. Since most regressions are from targets with implicit antecedents (both anaphoric and non-anaphoric); this pattern of regressions may reflect different processing strategies for integrating references with explicit and implicit antecedents. The ability to extract such detailed information illustrates one of the advantages of using eye movements rather than sentence or word-by-word reading time which does not allow such a detailed level of analysis.

Overall, the pattern of Results replicates those of Garrod & Sanford (1982) and supports the use of verb-based information to assist the establishment of discourse coherence. However, Verb-based information may not always be used to support integration. Evidence for the limited use of Verb-based information is provided by Experiment 2.

5B.3 Experiment Two: Replication of Singer (1979)

5B.3.1 Rationale

The results of Singer (1979), later replicated by Cotter (1984), suggest that the use of verb-based information in instrument inferencing is limited. Recall that Cotter (1984) explained the discrepancy between the results of Garrod & Sanford and Singer from a lexical perspective: Instruments associated with Garrod & Sanford Verbs are a more fundamental part of the verbs' meaning than the Instruments associated with Singer Verbs. Semantically related information is more likely to be available to assist the integration process. Given the replication of Garrod & Sanford's results (Experiment 1), it is important to evaluate Cotter's proposal concerning Singer Verbs using a more precise methodology. It also enables the time course of integration in the assumed absence of discourse role to be explored.

If Cotter's proposals are correct, and verb-based information is not available to assist integration then longer reading times for referents with implicit antecedents would be expected. The reference will need to be integrated by a time consuming bridging inference rather than being supported by verb-based information.

5B.3.2 Method

5B.3.2.1 Materials

The 12 'Singer Verbs' and Instruments used by Cotter (1984) were used to generate the stimulus materials (for full list see Appendix 2).

The stimulus passages all conformed to a standard format. Each had an introductory sentence that established the context for interpretation. The second sentence introduced the antecedent for the Target Instrument either explicitly (verb and instrument) or implicitly (verb). The third sentence contained the Target Instrument which referred either anaphorically or non-anaphorically to the Instrument introduced earlier. The forth, and final, sentence was simply a concluding sentence to make the passage of text more coherent.

The passages used are slightly longer than those of Singer (1979), or Cotter (1984). This was to ensure that subjects' processed the text as a short discourse rather than single sentences in order to evaluate the use of verb-based information in the integration of discourse and to ensure they were comparable with those used in Experiment 1.

An example of the materials used, in all conditions, is given below:

Explicit Anaphoric Condition

The architect was behind schedule on his design for the new shopping centre. He carefully drew the lines with a pencil. He chewed on the pencil as he considered possible sites for the car park. Once that was settled the project would be complete. Was the architect running to schedule?

Explicit Non-anaphoric Condition

The architect was behind schedule on his design for the new shopping centre. He carefully drew the lines with a pencil. He chewed on a pencil as he considered possible sites for the car park. Once that was settled the project would be complete. Was the architect running to schedule?

Implicit Anaphoric Condition

The architect was behind schedule on his design for the new shopping centre. He carefully drew the lines on the plan. He chewed on the pencil as he considered possible sites for the car park. Once that was settled the project would be complete. Was the architect running to schedule?

Implicit Non-anaphoric Condition

The architect was behind schedule on his design for the new shopping centre. He carefully drew the lines on the plan. He chewed on a pencil as he considered possible sites for the car park. Once that was settled the project would be complete. Was the architect running to schedule?

5B.3.2.2 Subjects

24 students from the University of Glasgow participated in the experiment. All were native speakers of English. Some subjects had previously participated in other eye tracking studies. Each subject was paid £5.

5B.3.2.3 Design

A within subjects design was used. Four experimental list of materials were compiled for presentation, with each set containing 3 passages in each of the four experimental conditions. This meant that each passage, in each condition, was read by 6 subjects. The stimuli were presented along with 48 filler items of a similar format in a fixed random order.

5B.3.2.4 Procedure

Identical to that used in Experiment 1, except that Subjects were given a rest interval after every 15 trials. There were 4 such break periods, and the eye tracking system was re-calibrated after each one. Subjects usually completed the experiment in 45 minutes.

5B.3.2.5 Apparatus & Analysis

Identical to that used in Experiment One.

5B.5.3 Results

5B.5.3.1 Noun Region Results

First-Pass Reading Times

Condition	FP Reading Time	Standard Error
Explicit Anaphoric	29.715	3.637
Explicit Non-Anaphoric	23.991	2.594
Implicit Anaphoric	27.202	3.592
Implicit Non-Anaphoric	31.146	3.376

Table 5B.4 Mean First-Pass Reading Times (ms/pc) and Standard Errors By Condition For Target Instrument

A 2 (explicitness) x 2 (anaphoricness) repeated measures ANOVA calculated on First-Pass subject and item Reading Time means revealed no significant main effects (explicitness: $F_1(1,23) = .575, p = .456, MSe = 224.832$; $F_2(1,11) = 1.218, p = .2934, MSe = 74.538$; anaphoricness both $F_s < 1$), or interaction ($F_1(1,23) = 2.609, p = .1199, MSe = 214.965$; $F_2(1,11) = 2.465, p = .1447, MSe = 93.962$).

Although statistical analysis revealed no reliable effects, the pattern of results is as expected: the implicit non-anaphoric condition receives the longest reading time, suggesting that subjects found this the most difficult to integrate. Interestingly, there is no difference in the reading times of the Target Instrument in explicit and implicit anaphoric conditions. This is not entirely unexpected, as previous studies (Cotter 1984) show explicitness effects in sentence reading time.

First-Pass Regressions from Target Instrument to All Prior Text

Condition	Mean Number of Regressions	Standard Error
Explicit Anaphoric	.139	.040
Explicit Non-Anaphoric	.125	.034
Implicit Anaphoric	.125	.052
Implicit Non-Anaphoric	.125	.034

Table 5B. 5 Mean Number of First-Pass Regressions and Standard Errors By Condition From Target Instrument To All Prior Text

A 2 (explicitness) x 2 (anaphoricness) repeated measures ANOVA calculated on the mean number of First-Pass regressions from the Target Instrument by subject and items revealed no significant main effects or interactions (all Fs < 1). Although there were no reliable statistical effects, the highest number of regressions are evoked by the Target Noun in the explicit anaphoric condition which is consistent with the first pass reading time data where the explicit anaphoric received a relatively long fixation time.

Total Reading Time on Target Instrument

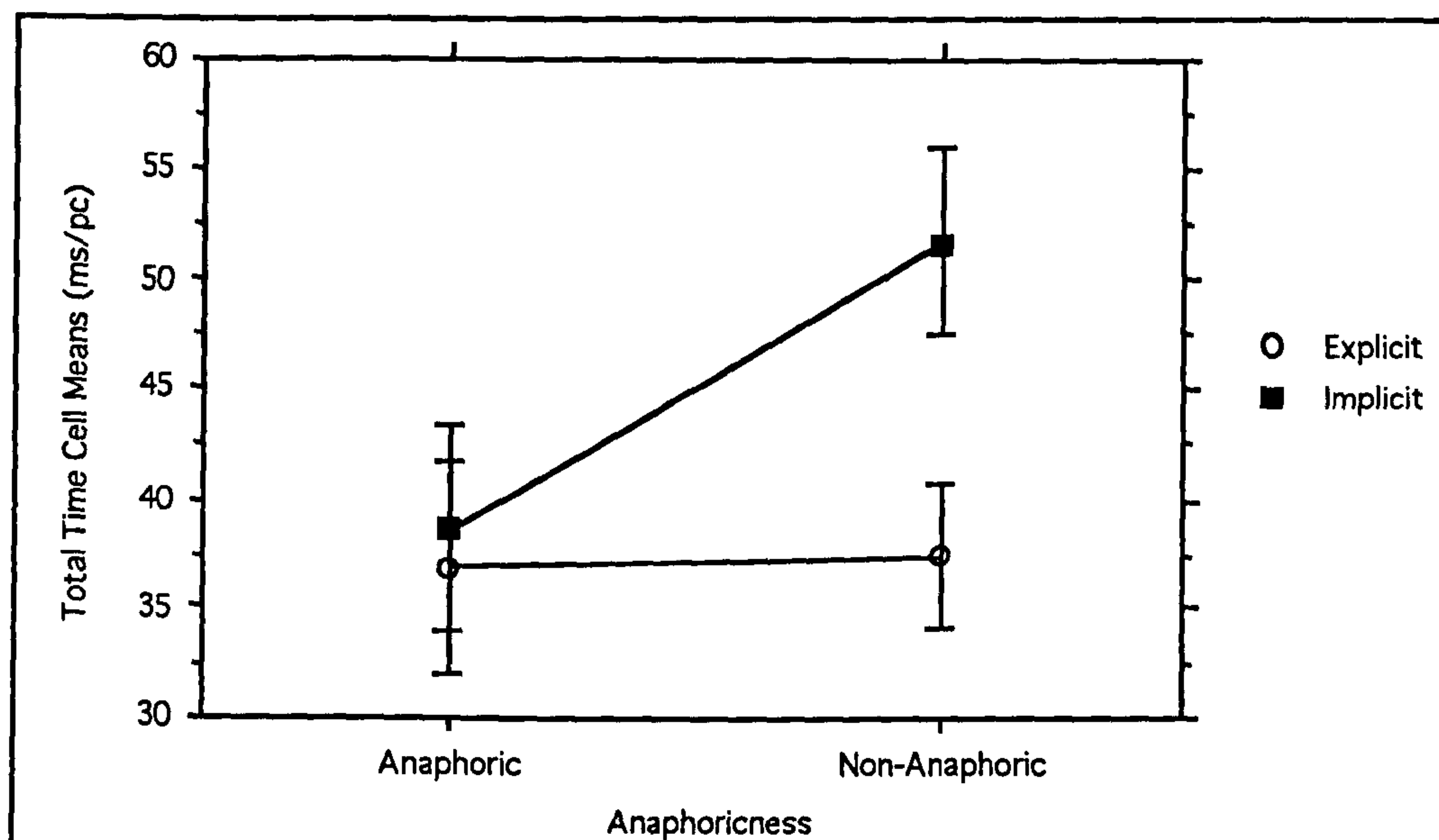


Fig. 5.3 Mean Total Reading Times (ms/pc) And Standard Errors By Condition For Target Instrument

A 2 (explicitness) x 2 (anaphoricness) repeated measures ANOVA calculated on Total subject and item reading time means revealed a significant main effect of explicitness: $F_1(1,23) = 5.892$, $p < .03$, $MSe = 261.847$; $F_2(1,11) = 4.544$, $p < .06$, $MSe = 157.713$. A significant main effect of anaphoricness: $F_1(1,23) = 2.963$, $p = .0986$, $MSe = 376.043$; $F_2(1,11) = 6.091$, $p < .04$, $MSe = 97.471$. Statistical analysis also revealed a Non-significant interaction $F_1(1,23) = 2.847$, $p = .1051$, $MSe = 322.092$; $F_2(1,11) = 3.053$, $p = .1084$, $MSe = 150.894$.

The significant explicitness effect indicates, as predicted, that there is a significant advantage in having an explicitly introduced antecedent for a reference to an instrument associated with a Singer Verb. The significant anaphoricness effect suggests that subjects experience difficulty resolving a non-anaphoric reference to the instrument.

The reading time data for the Noun Region suggests that subjects' experience most difficulty with the implicit non-anaphoric condition. Further evidence for the difficulty associated with the implicit non-anaphoric target is provided by the pattern of regressive eye movements.

Total Time Regressions from Target Instrument to All Prior Text

Condition	Mean Number of Regressions	Standard Error
Explicit Anaphoric	.153	.045
Explicit Non-Anaphoric	.194	.049
Implicit Anaphoric	.153	.057
Implicit Non-Anaphoric	.250	.046

Table 5B. 6 Mean Number of Total Regressions and Standard Errors By Condition From Target Instrument to All Prior Text

A 2 (explicitness) x 2 (anaphoricness) repeated measures ANOVA calculated on the mean number of Total Regressions by subject and items revealed no significant main effects (anaphoricness $F_1(1,23) = 2.4, p = .135, MSe = .048$; $F_2(1,11) = 2.952, p = .1138, MSe = .1138$) or interaction (both $F_s < 1$). Inspection of the mean data indicates that the anaphoricness trend is due to a greater number of regressions from the implicit non-anaphoric target noun.

The pattern of regressive eye movements is consistent with the Reading Time data in that most regressions are evoked by implicit non-anaphoric targets which also received the longest reading time.

In general, the data for the Target Instrument (Noun) region is consistent with the experimental predictions. The significant effect of explicitness in Total Time suggests that subjects experience difficulty resolving a reference with an implicitly introduced antecedent.

5B. 5. 3. 2 Post- Target Region

As outlined earlier, difficulty associated with processing a word may spill-over onto subsequent words. It was predicted that the difficulty associated with integrating a reference with an implicit antecedent should be apparent in the Post-Noun Region. Longer reading times are expected on the Post Noun Region as complex bridging process must be used to integrate a reference with an implicitly introduced antecedent in the absence of verb-based information. To test these predictions, the fixation time on the two words following the target was examined.

First-Pass Reading Times on Post-Target Region

Condition	FP Reading Time	Standard Error
Explicit Anaphoric	24.712	2.800
Explicit Non-Anaphoric	30.111	2.708
Implicit Anaphoric	29.175	2.536
Implicit Non-Anaphoric	31.515	3.715

Table 5B. 7 Mean First-Pass Reading Times (ms/pc) and Standard Errors By Condition For the Post-Target Region

A 2 (explicitness) x 2 (anaphoricness) repeated measures ANOVA calculated on First-Pass subject and item Reading Time means revealed no significant main effects (explicitness: F1 (1,23) = 1.208, p = .2831, MSe = 171.019; F2 (1,11) = 1.118, p = .3004, MSe = 71.049; anaphoricness (F1 (1,23) = 2.312, p = .1420, MSe = 155.413; F2 (1,11) = 2.886, p = .1174, MSe = 68.989) or interaction (both Fs < 1).

Although statistical analysis shows no significant effects, examining the pattern of the means provides an good indication of the trends within the data. The Implicit non-anaphoric condition receives the longest reading time suggesting that subjects find it difficult to integrate. In addition, the post-target region in the implicit anaphoric condition receives a longer reading time than the explicit anaphoric condition. Overall the results suggest that subjects experience difficulty integrating an anaphoric reference with an implicitly introduced antecedent.

Total Reading Time on Post-Target Region

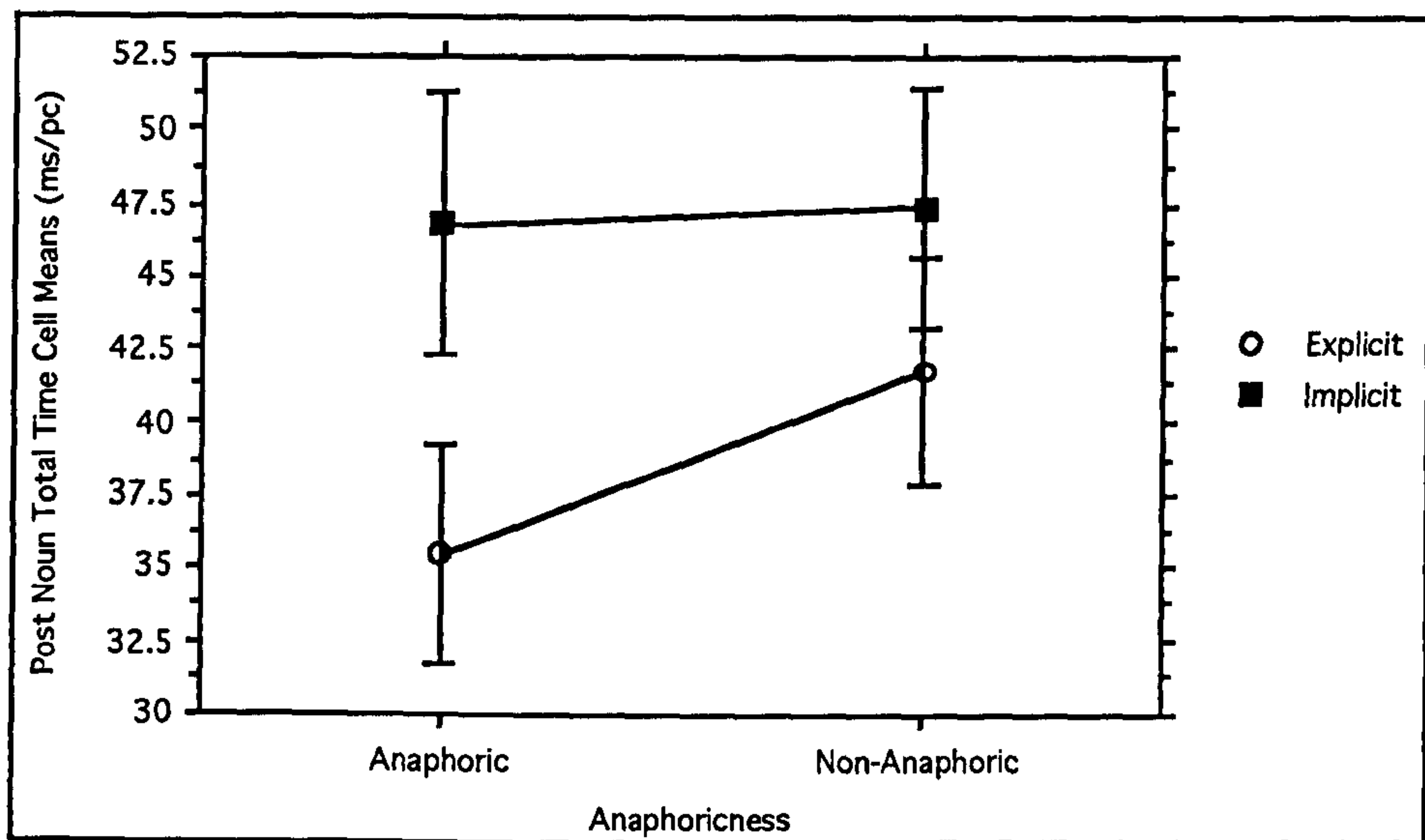


Fig. 5. 4 Mean Total Reading Times (ms/pc) And Standard Errors By Condition For the Post-Target Region

A 2 (explicitness) \times 2 (anaphoricity) repeated measures ANOVA calculated on Total subject and item Reading Time means revealed a significant main effect of explicitness: $F(1,23) = 5.153$, $p < .04$, $MSe = 331.766$; $F(1,11) = 4.828$, $p < .06$, $MSe = 170.07$. No main effect of anaphoricity ($F(1,23) = 1.307$, $p = .2648$, $MSe = 376.043$; $F(1,11) = 2.115$, $p = .1738$, $MSe = 84.849$), and a Non-significant interaction ($F(1,23) = .618$, $p = .44$, $MSe = 320.451$; $F(1,11) = 1.630$, $p = .2281$, $MSe = 74.519$). The significant effect of explicitness is consistent with the experimental predictions.

The spill over effects on the Post-Noun Region are consistent with the experimental predictions. Namely, an anaphoric reference with an implicit antecedent is much more difficult to resolve, than an anaphoric reference with an explicit antecedent, if verb-based information is not available to assist the resolution process. As expected, the implicit introduction of an antecedent results in a longer reading time for a subsequent reference. The reading time for the implicit anaphoric condition is similar to that of the implicit non-anaphoric condition, but significantly longer than the explicit anaphoric condition. This long reading time is indicative of the predicted difficulty associated with integrating a reference to an implicit antecedent when verb-based information is not available to assist the integration process.

The difficulty integrating an anaphoric reference with an implicit antecedent is reflected in the pattern of regressive eye movements from the post-noun region to the noun.

Regressions From The Post-Target Region

The pattern of regressive eye movements from the Post-Noun Region to the Target Instrument was examined. As mentioned previously, regressions are thought to reflect difficulties in processing. Hence, they are used here as a means to asses difficulty of integration.

First-Pass Regressions From The Post-Target Region to Target Instrument

Condition	Mean Number of Regressions	Standard Error
Explicit Anaphoric	.028	.019
Explicit Non-Anaphoric	.104	.040
Implicit Anaphoric	.076	.038
Implicit Non-Anaphoric	.111	.033

Table 5B. 8 Mean Number of First-Pass Regressions and Standard Errors By Condition From The Post-Target Region to Target Instrument

A 2 (explicitness) x 2 (anaphoricness) repeated measures ANOVA calculated on the mean Number of First-Pass Regressions by subjects and items revealed no significant main effect of Explicitness (both Fs <1), a marginal effect of Anaphoricness F1 (1,23) = 2.054, p = .1653, MSe = .036; F2 (1,11) = 3.366, p = .0937, MSe = .01 and a non-significant interactions (Fs < 1).

Total Time Regressions From The Post-Target Region to Target Instrument

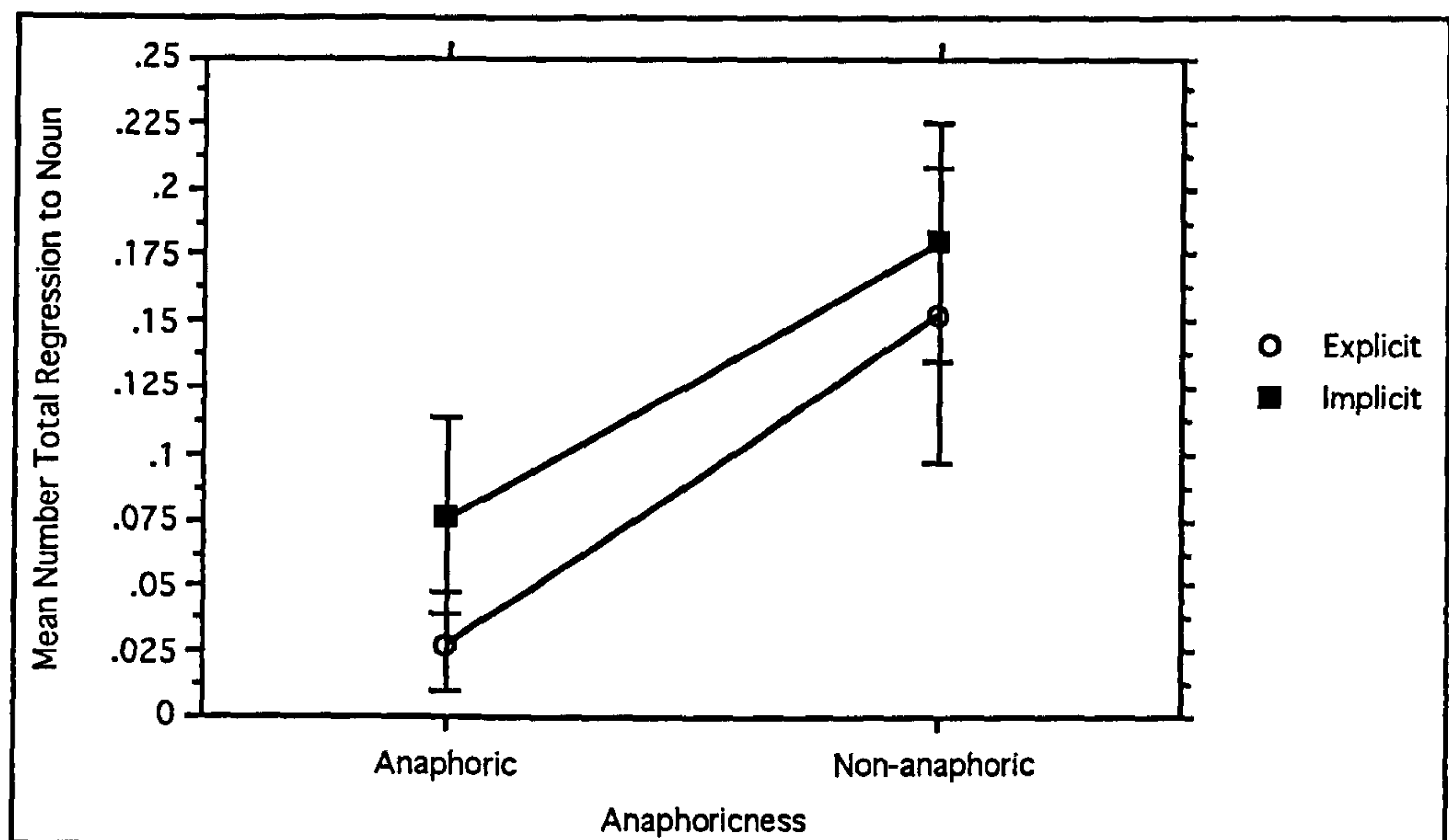


Fig 5B. 7 Mean Number of Total Regressions and Standard Errors By Condition From The Post-Target Region to Target Instrument

A 2 (explicitness) \times 2 (anaphoricness) repeated measures ANOVA calculated on the mean number of Total Regressions by subjects and items revealed no significant effect of explicitness ($F_1(1,23) = 1.182, p = .2882, MSe = .030$; $F_2(1,11) = 1.436, p = .256, MSe = .014$). A significant effect for Anaphoricness ($F_1(1,23) = 5.174, p < .04, MSe = .061$; $F_2(1,11) = 12.083, p < .006, MSe = .013$) and non significant Interaction (both $F_s < 1$).

The regression data from the Post-Target region shows a strong anaphoricness effect for both explicit and implicit conditions suggesting that subjects are experiencing great difficulty integrating a non-anaphoric reference to the target instrument. Although not statistically significant, there is a large difference in the number of regression evoked by the implicit anaphoric condition compared to the explicit anaphoric condition suggesting that subjects find a reference to an implicitly introduced antecedent difficult to resolve.

Overall the data from the Post-Target Region supports the experimental predictions. The Reading Time data from the Post-Target Region is consistent with the experimental predictions as it shows a significant difference between the reading time for a definite reference to an implicit antecedent compared to that

with an explicit antecedent. The difficulty resolving such an implicit reference is also reflected in the pattern of regressive eye movements.

5B. 3. 3. 3 Discussion of the Results of Experiment 2

It was predicted that Verb-based information about Instruments would not be available to assist the integration process, therefore longer reading times were expected for references to implicit antecedents. The experimental results support this prediction. The reading time data for the Post-Target Region indicates that subjects spend significantly longer reading an anaphoric reference with an implicitly introduced antecedent compared to that with an explicit antecedent. Such findings support the work of Singer (1979) and Cotter (1984) and suggest that the influence of verb-based information during discourse processing is limited.

These results provide more detailed information about the timing of the integration process. Unlike previous work that relied on sentence reading time as an indicator of the processing difficulty associated with an anaphoric reference, the present experiment used eye movement data. Consequently, a more detailed description of the time course of the reference resolution process can be obtained. The fact that the explicitness effect is not apparent till the Post-Target region suggests that subjects do not immediately experience difficulty, and the difficulty only becomes apparent when they attempt to integrate the reference into their overall interpretation of the discourse. Since verb-based information about Instruments is not available to assist the integration process the reference can only be integrated by drawing a time consuming bridging inference, hence the increased reading time.

5B. 4 Discussion of Experiments One and Two

The results of Experiment 1 confirm the experimental predictions that Verb-based information can assist the establishment of discourse coherence. The results from the Noun Region (both Reading Time and Regression data) support the experimental predictions. Firstly, a non-anaphoric reference to an implied instrument (control condition) produced the longest reading time, suggesting it was the most difficult to integrate into the discourse. The apparent lack of

difficulty (no difference in the reading times for the explicit and implicit anaphoric conditions) for the implicit anaphoric condition suggests that verb-based information is available to assist the integration process. In contrast, in line with Garrod et al. (1990) findings, such verb-based information will not facilitate the integration of a non-anaphoric reference, hence the difficulty (long reading times) produced by the implicit non-anaphoric condition. The Reading Time and Regression data for the Post Target Region is consistent with the experimental predictions, in that the implicit anaphoric target does not produce a significant increase in fixation time suggesting that a definite reference with an implicit antecedent can easily be resolved if the integration process is supported by verb-based information.

The results of Experiment 2 are also consistent with the experimental predictions, but they are slightly surprising as there is no difference in the reading times of the Target Instrument in explicit and implicit anaphoric conditions; the difference is only significant in the Post-Target Region. However, this is not entirely unexpected, as previous studies (Cotter, 1984) show explicitness effects in sentence reading time. The reading time data for the Noun Region suggests that subjects' experience most difficulty with the implicit non-anaphoric condition. Further evidence for the difficulty associated with the implicit non-anaphoric target is provided by the pattern of regressive eye movements.

The spill over effects on the Post-Noun Region are also consistent with the experimental predictions. Namely, an anaphoric reference with an implicit antecedent is much more difficult to resolve, than an anaphoric reference with an explicit antecedent, if verb-based information is not available to assist the resolution process. As expected, the implicit introduction of an antecedent results in a longer reading time for a subsequent reference. The reading time for the implicit anaphoric condition is similar to that of the implicit non-anaphoric condition, but significantly longer than the explicit anaphoric condition. This long reading time is indicative of the predicted difficulty associated with integrating a reference to an implicit antecedent when verb-based information is not available to assist the integration process. The difficulty integrating an anaphoric reference with an implicit antecedent is reflected in the pattern of regressive eye movements. However, the results from the Post-Noun region are open to criticism as they were not consistent between materials. This problem is addressed in subsequent experiments (cf. Chapter 8). Despite this problem, and given the fact that post-target region was consistent across materials, the pattern of Spill-over effects can be regarded as providing a good indicator of the difficulty

of processing an anaphoric referent with an implicit antecedent when verb-based information is not available to support processing.

The results of Experiments 1 & 2 provide an interesting insight into the influence of verb-based information during discourse processing. The results suggest that verb-based information about instruments will only assist integration under limited conditions. The fact that subjects experienced little difficulty integrating a reference to an implicit antecedent following a Garrod & Sanford verb, but experienced great difficulty when the reference followed a Singer verb suggests that Cotter's explanation may be accurate and there may be some difference between the two sets of Verbs in their ability to support integrative processes.

It is proposed that verb-based information can assist the process of reference resolution by establishing Discourse Roles. It is differences in a Verb's ability to establish an Instrument Discourse Role that explains the differential benefits associated with Garrod & Sanford and Singer Verbs. Reading a Garrod & Sanford verb establishes an Instrument Discourse Role in the developing discourse model of the text. Such a discourse role can then function as an antecedent for a subsequent reference to an instrument that fills the role. In contrast, a Singer Verb does not establish a discourse referent, therefore there is no information in the discourse model that can assist the integration of a subsequent reference to an instrument, hence the longer reading times.

The use of verb-based information to assist discourse integration via roles is consistent with Carlson & Tanenhaus' proposals concerning "open-thematic roles" (cf. Chapter 4 for detailed discussions of these proposals). The question is why these benefits are only provided by certain Verbs (Garrod & Sanford, but not Singer). Unlike Carlson & Tanenhaus (1988), these Instrument Discourse Roles are not thematic, therefore their establishment is not determined solely by syntactic considerations.

The work of Garrod & Sanford (1983) suggests that content may establish Discourse Roles. A range of evidence in the empirical literature (Lucas et al., 1990; McKoon & Ratcliff 1992), on inference processing indicates that contextual factors play an important role in the Instrument Inference process. Given this, and the powerful influence that contextual factors exert on discourse processing in general, it is not surprising that contextual factors may play an important role in the establishment of Discourse Roles. The influence of context on the encoding of Instrument Discourse Roles is explored in the following chapter.

Chapter Six

Context and Discourse Roles

6. A Context and Discourse Integration

Contextual information not only provides a general background against which the text can be interpreted but also influences the processes involved in the establishment of discourse coherence (cf. Chapter 2). Context has been shown to be a major motivation for the on-line encoding of elaborative inferences (O'Brien et al., 1988). The empirical evidence for the encoding of implicit instruments also suggests that contextual factors play a fundamental role. Given the important contribution of context, it is not surprising that contextual information may assist the establishment of Instrument Discourse Roles.

Discourse Roles may be established in two ways: either by a verb that identifies a stereotypical situation that supports the role or, more generally, from the stereotypical situation described in the text (Sanford & Garrod, 1981). The contribution of verb-based information to the establishment of Instrument Discourse Roles was empirically assessed in Chapter 5. The task, now, is to determine the contribution of contextual information to the establishment of Instrument Discourse Roles. Can Instrument Discourse Roles be established by both lexical and contextual factors? The contribution of contextual information to the establishment of Instrument Discourse Roles is assessed with respect to "general verbs". General verbs are used to explore the viability of contextually established discourse roles because their associated instruments are context dependent: particular instruments will be used to perform specific actions in certain situations. For example, the instruments used to perform various acts of "cutting" will vary according to the context, i.e. to "cut cake" you would generally use a "knife", but to "cut hair" you would normally use "scissors".

The contribution of context to the establishment of Instrument Discourse Roles is explored in two experiments. Sanford & Garrod's predictions concerning the contribution of context to the establishment of Discourse Roles is assessed with respect to Instrument Discourse Roles. The results suggest that a supportive context will establish of an Instrument Discourse Role that will support subsequent reference without the need for time-consuming bridging processes.

6A.1 Context and Discourse Roles

Garrod & Sanford (1983) demonstrated how context can either facilitate or hinder the process of discourse integration: a supportive context assists the process of reference resolution; whereas an inappropriate context fails to support referential processing and assist discourse integration. Consider the following sentence pairs.

- (1) HARRY FELL SEVERAL TIMES IN THE SNOW.
 (1') THE SNOW WAS WET AND COLD.

In example 1, it is relatively simple to integrate 1' as 1 contains an explicit antecedent, "snow".

However, things are more complicated in example (2) which contains no explicit antecedent.

- (2) HARRY FELL SEVERAL TIMES.
 (1') THE SNOW WAS WET AND COLD.

1' can only be resolved on pragmatic grounds: that it must have been snowing, that Harry fell in the snow, and that it was this snow that is cold and wet. Therefore, in Haviland & Clarks view 1' can only be integrated by drawing a time consuming bridging inference. However, the difficulty (degree of bridging required) associated with understanding the sentence 1' which contains a reference to an implicitly introduced antecedent is greatly reduced (no more difficult than the explicit case) when the sentence is included in a context which supports the reference, example 3.

- (3) LEARNING TO SKI
 HARRY FELL SEVERAL TIMES.
 HE DIDN'T LIKE SKIING AT ALL.
 THE SNOW WAS WET AND COLD.

The fact that Harry is "learning to ski" seems to presuppose the existence of "snow" (i.e. "snow" is present in the context of skiing). If our knowledge of the events described by the text is available during comprehension then this knowledge may serve as a source of reference an "extended domain of

reference" for subsequent expressions in the text (Garrod & Sanford, 1983, P. 279).

Using self-paced reading time, as an index of the ease of comprehension, Garrod & Sanford (1983) tested the difficulty associated with understanding sentences containing indirect references in a context which is either consistent (appropriate) or inconsistent (inappropriate) with the inference concept (see Table 6. 1). The results show there is no advantage in having an explicit antecedent in the "appropriate context condition". However, an explicit antecedent was a significant advantage in the "inappropriate context condition" where references to implicit antecedents produced significantly longer reading times than those to explicit antecedents when the context did not support the reference.

Appropriate Context Passage

Title	Learning to ski
Context sentence	Harry fell several times (in the snow).
Filler sentence	He didn't like skiing at all.
Target sentence	The snow was wet and cold.

Inappropriate Context Passage

Title	Cross-country running
Context sentence	Harry fell several times (in the snow).
Filler sentence	He hated running in winter.
Target sentence	The snow was wet and cold.

Table 6. 1 Example of Materials used by Garrod & Sanford (1983)

It is assumed that if context can support reference to an implicit antecedent then the integration of the reference should not require such extensive bridging processes. Consequently, the reading time for a reference to an implicitly introduced antecedent should be no longer than the reading time for a reference to an explicitly introduced antecedent; if the context supports the resolution of the reference by establishing a Discourse Role. The "appropriate context" (skiing) calls to mind a scenario that supports a discourse

role for "snow", this role then functions as an antecedent for the subsequent reference to "the snow". In contrast, the "inappropriate context" (cross country running) does not support a Discourse Role for "snow" as snow is not central to the scenario of cross-country running. Consequently, the resolution of a reference to "the snow" can not be resolved via a Discourse role, only by time consuming bridging processes.

6A.2 Context and Instrument Discourse Roles

There are three main reasons why context is thought to make an important contribution to the establishment of Instrument Discourse Roles. Firstly, context plays an important role in comprehension generally (Bartlett, 1932; Dooling & Lachman, 1971). Secondly, Garrod & Sanford (1983) demonstrated how a stereotypical context can establish discourse roles that assist the process of reference resolution. Thirdly, the empirical data (Lucas et al., 1990) suggests that context is a crucial factor in the encoding of instrument inferences. Since the encoding of implicit instruments is sensitive to contextual factors, then the establishment of Instrument Discourse Roles is expected to be open to contextual influence.

The empirical data concerning the encoding of implicit instruments addresses the issue from an inference perspective: Instrument Inferences. An Instrument inference occurs when a reader infers an instrument or tool for accomplishing an action. For example, "scissors" being inferred in response to "cut hair". From a psychological perspective, inferences about highly plausible implicit instruments seem intuitively likely. Consider the sentence, "The teacher wrote on the blackboard" if you were asked what the teacher wrote with you would most probably reply, "chalk". This inference is so compelling because explicit information to the contrary is not presented. Had a less likely instrument been used, we would expect it to have been explicitly stated. Since no contradictory information was given, we are justified in assuming that the most likely instrument was used. In short, it seems reasonable to assume that the most probable instrument was used unless the text suggests otherwise. Hence, it is relatively easy to identify both where an instrument inference may occur and what the content of the inference may be. There is little doubt that Instrument inferences can be made. However there is less agreement as to when the inference is made: encoded as the text is read, or only inferred when necessary to establish coherence.

6A.2.1 Instrument Inferences and Instrument Discourse Roles

It is important to consider whether evidence of instrument inferencing (encoding of an implicit instrument) is necessarily evidence for the establishment of an Instrument Discourse Role. It is tempting to do so, as Lucas et al. (1990) have demonstrated that instrument inferencing involves access to a discourse level of representation and both instrument inferences and instrument discourse roles can be derived from the background knowledge used to interpret the text.

The establishment of an instrument discourse role may appear similar to the process of 'elaborative inferencing', but there are two main differences. The establishment of Discourse Role is a product of the 'comprehension as role-mapping' view of discourse processing in which text is interpreted by being mapped into relevant background knowledge. In this sense, the establishment of roles is not elaborative, but instead, a necessary part of the comprehension process. In addition Discourse Roles, unlike inferences, can function as antecedents for subsequent reference, whereas inferences can only contribute to the establishment of discourse coherence via bridging processes. Consider this difference in relation to example (4).

- (4) THE NURSE TOOK THE PATIENT'S TEMPERATURE.
THE THERMOMETER READ 39° C.

If reading the initial sentence of this short text calls to mind a "taking temperature scenario" in which a thermometer plays a central role, then the discourse model constructed to represent this text would include an instrument role for thermometer. Consequently, the subsequent reference to "the thermometer" can easily be resolved as the discourse representation contains the role of instrument into which "the thermometer" can be mapped. In the absence of such an instrument role the reference to "the thermometer" can only be resolved by complex bridging processes: "the thermometer" must be what the nurse used to take the patient's temperature. Even if the instrument was inferred elaborately, before the reference is encountered, it still cannot assist the process of reference resolution in the same way as an instrument discourse role.

In conclusion, the main difference between an Instrument Inference and an Instrument Discourse Role is that although inferences can assist the process of

reference resolution (i. e. bridging inferences), an inference can not serve as antecedent site for subsequent reference.

6A.3 Methodological Factors

Despite Instrument inferences being highly plausible, therefore likely to be encoded during comprehension, the empirical evidence for their encoding is mixed. Methodological differences between the studies is one possible explanation for the discrepant findings. In addition to these methodologies issues, studies differ in the nature of stimulus materials used, especially context. The conflicting empirical evidence for the on-line encoding of implicit instruments may be attributable to characteristics of the experimental text. Specifically, the nature of the context (whether the to-be-inferred-instrument is mentioned in the prior text) and the semantic relationship between the verb and the to be inferred instrument. Evidence has shown that inferences in general, and elaborative inferences in particular, are more likely to be made if the context is restrictive. A restrictive context constrains the range and content of possible inferences (O'Brien et al. 1988). In addition to this constraining function, context may act as a motivating factor to establish discourse coherence. The relative impact of methodological and contextual factors on the encoding of implicit instruments is outlined below.

A variety of paradigms have been used to assess the encoding of implicit instruments. Unfortunately, the different methods are not comparable. Methodological issues are further complicated because task requirements and the time of test tend to be confounded. For instance, memory measures, such as cued recall, are always used after a long delay; whereas activation measures such as lexical decision, tend to be used either immediately or after a very short delay. Consequently, it is unclear whether the conflicting experimental findings reflect differences in the conditions where implicit instruments will be encoded, or whether they are the product of the task used to assess their encoding. In order to illustrate these methodological problems, a detailed discussion of the three main paradigms: reading time, memory measures, and activation measures is given below.

6A.3.1 Reading Time Measures

One of the major problems associated with reading time measures is word-based priming. By comparing the reading time of a sentence which refers to either an explicitly or an implicitly introduced concept, the possibility of word-based priming, due to lexical repetition, is always present in the explicit version of the experimental text. Hence, even if no inference is involved, the target sentence in the implicit version might be read more slowly, solely on the basis of lexical priming. Although Haviland & Clark (1974) demonstrated that differences in reading time could not be attributed to lexical priming alone; it still remains a potential problem in all reading time studies. However, it should be noted that the confound between inferencing and word-based priming is not unique to the reading time paradigm. In fact, all activation measures of inferencing are subject to this problem.

Using reading time, as a means to assess the encoding of implicit instruments, generally involves accepting the null hypothesis. Yet, exactly the same result (no difference in reading time) would occur if the inference was not made. Thus, even if we are prepared to accept the null hypothesis, there is no way of knowing whether the lack of effect is due to no inference being encoded rather than the implicit instrument being inferred during reading. A possible solution to the "null hypothesis problem" is to design the experimental text so that the target sentence is inconsistent with the concept that is likely to-be inferred. As a result, subjects will take longer to read the contradictory target sentence if the expected inference is drawn.

It is difficult to determine the exact time course of the inference process using sentence reading time. The increased reading time for the target sentence could reflect a difference in the ease with which the target is integrated on grounds other than the inference, i.e. syntax. Since the inference and control sentences differ; one of these sentences may be integrated with the target sentence on syntactic grounds more easily than the other.

6A.3.2 Memory Measures

Numerous memory measures have been used to investigate the encoding of implicit instruments: cued recall, recognition, and sentence verification. Before discussing specific memory paradigms and their associated problems; it is important to consider two general problems associated with memory measures.

Despite task differences, all memory measures depend on accessing the representation of the text to determine if the inferred information is part of that representation. Since memory measures are sensitive to activation, the time of test must be sufficiently delayed to allow activation to dissipate; otherwise the memory task may assess activation rather than inference processes.

The second general problem associated with memory measures is that they do not provide information about the time course of the inference process. The very nature of the task requires access to the representation of the text, thereby providing the opportunity to draw the inference at the time of test rather than encoding. Having the test occur on-line, as opposed to delayed, is not sufficient to prevent the problem. Although testing during comprehension may be preferable to delayed testing because it minimises reconstruction, there is no guarantee that any inferences detected were drawn when the text is read.

6A.3.2a Cued Recall

One of the most widely used memory techniques is cued recall. The technique is based on the assumption that information included in the representation functions as an effective retrieval cue. The work of Singer (1979) suggests that cued recall may reflect reconstructive processes during retrieval rather than inference processes at encoding. Consider the verb phrase "stir the soup" which has two asymmetrically related instruments, "ladle" and "spoon". There is a strong forward association between "stir the soup" and "spoon", but a rather weak backward association from "spoon" to "stir the soup". In contrast, there is a weak forward association between "stir the soup" and "ladle", but a strong backward association of "ladle" to "stir the soup". If instruments are inferred during comprehension, then reading "stir the soup" should lead to "spoon" being encoded more often than "ladle" because it is

more strongly associated to the verb. Consequently, "spoon" should be a more efficient recall cue than "ladle". However, if cued recall reflects reconstructive processes at retrieval, then "ladle" should be a better cue than "spoon" because 'ladle" is more strongly associated to "stir the soup". Singer's results showed "ladle" to be the more effective cue, suggesting that cued recall reflects reconstruction processes at retrieval rather than encoding processes during reading.

It is not surprising that cued recall may reflect retrieval processes. The delayed testing time may mean that the sentence is no longer readily retrievable; therefore reconstruction and inference at the time of test is more likely. Given its sensitivity to retrieval processes cued recall appears to be a questionable means to assess the encoding of implicit instruments.

The inability to unequivocally differentiate between encoding and retrieval processes is not limited to cued recall techniques; in fact it applies to all memory measures including the popularly used recognition procedure.

6A.3.2b Recognition

Recognition tests, like all memory measures, require subjects to access their representation of the text. The subject's task is to read either an inference or a no inference control text and determine whether a test word representing the inference occurred in the text. The rationale being, the false recognition of implied information is evidence that an inference has been drawn.

The major problem with the recognition paradigm is that there is no way to determine if the inferences detected were drawn while the subjects read the text, or at the time of test. The results may reflect processes occurring at the time of test because a recognition task requires the subject to check the test word against their representation of the text. There are two ways in which the processing of the text at the time of test could result in a difference in response time and accuracy between inference and control versions even when no inference was drawn during reading. Firstly, when checking the probe against the text the reader may draw the inference. Making such an inference at the time of test would slow response time. The same response that would be expected if one had drawn the inference while reading and now had to say that it did not occur. Secondly, the inference may not be drawn either during

encoding or at the time of test but the greater relatedness or compatibility of the test word to the inference text ("text-probe compatibility") than the no inference control text may affect the speed and accuracy of the recognition decision process. Specifically, the more compatible the test word to the text, the harder it is to say it did not occur in the text and the easier to say it did occur.

A similar paradigm to word recognition is sentence verification. The rationale is the same as that of recognition, except subjects are asked to make recognition decisions on sentences rather than words. Its major problem is that it involves accepting the null hypotheses. However, a non-significant difference (null result) could occur for numerous possible reasons: lack of statistical power or non-comprehension. In addition, memory for the surface form of the text may hinder the ability to detect inferences: the test item (sentence to be verified) is explicitly presented in the control version but not the inference version. Memory for surface form may facilitate (prime) the processing of the test statement following the control. Consequently, even if subjects consistently draw the inference it may appear that it is not drawn because verification times following inference versions will be slower than those following the explicit controls, if subjects retain the surface form of the text.

Verification has an additional problem when used to detect forward inferences. A statement that is likely to be true, may not be recognised as such because it was not stated in the text. Even when subjects make such a forward inference, they may hesitate to endorse it as readily as when it is explicit or required for coherence. The slow verification times following inference versions, may suggest that the inference was not drawn when, in fact, it was.

In conclusion, the results of a recognition test, like all memory measures, do not allow us to distinguish between inferencing at encoding or inferencing at the time of test (retrieval). In an attempt to deal with the inferencing at retrieval problem McKoon & Ratcliff (1986) suggested imposing a deadline on the recognition procedure (speed item recognition) as it would eliminate the possibility of subjects drawing inferences at the time of test because time would be limited. Consequently, the results should reflect automatic activation of inferences during reading rather than retrieval processes. However, such a procedure does not eliminate the comparison process and therefore does not eliminate the possibility of compatibility matching affecting the decision process. So, although the deadline procedure restricts the amount of time, it

does not change the fact that recognition, by its very nature, requires subjects to perform a comparison between the test word and the text. As long as this comparison occurs, it is possible for text-probe compatibility to affect recognition latencies

6A.3.3 Activation Measures

Another commonly used paradigm to assess the encoding of implicit instruments are activation-based measures. The major advantage of activation-based measures is that they avoid many of the problems associated with memory-based techniques. The best way to ensure that the results of an inference test reflect inferences occurring during comprehension is to use a method that does not require subjects to evaluate the test-probe against the text. This can be achieved using activation measures such as Naming, Lexical Decision, or the Modified Stroop task. The logic behind activation measures is as follows. If the inference has just been drawn, then the activation level of the inference concept should be elevated. If the activation level is elevated, then lexical access should be facilitated. Hence, any task that involves lexical activation of an inference concept can be used to assess whether the inference has been drawn.

6A.3.3a Lexical Decision

In the lexical decision paradigm, subjects read either an inference or a control version of a text, then decide whether or not a letter string is a word. The letter strings of interest are those representing possible inferences. Since subjects have no reason to compare the letter string to the text; it would seem that the relatedness of the probe to the text, which may affect the decision process, would be irrelevant. Consequently, lexical decision appears to be a good measure of the priming of lexical access, due to inferencing while reading. However, even though lexical decision does not require subjects to compare the test word to the text, evidence (Balota & Chumbley, 1984) suggests that such a comparison does occur. Lexical decision latencies are affected by the probability that the prime and target are related by the presence of a backward association between the prime and target. This context checking occurs after lexical access, ostensibly to help the decision process: if the target is related to the text, it promotes the decision that it is a word.

It would seem that lexical decision is susceptible to post-access context checking. However, since context checking is not as inherent to lexical decision, as it is to recognition, it may be possible to eliminate it. For example, context checking may occur in lexical decision as a way of verifying one's decision. If so, it may be eliminated by forcing subjects to respond quickly with the use of a response dead line.

6A.3.3b Naming

In a Naming task, subjects are presented with the test word after reading either an inference or control text and asked to read the test word aloud. Naming latencies, therefore reflect the time for lexical access plus the time for articulation. Unlike lexical decision, it is difficult to see how the post access process of articulation could be influenced by the test word's relatedness to the text. Consequently, Naming is often regarded as a purer measure of lexical access. Although Naming may eliminate one of the major problems associated with most paradigms used to investigate inference, the problem of priming post access processes, it has its own specific problems.

One of the main problems is that because Naming is such a fast response, it may be less sensitive to top-down (text and knowledge-based) factors. Another disadvantage is that, in principle, naming can be accomplished without going through the lexicon; it can occur simply by using grapheme-to-phoneme correspondence rules. If this is so, then naming cannot reflect priming of lexical access. Even if lexical access is by-passed on only some trials this can weaken the sensitivity of naming as a measure of inferencing. Finally, a problem associated not only with naming, but with any task that uses only a single probe, is that subjects might learn to anticipate what the probe is going to be, "expectancy priming". Instead of generating inferences as part of the normal comprehension process, subjects may be generating expectancies about the nature of the test probe itself. If this is so, the measure used to detect inferences is causing inferences to be made that might not generally occur and therefore providing a false measure of their encoding.

Despite these problems, Naming is widely used to assess the encoding of implicit information because it is not influenced by reconstructive processes at the time of test. Therefore, it is possible to determine if the implied information was encoded while reading the text (on-line).

6A.3.3c Modified Stroop Task

The Stroop task (Stroop, 1935) involves naming the colour of ink in which colour words, such as "red", are written. The Modified Stroop task involves subjects reading a text and then naming the ink colour of a non-colour test word. It allows us to determine whether the test word has been primed by the text. If the test word has been primed, then it should take longer to name the ink colour of that word in comparison to a control word that has not been primed. For instance, it should take longer to name the ink colour of "doctor" following a text that referred to "hospitals" than one about "subways" because when the word is primed, it is harder to suppress its articulation in favour of articulating the ink colour.

The major advantage of the modified Stroop task is that it allows one to determine whether subjects are processing inferences at a conceptual level or a lexical level. When a word is primed at a conceptual level it results in Stroop-like interference. However, when a word is primed at the lexical level it results in the opposite effect, namely a facilitation effect: if "doctor" has been preceded by "doctor" then its ink colour can be identified faster than if it has been preceded by a control.

Like other activation measures of inferencing, the Stroop Task assesses not only priming of lexical access of the inference concept but also other processes: ink colour identification, articulation of the colour name. However, like naming, it is difficult to see how these other processes would be affected by the relatedness of the probe to the text. Hence, the modified Stroop task may provide a relatively pure measure of lexical access.

In the preceding discussion, the major paradigms used to assess the encoding of implicit information have been discussed. Their relative advantages and disadvantages should be kept in mind when reviewing the conflicting empirical findings for the encoding of implicit instruments. In addition to these various methodological factors; the encoding of implicit instruments is strongly influenced by contextual factors. In the following section the conflicting literature on the encoding of implicit instruments will be reviewed and the important contribution of contextual factors assessed.

6A.4 Context and the Encoding of Implicit Instruments

Empirical studies of the encoding of implicit instruments differ not only on methodological grounds but also with respect to contextual factors. If discourse processing is to be examined, then context is necessary to ensure that discourse level processes are being assessed. Contextual factors are thought to make an important contribution to whether an implicit instrument is encoded. The main context factors explored are: the nature of the context (single sentences or short passages), whether the to-be-inferred instrument is mentioned previously in the experimental text, the degree of association between the verb and instrument, and the nature of the pre-testing procedures used to select the experimental stimuli. All these factors contribute to the encoding of implicit instruments and the establishment of Instrument Discourse Roles.

Experimenter	Method	Time of Test	Inference Drawn
Johnson et al. (1973)	Recognition	Delayed	Yes
Paris & Lindauer (1976)	Cued Recall	Delayed	Yes
Corbett & Doshier (1978)	Cued Recall	Delayed	No
McKoon & Ratcliff (1981)	Recognition	Immediate	Yes (if semantic relationship)
Doshier & Corbett (1982)	Stroop	Immediate	No
Singer (1979,1980)	Reading Time / Verification	Immediate / Delayed	No / No
Garrod & Sanford (1982)	Reading Time	Immediate	Yes
Cotter (1984)	Reading Time	Immediate	Replicated Singer & GS
Lucas et al. (1990)	Lexical Decision /Naming	Immediate	Yes, if context / No
Osterhout & Swiney (1989)	Naming	Immediate	Yes, if context

Table 6.2 Empirical Data on the Encoding of Implicit Instruments

The earliest evidence for the immediate encoding of implicit instruments is that of Johnson, Bransford & Solomon (1973) who examined the encoding of implicit instruments in a sentence recognition task. Subjects read paragraphs describing an action that accepts a highly likely instrument, in half the instrument was explicit, in the other half, implicit. In a subsequent recognition task subjects consistently recognised sentences that were only true by implication.

Experimental Condition

It was seven on Monday morning and the man drove to work. It was a beautiful day, and he really enjoyed the trip.

TEST: It was seven on Monday morning and the man took his car to work.

Control Condition

It was seven on Monday morning and the man walked to work. It was a beautiful day, and he really enjoyed the trip.

TEST: It was seven on Monday morning and the man took his car to work.

Table 6.3 Example of Materials used by Johnson et al. (1973)

It is important to note the nature of the materials used by Johnson et al. (1973). The instrument is never explicitly mentioned, instead it is implied by the verb. This contrasts with many other studies (McKoon & Ratcliff, 1981; Lucas et al., 1990) where implicit instruments are only encoded if the instrument is explicitly mentioned earlier in the discourse.

Further evidence for the immediate encoding of implicit instruments comes from Paris & Lindauer (1976). Using cued recall, they found that "knife" was a good retrieval cue for "The teacher cut into the juicy steak" which only implies the use of a knife, and "The teacher cut into the juicy steak with a knife" which explicitly states that a "knife" was used. It is assumed that implicit instruments are good retrieval cues because they are incorporated into the representation of the sentence at the time of encoding.

Contradictory evidence for the encoding of implicit instruments comes from Corbett & Doshier (1978) who specifically tested Paris & Lindauer's claim that an implicit instrument was a good retrieval cue because it was encoded into

the representation of the sentence during reading. In addition, they extended Paris & Lindauer's design by using both high and low probability instruments. The experimental results show that a probable instrument was a good retrieval cue for both explicit and implicit sentences (as did Paris & Lindauer) but also that a probable instrument was an equally good retrieval cue for a sentence containing an improbable instrument. For instance, "hammer" was an equally effective retrieval cue for all of the following: "The worker pounded the nail with the hammer" (probable explicit), "The worker pounded the nail" (probable implicit), "The worker pounded the nail with the rock" (improbable explicit).

The work of Corbett & Doshier (1978) illustrates the ambiguity produced by using cue effectiveness as an index of inferencing. Highly probable instruments were good recall cues even when the sentence to be recalled contained a different instrument. This may be due to semantic associations activated by the cue at retrieval. The fact that a probable instrument can serve as a retrieval cue for a sentence containing an improbable instrument contradicts the view that an implied instrument is an effective retrieval cue because it was inferred during encoding. Instead, it supports the proposal that recall cue effectiveness may be mediated by the use of world knowledge at retrieval. Therefore, the inferences that have been studied using the cued-recall paradigm may be the product of retrieval, rather than encoding, factors. Recall cue effectiveness is not a realistic indicator of the actual processes that occur during comprehension. Instead, it simply demonstrates that the inference can be made, and provides no indication of when the inference was drawn. The inference could be an encoding, a retrieval phenomena, or both. The cued recall technique is not sensitive enough to decide.

Further evidence that implicit instrument are not routinely encoded during comprehension comes from Doshier & Corbett (1982). Using the Stroop paradigm they examined the on-line activation of instruments during comprehension; they expected instruments to be activated as part of the schema accessed by the verb. Cued-recall, verification, and probe recognition, all force the subject explicitly to consider the instrument in relation to the discourse and this may not reflect the normal course of comprehension. Doshier & Corbett regarded their method as an on-line measure of inference encoding that does not require an explicit recall or recognition decision and one that could provide information about comprehension before the final product is stored in memory. They used a Stroop task to measure activation of

instruments: presented target instruments either at the end of simple sentences containing predicates that implied the use of certain instruments or at the end of control sentences that didn't contain such predicates. There was no evidence that the most probable or second most likely instrument was activated, although there was some facilitation when subjects were told to generate an instrument that might have been used.

Singer (1979), using both sentence verification and reading time, failed to find evidence for the automatic encoding of instruments. In a typical verification experiment subjects read a short description of an action that involves a likely instrument and were then asked to verify a True/False statement about the likely instrument. Subjects were faster at verifying the likely instrument, and faster at rejecting an impossible instrument when the likely instrument was explicitly mentioned in the text. Singer used similar materials in a reading time study which also demonstrated that implicit instrument were not being inferred during reading (cf. Chapter 5 for detailed discussion).

In contrast, Garrod & Sanford (1982), using a similar self-paced reading procedure, found no significant difference in the reading times for target sentences referring to implicitly or an explicitly introduced antecedent instruments. Suggesting that implicit instruments are encoded during comprehension (cf. Chapter 5).

It is important to note differences in the nature of the materials used: Singer (1979) used single sentences where as Garrod & Sanford used short passages of text. Cotter (1984) replicated the results of both Garrod & Sanford (1982) and Singer (1979) and excluded methodological factors as an explanation for the conflicting results. Cotter attributed the differing results to differences in the verbs used in the two studies (cf. Chapter 5 for a detailed discussion). The work of Cotter is important as it illustrates the importance of context and the results of the "Dictionary Exercise" highlight the importance of strict selection procedures and the nature of the relationship between Verb and Instruments.

The importance of the relationship between verbs and the instruments they are thought to imply was first discussed by McKoon & Ratcliff (1981). They demonstrated that only instruments highly related to the verb were activated and encoded when reading a sentence containing the verb. For example, the highly related instrument "hammer", but not "mallet" was inferred in

response to "Bobby pounded the boards". An important point to note is the nature of the materials used (see Table 6. 4).

Experimental Text

Bobby got the saw, *hammer/mallet*, screwdriver, and square from his tool box. He had already selected an oak tree as the site for the birdhouse. He had drawn a detailed blueprint and measured carefully. He marked the boards and cut them out.

Final Inference Sentence:

Then Bobby pounded the boards together with nails.

Final Control Sentence:

Then Bobby stuck the boards together with glue.

Test: Hammer or Mallet

Table 6. 4 Example of Materials used by McKoon & Ratcliff (1981)

The to-be-inferred instrument is always mentioned earlier in the text, making it an element in the discourse model. All the reader has to do is make the connection between the test word and the previously mentioned instrument at the time of test, rather than having to encode an implicit instrument. However, it is interesting to note that such a connection is not made for the low probability instrument, suggesting that the degree of relatedness between verb and instrument still plays an important role even if the instrument is explicitly mentioned in the prior discourse. The contribution of verb-based information is consistent with the results of Experiment One presented in the previous chapter. The influence of contextual information is explored in this chapter and the relative contribution of verb-based and context-based information to the establishment of Instrument Discourse roles is empirically assessed in Chapter Eight.

In a series of experiments, Lucas et al. (1990) explored the influence of context and the representational levels accessed during the instrument inference process. Prompted by the conflicting findings concerning the encoding of instrument inferences under different context conditions; Lucas et al.

examined instrument priming with and without context to determine if comprehension strategies varied across context conditions. Using both lexical decision and naming tasks they examined comprehension strategies when the same stimuli were presented without a context, or preceded by a context that explicitly mentions the instrument thereby making it an element in the discourse representation.

The influence of context was assessed by varying whether or not the target instrument was mentioned in the prior discourse. The representational level accessed was explored by exploiting the differential sensitivity of Lexical Decision and Naming tasks (Forster, 1979; cf. Chapter 5). Naming is thought to be primarily sensitive to lexical processes, whereas lexical decision is sensitive to both lexical and post-lexical processes. A different pattern of responses on both tasks may indicate which representational level is being accessed. If instrument inferencing requires changing the activation level of lexical form, then this will be reflected in both lexical decision and naming tasks. If, however, the process of instrument inferencing involves activation of the conceptual form of the relevant element in the discourse model, this will only be reflected in lexical decision responses.

Firstly, the conditions under which instrument inferencing would occur were explored. The instruments were not explicitly mentioned in the experimental sentences. Each experimental sentence was paired with two probes: its corresponding instrument, or a control target that was a highly implausible instrument for the action specified by the verb. For example,

HE DECIDED TO CHOP WOOD FOR THE FIRE * THAT EVENING.

Probe: AXE or WOODSHED presented at *.

The control probes ('woodshed') were chosen to accommodate subsequent experiments, in which both targets would be incorporated into a context sentence. Subjects performed either a Lexical Decision or a Naming task on the probe.

The results (no appropriateness effect for the instrument) suggest that the implied instrument was no more accessible than the inappropriate control. These results are consistent with those of Doshier & Corbett (1982) who also found no evidence of instrument priming in sentences without context.

In a second experiment, Lucas et al. investigated whether instrument inferences would be made when sentences with implied instruments were presented following contexts that explicitly mentioned the instrument. For example,

IN THE WOODSHED JOHN FOUND THE AXE THAT BELONGED TO HIS FATHER.

JOHN DECIDED TO CHOP WOOD FOR THE FIRE * THAT EVENING.

Probe: AXE or WOODSHED presented at *.

In addition, the differential sensitivity of the Lexical Decision and Naming tasks should indicate whether representations of implied instruments are present in a linguistic form representation or in a discourse model.

The results show an appropriateness effect (faster response times for the appropriate instrument probe), suggesting that the implied instrument was activated. The question remains as to whether the "appropriateness effect" involves a congruity effect that is the result of using general conceptual knowledge to integrate the target with its immediate context as a post lexical check, or whether it is the result of accessing a discourse model. If the congruity effect explanation is correct, then we would expect it to be apparent in the "no context" experiments, but it wasn't. Subjects need to access information that goes beyond the immediate context, information that is only available from a discourse level representation. It was concluded that implicit instruments would be inferred in context and since there was no "appropriateness effect" in the naming task, Lucas et al. concluded that a discourse model and not a linguistic level of representation was being accessed.

It is possible that the results are not due to inference processes; instead there may be a simpler explanation: the appropriate target instrument may be more salient than the inappropriate target (a location). Instruments may be perceived as more important than locations. Two control experiments were designed to check that the obtained results were not due to the salience of instruments. If instruments are more salient, the priming observed could be a result of a post-access context check where the instrument is found to be more consistent with the discourse than the location. Thus, the instrument would be primed only because of its discourse function in the context sentence, not because of an inference in the second sentence. The results suggest that post

access context checking to facilitate lexical decision making is unlikely. There is no evidence that instrument targets were more salient or consistent with the context than locations. Instruments were not responded to faster than locations when the second sentence did not contain an inferential verb but was still consistent with the context sentence.

The work of Lucas et al. (1990) highlights the important contribution of contextual factors to instrument inferencing: only those instruments presented in context were inferred. It is important to note that the "context condition", like that used by McKoon & Ratcliff (1981), always explicitly mentioned the to-be-inferred instrument. However, the explicit mention of the instrument in the prior text may not be necessary for the encoding of an implicit instrument. Osterhout & Swiney (1989) demonstrated that implied instruments would be inferred when they were presented in a rich context. The contexts used did not specifically mention the instrument but instantiated a schema in which the instrument played a prominent role.

In conclusion, the empirical data concerning the encoding of implicit instruments is mixed. There are two main reasons for this: methodological and contextual. Often the influence of these factors is confounded, with the nature of the materials used often determined by the method. Some studies (Singer, 1979) used single sentences, whereas others used short paragraphs of text (Garrod & Sanford, 1982). Some inference texts explicitly mentioned the inference concept (McKoon & Ratcliff, 1981, Lucas et al, 1990), where others simply use highly restraining contexts (Osterhout & Swiney, 1989) or allow a verb to imply the instrument (Johnson et al, 1973; Garrod Sanford, 1982). The constraining function of context and the finding that the encoding of implicit instruments involves access to a discourse level representation is consistent with the work of Garrod & Sanford (1983) which suggests that contextual information contributes to the establishment of discourse roles. The contribution of context to the encoding of implicit instruments and the establishment of Instrument Discourse Roles is explored in Experiments Three and Four.

6. B Context and Discourse Roles: The Empirical Data

The earlier discussion illustrates the influence of context on the encoding of implicit instruments. The evidence also suggests that context is a powerful motivation for the encoding of inferences to establish discourse coherence. Therefore, it is not surprising that context makes an important contribution to the establishment of Discourse Roles. The contribution of contextual information to the establishment of Instrument Discourse Roles was assessed in two experiments. Specifically, will a restrictive context establish an Instrument Discourse Role that can support subsequent reference. Experiment Three illustrates how a supportive context can assist the creation of an Instrument Discourse Role, while Experiment Four illustrates that an inappropriate context does not assist integration and establish Instrument Discourse Roles.

6B.1 Experiment Three Context Establishes Discourse Roles

6B.1.1 Methodological and Contextual Issues

Whereas Garrod & Sanford (1983) relied on sentence reading time to provide an indication of the time taken to integrate a single word within a sentence; the experiments reported below use eye movement data. As discussed in Chapter 5, the fine grain analysis that eye-movement data supports, allows the detailed examination of the time course of contextual information on the integration process. The problems normally associated with reading time measures are also addressed in these experiments. Eye movement data allows us to precisely monitor the time course of the inference process. In addition, the inclusion of an inappropriate context (Experiment 4) by-passes the problem of accepting the null hypothesis and, to some extent, provides information about the content of the inference.

The nature of the materials (context) also addresses many of the problems outlined earlier. The contexts used here differ from those generally used to study the encoding of implicit instruments. Recall that Lucas et al. (1990) only found evidence for instruments being inferred "in context". They found no

evidence that instruments were inferred in response to single sentences such as "He swept the floor every week on Saturday", but did find evidence of priming in the contexts condition such as "There was a broom in the closet. John swept the floor every week on Saturday." Under such "context conditions" (explicit mention of the instrument that was later implied by the verb) a discourse referent is established by the earlier mention of the instrument which is later accessed to assist the integration process. This suggests that the inference was not made in the "no context conditions" because there was no explicit antecedent to establish a discourse level representation to support the inference process. However, subjects may have failed to make the inference not because there was no antecedent in the discourse model to support it, but rather because the context was not restrictive enough to constrain the inference. In such a case, the inference was not made in the absence of an explicit antecedent because the context could not support the inference; rather than there being no explicit antecedent to establish a role in the discourse model.

It is also important to note how the experimental materials differ from those used by Garrod et al. (1990) and O'Brien et al. (1988). Like Lucas et al. there was always an antecedent in the discourse model to which the reference can refer. It was either explicitly introduced or introduced by a category name ("weapon" when probing for "knife"). The presence of an antecedent may encourage the inference to be made and thereby assist the integration process.

It is proposed that an Instrument Discourse Role will be included in the discourse representation, in the absence of an explicit antecedent, if the antecedent role can be supported by a restrictive context. If the context does not support the establishment of an instrument discourse role (as is the case in Experiment 4) then references to the instrument with an implicitly introduced antecedent will be difficult to resolve.

6B.1.2 Rationale

The main aim is to empirically evaluate Garrod & Sanfords' (1983) proposal that context can establish Discourse Roles, with respect to the Instrument Discourse Roles associated with General Verbs. It is predicted that an Instrument Discourse Role will be established in the absence of an explicit antecedent if the context supports the creation of such a role.

The method of antecedent introduction was varied to test whether context would establish an Instrument Discourse Role that would function as an antecedent for a subsequent reference to an Instrument. For example, does the verb "wash" in the context of "washing hair" establish a discourse role for an instrument, "shampoo". If so, the question is, when? If the Instrument Discourse Role is established in response to reading the verb then it should assist the integration of a subsequent reference to "shampoo". If not, subjects should experience difficulty integrating an instrument with an implicitly introduced antecedent.

Haviland & Clark's (1974) bridging inference rationale was used to evaluate these alternatives and thereby establish the time course of the availability of contextually appropriate role information. As outlined earlier (Chapter 5) bridging inferences of the kind necessary to integrate the target instrument with the text have been shown to take considerable time. Hence, it should take longer to integrate a reference with an implicit antecedent, in comparison to a reference with an explicit antecedent. However, if context allows a Discourse Role to be inferred as the text is read, there should be no difference in the fixation times on the instrument regardless of whether it has an explicit or implicit antecedent because Discourse Role information will be available to assist the resolution of a reference with an implicitly introduced antecedent. Hence a time consuming bridging inference will not be necessary.

Garrod et al. (1990) demonstrated that a restrictive context was only beneficial if the reference was anaphoric. Consequently, it was predicted that the implicit non-anaphoric target should receive the longest fixation time since readers were not expected to use a contextually established discourse role to resolve a non-anaphoric reference. In addition, there should be no difference between the fixation times on explicit and implicit anaphoric targets because context-based role information should assist the integration of the implicit anaphoric target instrument.

6B. 1. 3 Method

6B. 1. 3. 1 Selection of Materials

Twenty Verbs and their forty contextually appropriate instruments were selected on the basis of strict selection procedures, an Instrument Generation Questionnaire Task and a Dictionary Exercise

6B. 1. 3. 1a Instrument Generation Task

Subjects

The questionnaire was completed by 30 volunteer subjects, all undergraduates at the University of Glasgow.

Design and Procedure

Subjects were asked "to specify the instrument(s) which were most likely to be used when performing the listed actions". A definition of an instrument was given and examples provided (see Appendix 3). No time limit was imposed on completion, with the average completion time being twenty minutes.

Two versions of the questionnaire were necessary since verbs were placed in two different restrictive contexts. Each questionnaire included a verb in one context; the same verb was never presented in both contexts within the one questionnaire. For example, "cut grass" and "cut hair" never appeared in the same questionnaire.

Results

The percentage of subjects who stated a particular instrument for each verb was calculated. Only those verbs and instruments that reached the 60% selection criteria were used to generate the experimental materials.

6B.1.3.1b Dictionary Exercise

Rationale

The use of dictionary definitions was suggested by Cotter (1984). Cotter used a Dictionary Exercise as a means of assessing the degree of association between Verbs and their Instruments (cf. Chapter 5). In fact, Cotter used the Dictionary Exercise not only as a way of assessing Verb - Instrument relations, but also as a means of establishing semantic relatedness. She regarded dictionary definitions as reflecting the semantic structure of the verb: if the instrument was cited in the definition of the verb, then the instrument was assumed to be inherent to the meaning of the verb.

The present Dictionary Exercise, used in Verb selection, differs from Cotter's in one very important respect. Cotter referenced Verbs, in order to check how often their associated Instruments were cited as part of the dictionary definition of the Verb. The present study referenced the Instrument, in order to check how often the "Verb in Context" was cited. It was necessary to reference the Instrument because "general verbs" and their associated Instruments are determined by their context of use, and not simply by the Verb itself. Hence, the Dictionary Exercise is assumed to provide information about the degree of Instrument-to-Verb association. A high degree of association is thought to be a major determining factor in the drawing of instrument inferences (McKoon & Ratcliff, 1989; cf. Chapter 7 for detailed discussion of the contribution of semantic-associative information to the inference process).

Procedure

The Collins Cobuild English Language Dictionary (1987) was used to reference the Instrument definitions. The Cobuild Dictionary was used because it is based on an extensive data-base which reflects modern usage and collocations.

The dictionary definitions of Instruments were assigned to one of three categories:

(i) Explicit Mention of Verb

For example, the instrument "blindfold" associated with the verb-object pair "cover eyes" was defined as "a strip of cloth that can be tied around someone's head so that it covers their eyes and prevents them from being able to see". In this definition, the verb ("cover") is explicitly mentioned.

(ii) Category Implying Verb Mentioned

In some cases, the verb was not explicitly cited; instead a category that included the verb was mentioned. Such was case for the verb-instrument pair "carve wood - chisel". "chisel" was defined as "a tool that has a long metal blade used for cutting and shaping wood, metal and stone".

In this instance, "cutting and shaping" was regarded as category including or implying "carve". Such an assumption was supported by the dictionary definition of "carve": " if you carve an object you make it by cutting it out of a substance such as stone or wood".

(iii) No Verb (or Category) Mentioned

Consider the verb - instrument pair "spread butter - knife", with "knife" being defined as "an object that you hold in your hand and use to cut things or as a weapon". In this definition there is no mention of either the verb ("spread") or a category that includes or implies it.

Results

Verb Mentioned	Category Implying Verb	No Verb Mentioned
60%	35%	5%

Table 6. 5 Percentage of Instruments that Mentioned Verb in Definition

The 5% (2) instruments that failed the Dictionary Exercise were retained because they performed well on the instrument generation pre-test. In addition, the degree of association was thought to be strengthened by the contexts in which they were presented.

6B. 1. 3. 1.c Experimental Stimuli

The Verbs and Instruments selected had a high degree of association. The degree of Verb-to-Instrument association was assessed on the basis of the instrument generation task, and Instrument-to-Verb relations were assessed by the Dictionary Exercise.

The verb-instrument pairs selected were used to generate stimulus passages that conformed to a standard format. Each had an introductory sentence that established the context for interpretation. The second sentence introduced the antecedent for the target instrument either explicitly by mentioning the Verb and the Instrument, or implicitly by just mentioning the Verb (explicitness factor). The third sentence contained the Target Instrument which referred either anaphorically or non-anaphorically to the instrument introduced earlier (anaphoricness factor). The anaphoric nature of the reference was manipulated by using either a definite or an indefinite article before the target instrument. The forth, and final, sentence was simply a concluding sentence to make the passage of text more coherent.

The 20 verbs and their context appropriate instruments were placed in two contexts. For example, the verb "steer" and it associated context-dependent instruments: "wheel" and "rudder" was placed in the following contexts.

1) Steer boat - Rudder

Explicit Anaphoric

Due to the high winds and rough sea the small fishing boat was far from its charted course. The stormy weather had made it difficult to steer the boat with the rudder. When the storm subsided the Captain discovered that the rudder was damaged. He decided to radio for assistance.
Was the weather stormy?

Explicit Non-Anaphoric

Due to the high winds and rough sea the small fishing boat was far from its charted course. The stormy weather had made it difficult to steer the boat with the rudder. When the storm subsided the Captain discovered that a rudder was damaged. He decided to radio for assistance.
Was the weather stormy?

Implicit Anaphoric

Due to the high winds and rough sea the small fishing boat was far from its charted course. The stormy weather had made it difficult to steer the boat towards the shore. When the storm subsided the Captain discovered that the rudder was damaged. He decided to radio for assistance.
Was the weather stormy?

Implicit Non-Anaphoric

Due to the high winds and rough sea the small fishing boat was far from its charted course. The stormy weather had made it difficult to steer the boat towards the shore. When the storm subsided the Captain discovered that a rudder was damaged. He decided to radio for assistance.
Was the weather stormy?

2) Steer car - Wheel

Explicit Anaphoric

James reduced his speed as the road contained many sharp bends. He steered the car around the bends with the wheel. Sometimes, he had to turn the wheel quickly to keep the car on course. Once he almost ran off the road and into a ditch.

Did the road contain many sharp bends?

Explicit Non-Anaphoric

James reduced his speed as the road contained many sharp bends. He steered the car around the bends with the wheel. Sometimes, he had to turn a wheel quickly to keep a car on course. Once he almost ran off the road and into a ditch.

Did the road contain many sharp bends?

Implicit Anaphoric

James reduced his speed as the road contained many sharp bends. He steered the car around the bends with great care. Sometimes, he had to turn the wheel quickly to keep the car on course. Once he almost ran off the road and into a ditch.

Did the road contain many sharp bends?

Implicit Non-Anaphoric

James reduced his speed as the road contained many sharp bends. He steered the car around the bends with great care. Sometimes, he had to turn a wheel quickly to keep a car on course. Once he almost ran off the road and into a ditch.

Did the road contain many sharp bends?

6B.1.3.2 Subjects

24 students from the University of Glasgow participated in the experiment. All were native speakers of English. Some subjects had previously participated in other eye tracking studies. Each subject was paid £5.

6B.1.3.3 Design

A within subjects design was used. Four experimental lists of materials were compiled for presentation, with each set containing five passages in each of the four experimental conditions. This meant that each passage, in each condition, was read by six subjects. The stimuli were presented along with twenty filler items of a similar format in a fixed random order.

6B.1.3.4 Procedure, Apparatus, Analysis

As Experiment One.

6B.1.3.5 Regions

Only the reading time data for the Noun Region (target instrument) will be reported. Data for the Post-Target Region and Regressive eye movements is not reported because analysis of the reading time (section 6B. 4) data suggests that there are problems with some of the materials used.

6B.1.4 Results

First-Pass Reading Times

Condition	FP Reading Time	Standard Error
Explicit Anaphoric	29.301	1.729
Explicit Non-Anaphoric	28.969	2.363
Implicit Anaphoric	30.588	2.292
Implicit Non-Anaphoric	31.069	1.500

Table 6.6 Mean First-Pass Reading Times (ms/pc) and Standard Errors By Condition For Target Instrument

A 2 (explicitness) \times 2 (anaphoricness) repeated measures ANOVA calculated on first pass subject and item reading time means revealed no significant main effects (explicitness: $F_1(1, 23) = 1.225$, $p = .2799$, $MSe = 56.175$; $F_2(1, 37) = 1.820$, $p = .1855$, $MSe = 94.111$) or interaction (all $F_s < 1$).

Although statistical analysis fails to attain significance, it is interesting to note that the trend in the data is consistent with predictions. There is little difference in the reading times of the explicit and implicit anaphoric targets instruments, and the implicit non-anaphoric target receives the longest fixation time.

Total Reading Time

Condition	Total Reading Time	Standard Error
Explicit Anaphoric	38.522	2.403
Explicit Non-Anaphoric	45.348	3.450
Implicit Anaphoric	39.858	2.639
Implicit Non-Anaphoric	45.478	3.435

Table 6.7 Mean Total Reading Times (ms/pc) And Standard Errors By Condition For Target Instrument

A 2 (explicitness) x 2 (anaphoricness) repeated measures ANOVA calculated on Total subject and item reading time means revealed a significant main effect for anaphoricness: $F_1(1,24) = 7.756, p < .02, MSe = 119.837$; $F_2(1,37) = 6.449, p < .02, MSe = 197.296$. There was no other significant main effect or interaction (all $F_s < 1$).

The Total Reading Time results are consistent with the experimental predictions in that there is no difference in the reading times of an anaphoric reference to a target instrument with an explicitly rather than an implicitly introduced antecedent. Suggesting that contextual role information assists the integration of instruments associated with general verbs.

6B.1.5 Discussion of Experiment Three

The First Pass reading time results are consistent with the experimental predictions in that they show no advantage to having an explicit antecedent for an anaphoric reference, if the context can support the reference process. Also, as predicted, the implicit non-anaphoric target instrument receives the longest reading time.

The Total reading time results do not totally support the experimental predictions. Although, they show no advantage to having an explicitly introduced antecedent, the explicit non-anaphoric target instrument received an unexpectedly long reading time. It seems readers experienced as much difficulty integrating the explicit non-anaphoric target as they did with the implicit non-anaphoric target. This may be due to the fact that readers experience problems with a non co-referential reference to an appropriate instrument. It is interesting to note that the strength of Garrod et al.' prediction lies in the behaviour of the non-anaphoric references. However, it is more difficult to draw clear conclusions due to the nature of the instrument inference materials. Garrod et al. examined the instantiation of category member in response to a category label, hence they never had the problem of the explicit non-anaphoric condition seeming so strange and consequently receiving a long fixation time. Also they were examining noun-noun relations, here we are examining the contextual influence on verb-argument relations.

In general, the results of Experiment three substantiate the proposals of Garrod & Sanford (1983) in that a supportive context appears to establish an Instrument Discourse Role that assists the resolution of a subsequent reference to an contextually appropriate instrument. The influence of a non-supportive context on the establishment of Instrument Discourse Roles is explored in Experiment Four.

6B.2 Experiment Four Discourse Roles and a Non-Supportive Context

6B.2.1 Rationale

The results of experiment 3 support Garrod & Sanford (1983) proposals that a supportive context can establish a discourse role that assists the integration of a contextually consistent reference. It was shown that an appropriate context can assist the resolution of a reference to an instrument associated with a General Verb. If the verb "wash" is used in the context of "washing clothes" a reference to "powder" is resolved as easily as a reference to "shampoo" in the context of "washing hair", since the context supports the establishment of a discourse role that functions as an antecedent for subsequent reference.

In addition, Garrod & Sanford (1983) demonstrated that if the context is inconsistent with the to-be-inferred concept then a reference with an implicit antecedent should be more difficult to integrate than one with an explicit antecedent. Therefore, it should be difficult to integrate a reference to "shampoo" in the context of "washing clothes", and a reference to "powder" in the context to "washing hair" because the Instrument is not supported by the context i. e. the instrument has little significance in that context.

It is predicted that a reference with an implicitly introduced antecedent will be more difficult to integrate (and hence receive a longer reading time) than a reference with an explicit antecedent if the reference to be resolved is inappropriate with respect to the context (explicitness effect). This difficulty should be reflected in longer reading times; with the inappropriate implicit anaphoric Target Instrument receiving a significantly longer reading time than the inappropriate explicit Target Instrument. This is because the context does not support the integration of a contextually inappropriate instrument via an instrument discourse role, hence a time consuming bridging inference is required to integrate the reference. In addition, if definite noun phrases are thought to refer to entities already present in the representation of the text, then they should be easier to resolve in cases where they either have an explicit antecedent or where the inference is supported by the context. Since there is no contextual support, except for the explicit antecedent case, the non-anaphorics should take longer to process than the anaphorics (anaphoricness effect).

It is important to note that the context is established by the "verb in context" and the Target Instrument is inconsistent with the verb in that context, "wash clothes" - "shampoo". Although the target is inappropriate with respect to the use of the verb in that context, it is consistent with the use of the verb in its corresponding context: "wash hair" - "shampoo". It is because instruments associated with general verbs vary as a function of their context of use that make them ideal to explore the influence of context on inferencing and the establishment of discourse roles.

Like the experimental texts used by Garrod & Sanford (1983) the target instruments are "situation-dependent" in that they derive their significance because of their position in the scenario. For instance, in example 5 below

- (5) JANE WASHED HER HAIR
THE SHAMPOO NIPPED HER EYES.

"the shampoo" is not just any shampoo, it is the shampoo Jane used to wash her hair. Hence, "the shampoo" is significant given its place in the scenario of "washing hair". It is therefore possible to refer to "the shampoo" because the washing hair scenario that the text calls to mind contains an instrument role that can support a reference to "shampoo".

In contrast, a reference to "powder" is not supported by the context of "washing hair".

- (6) JANE WASHED HER HAIR
THE POWDER NIPPED HER EYES.

Since the reference to "the powder" can not be resolved by a contextually established role, it must be integrated by a time consuming bridging inference. Hence increased reading times for contextually inappropriate instruments are predicted.

6B.2.2 Method

6B.2.2.1 Materials

The same 20 Verbs and 40 Context-dependent Instruments used in Experiment 3 were used to generate the experimental materials (see Appendix 5).

The stimulus materials all conformed to a standard format. Each had an introductory sentence that established the context for interpretation by stating the verb in context, for example "steer boat". The second sentence reinforced the context suggested by the introductory sentence. The third sentence either explicitly stated (incidental mention) or implied a contextually inappropriate instrument (explicit or implicit introduction of antecedent). The crucial point to note is that this inappropriate instrument was associated with the verb in another context. The final sentence contained a reference to the inappropriate instrument (target) introduced in the preceding sentence. The reference to the target instrument could either be anaphoric or non-anaphoric. The anaphoric nature of the reference was manipulated by using either a definite or an indefinite article before the target instrument.

Consider the verb "steer" which can be used in the context of "steer boat" and imply the use of "a rudder"; alternatively it can be used in the context of "steer car" and suggests the use of "a wheel". An example material, in all conditions, is given below. The names of the conditions refer to the method of antecedent introduction. Note that the target is always inappropriate with respect to the "verb in context": the verb in that context does not imply the use of that particular instrument, although the same verb in a different context would imply the use of that instrument.

(1) Steer Car

Explicit Anaphoric

Allan carefully steered the car through the narrow entrance of the yard. He looked around for the owner as he needed some advice. He was having some problems with his boat and thought he might need a new rudder. On hearing the problem the owner suggested that the rudder should be replaced.

Did Allan need a new rudder?

Explicit Non-Anaphoric

Allan carefully steered the car through the narrow entrance of the yard. He looked around for the owner as he needed some advice. He was having some problems with his boat and thought he might need a new rudder. On hearing the problem the owner suggested that a rudder should be replaced.

Did Allan need a new rudder?

Implicit Anaphoric

Allan carefully steered the car through the narrow entrance of the yard. He looked around for the owner as he needed some advice. He was having some problems with his boat and thought he might need a new part. On hearing the problem the owner suggested that the rudder should be replaced.

Did Allan need a new rudder?

Implicit Non-Anaphoric

Allan carefully steered the car through the narrow entrance of the yard. He looked around for the owner as he needed some advice. He was having some problems with his boat and thought he might need a new part. On hearing the problem the owner suggested that a rudder should be replaced.

Did Allan need a new rudder?

(2) Steer Boat

Explicit Anaphoric

Peter was having difficulty steering the rowing boat towards the bank. The oars were catching in all the junk that had been thrown into the canal. Earlier he had spotted an old bicycle wheel in the water. Now the boat was completely stuck.

The boat had hit the wheel of the abandoned bicycle. He called to a passer-by for help.

Explicit Non-Anaphoric

Peter was having difficulty steering the rowing boat towards the bank. The oars were catching in all the junk that had been thrown into the canal. Earlier he had spotted an old bicycle wheel in the water. Now the boat was completely stuck. The boat had hit a wheel of the abandoned bicycle. He called to a passer-by for help.

Implicit Anaphoric

Peter was having difficulty steering the rowing boat towards the bank. The oars were catching in all the junk that had been thrown into the canal. Earlier he had spotted an old bicycle floating in the water. Now the boat was completely stuck. The boat had hit the wheel of the abandoned bicycle. He called to a passer-by for help.

Implicit Non-Anaphoric

Peter was having difficulty steering the rowing boat towards the bank. The oars were catching in all the junk that had been thrown into the canal. Earlier he had spotted an old bicycle floating in the water. Now the boat was completely stuck. The boat had hit a wheel of the abandoned bicycle. He called to a passer-by for help.

6B.2.3 Subjects

24 students from the University of Glasgow participated in the experiment. All were native speakers of English. Some subjects had previously participated in other eye tracking studies. Each subject was paid £5.

6B.2.4 Design

A within subjects design was used. Four experimental lists of materials were compiled for presentation, with each set containing five passages in each of the four experimental conditions. This meant that each passage, in each condition, was read by six subjects.

6B.2.5 Procedure, Apparatus, Analysis and Regions

As Experiment Three.

6B.2.6 Results

First Pass Reading Time

Condition	FP Reading Time	Standard Error
Explicit Anaphoric	27.520	1.670
Explicit Non-Anaphoric	27.481	2.290
Implicit Anaphoric	27.945	1.945
Implicit Non-Anaphoric	29.278	1.923

Table 6.8 Mean First-Pass Reading Times (ms/pc) and Standard Errors
By Condition For Target Instrument

A 2 (explicitness) x 2 (anaphoricness) repeated measures ANOVA calculated on First Pass subject and item reading time means revealed no significant main effects or interactions (all Fs <1, except explicitness: F1 (1, 23) = 1.164, p = .2919, MSe = 25.448).

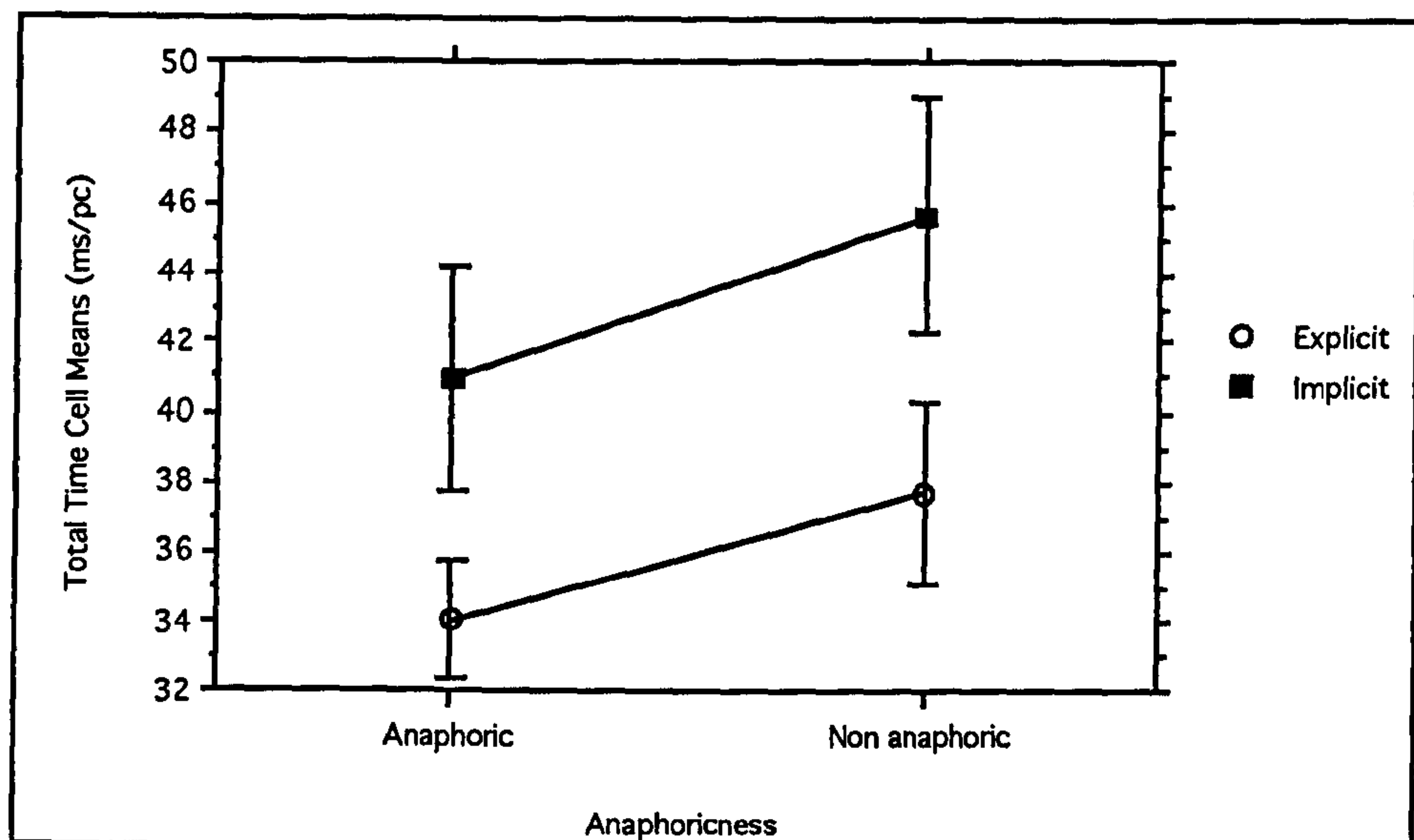
Total Reading Time

Fig. 6.1 Mean Total Reading Times (ms/pc) And Standard Errors By Condition For Target Instrument

A 2 (explicitness) \times 2 (anaphoricness) repeated measures ANOVA calculated on Total subject and item reading time means revealed a significant main effect for explicitness: $F_1(1,23) = 11.041$, $p < .004$, $MSe = 119$; $F_2(1,39) = 7.241$, $p < .02$, $MSe = 286.046$, and a marginally significant main effect for anaphoricness: $F_1(1,23) = 2.747$, $p = .111$, $MSe = 151.19$; $F_2(1,39) = 2.936$, $p = .09$, $MSe = 213.904$. As expected, there was no evidence of an Interaction ($F_s < 1$).

The significant effect of explicitness indicates, as expected, that readers took longer to read the target instrument in the absence of an explicit antecedent than in its presence. Since the context does not support a reference to a contextually inappropriate implied instrument, the reference can only be resolved with recourse to complex and time consuming bridging processes which are reflected in the longer reading time. The anaphoricness effect suggests that subjects experienced greater difficulty resolving non-anaphoric references to instruments.

Overall, the reading time supports the experimental prediction that references to implicit instruments will be very difficult to integrate in the absence of a supportive context. Suggesting that contextual factors exert a powerful influence on discourse processing and the encoding of implicit instruments.

6B.3 Discussion of Experiments Three & Four

The results of experiments 3 & 4 illustrate how context can assist the process of reference resolution and contribute to the establishment of discourse coherence probably through the creation of discourse roles. The results are consistent with Garrod & Sanford (1983), but extend them by showing that context effects do not influence the integration of an implicit instrument until Total Time.

The results of experiments 3 & 4 are interesting as they contradict those of previous studies which have examined the influence of context on the encoding of implicit instruments. Lucas et al. (1990) suggested that an implicit instrument would only be inferred if it was previously mentioned in the context. However, they do acknowledge that the instrument need not be previously mentioned if the context is strongly constrained. The verb-instrument pairs used to generate the experimental materials were selected on the basis of stringent selection procedures and the contexts were highly constrained, so the target instrument was a highly plausible instrument for the action. The results suggest that a restrictive context will facilitate the process of instrument inferencing and the establishment of Instrument Discourse Roles.

The important contribution of context to instrument inferencing is consistent with the proposal of Mauner et al. (1995) that implicit instruments are "optionally anaphoric implicit arguments" which may or may not take their interpretation from the context. This suggests that the encoding of implicit instruments should be sensitive to contextual factors. The empirical data suggests that they are sensitive to contextual factors and their optional anaphoric nature, may or may not use context, explains the conflicting results. Mauner proposes that implicit instruments are always encoded, but not always instantiated, with instantiation being dependent on contextual factors (cf. Chapter 4).

The use of context to assist resolution is consistent with the proposal that context will establish an Instrument Discourse Role. It seems that an implicit instrument will be encoded if the context is sufficiently restrictive. The fact that context can influence the encoding of implicit instruments is interesting given the results of McKoon & Ratcliff (1981) who suggested that only highly related instruments would be inferred and the experimental results reported in Chapter 5 (Experiments 1 & 2) that demonstrated the important

contribution of verb-based information and the nature of the relationship between the verb and instrument to the establishment of Instrument Discourse Roles. Sanford & Garrod (1981) suggested that discourse roles may be derived either from lexical (verb-based) or contextual information used by the reader during the process of comprehension. The question, then, is what is the origin of Instrument discourse roles: lexical or contextual? The data from experiments 1 and 2 highlights the important contribution of verb-based information; in contrast the data from experiments 3 and 4 suggests that context can also establish Instrument Discourse roles. Before any definite conclusions can be made regarding the origins of Instrument Discourse roles, it is necessary to check the restrictive effect of context. Are both contexts equally restrictive? In other words, do both contexts establish an Instrument Discourse role with equal ease, or are some instruments more easily encoded in some contexts than others. For example, is "shampoo" more easily resolved in the context of "washing hair", than "powder" in the context of "washing clothes".

6B. 4 Differential Context Effects

The data from Experiment 3 was re-analysed in order to check that both restrictive contexts were equally supportive in establishing Instrument Discourse Roles. Since the verbs were arbitrarily assigned to context, we would not expect any difference between the contexts if both context are equally supportive to the creation of Instrument Discourse Roles.

6B. 4. 1 Context 1

Condition	FP Reading Time (S. E)	Total Time (S. E)
Explicit Anaphoric	29.507 (2.399)	41.028 (3.015)
Explicit Non-Anaphoric	28.989 (2.868)	47.839 (4.541)
Implicit Anaphoric	28.299 (3.010)	35.823 (3.529)
Implicit Non-Anaphoric	28.675 (1.801)	46.080 (4.658)

Table 6. 9 Reading Time Data for Target Instrument in Context 1

Statistical analysis on the first pass reading times revealed no significant effects (all Fs < 1). Statistical analysis on the Total reading time means revealed significant effects consistent with the experimental predictions.

A 2 (explicitness) x 2 (anaphoricness) repeated measures ANOVA calculated on Total Subject and Item reading time means revealed a significant main effect for anaphoricness: F1 (1,23) = 7.683, p < .02, MSe = 227.516; F2 (1,18) = 9.602,p <.007, MSe = 167.530. There was no other significant main effect or interaction (all Fs < 1).

The results of Context 1 are comparable with those reported earlier (6B. 1. 4) and support the experimental prediction that context can support reference resolution and discourse integration as there is no difference in the reading times for target instruments with explicitly or implicitly introduced antecedents. The longer reading time on the implicit non-anaphoric target instrument suggests subjects experience difficulty integrating this information

into the developing discourse representation. The explicit non-anaphoric target also receives a long reading time, suggesting that subjects also experience difficulty this information. This is most likely because the occurrence of two non-referential nouns within such a short text is rather unexpected and infelicitous.

6B.4.2 Context 2

Condition	FP Reading Time (S. E)	Total Time (S. E)
Explicit Anaphoric	29.217 (2.129)	36.118 (3.193)
Explicit Non-Anaphoric	28.886 (2.495)	42.386 (3.643)
Implicit Anaphoric	33.032 (2.569)	43.789 (3.176)
Implicit Non-Anaphoric	33.200 (2.548)	44.899 (3.232)

Table 6.10 Reading Time Data for Target Instrument in Context 2

The reading time data for Context 2 differs from that of Context 1, in that Context 2 shows an explicitness effect on the first pass. Such an explicitness effect is not consistent with the experimental predictions suggesting that some contexts do not support the establishment of an Instrument Discourse Role that assists integration of the target instrument.

A 2 (explicitness) x 2 (anaphoricness) repeated measures ANOVA calculated on first pass subject and item reading time means revealed a significant main effect for explicitness $F_1(1,23) = 3.769, p < .07, MSe = 396.443$; $F_2(1,18) = 4.791, p < .05, MSe = 93.464$. There was no other significant main effect or interaction (all $F_s < 1$).

The first pass results from Context 2 suggest that subjects experience difficulty integrating a reference with an implicit antecedent, suggesting that contextual role information is not available to assist the comprehension process. Since this difficulty is most apparent in the items analysis it suggests that some

contexts do not support the establishment of Instrument Discourse roles. This difficulty is also shown in the Total Time results.

A 2 (explicitness) \times 2 (anaphoricness) repeated measures ANOVA calculated on Total subject and item reading time means revealed a significant main effect of explicitness: $F_1(1,23) = 3.123, p = .09, MSe = 199.256$; $F_2(1,18) = 4.086, p < .05, MSe = 156.556$. There was no other significant main effect (anaphoricness: $F_1(1,23) = 1.402, p = .2485, MSe = 232.948$; $F_2(1,18) = .501, p = .4882, MSe = 213.406$) or interaction ($F_1(1,23) = .739, p = .3989, MSe = 216.039$; $F_2(1,18) = 1.499, p = .2366, MSe = 173.421$).

6B.5 The Limited Influence of Context on Discourse Roles

The re-analysis data shows that there are differences between the Contexts on both First Pass and Total Reading Time. The main difference is that Context 2 shows an explicitness effect on both First Pass and Total Reading Times. The results indicate the implicit anaphoric targets are more difficult to integrate than explicit anaphoric targets suggesting that Context 2 does not establish an Instrument Discourse role that can assist the integration of the instrument.

In contrast, Context 1 does not exhibit an explicitness effect; but instead shows an anaphoricness effect, with the implicit non-anaphoric target being difficult to integrate. In addition, there is no difference between the reading time on the explicit and implicit anaphoric targets. Taken together, the data from Context 1 suggests that for these particular verbs and contexts, an instrument discourse role is established that assists integration of a subsequent reference.

Taken together these results of Experiments 3 & 4 highlight the use of contextual information in the encoding of implicit instruments and the establishment of Instrument Discourse Roles. However, evidence for the contextual establishment of Instrument Roles is not unequivocal, the effect of context is not consistent across both contexts. Therefore, we need to further explore the source of these context differences and how they influence the encoding of implicit instruments. Do these "context differences" occur because the context is not sufficiently restrictive to support the creation of an instrument role? Or is the establishment of Instrument Discourse Roles determined by lexical factors, such as the relationship between the verb and

the to-be-inferred instrument. Alternatively, lexical factors may influence the process by virtue of the fact that some verbs may have a preference for a particular instrument regardless of the context in which they appear. The Dictionary Exercises and Questionnaire Tasks reported in the following Chapter assess these alternative explanations. The empirical data reported in Chapter 8 examines the relative contribution of lexical and contextual information to the establishment of Instrument Discourse Roles.

Chapter Seven

Semantic Relations & Semantic Association:
Their Contribution to the Encoding of Instruments.

7.1 Semantic-Associative Information

In this Chapter, the contribution of semantic and associative information to the encoding of implicit instruments and the establishment of Instrument Discourse Roles is considered. Their relative contribution is explored using a Dictionary Exercise and series of Questionnaire Tasks; in an attempt to determine whether semantic association or semantic relatedness is a better predictor of a Verbs' ability to establish an Instrument Discourse Role.

The use of a series of off-line tasks was motivated by the differential context effects reported in the previous chapter (cf. 6B.4). The question is whether these "context differences" are attributable to a weakness in the context itself, i.e., the context is not sufficiently restrictive to support the establishment of an Instrument Role. Alternatively, the establishment of Instrument Discourse Roles may be determined by lexical factors, such as the relationship between the verb and the to-be-inferred instrument: lexical factors may influence the process by virtue of the fact that some verbs may have a preference for a particular instrument regardless of the context in which they appear. The Dictionary Exercise and Questionnaire Tasks reported in this Chapter allow us to explore these alternative explanations and the experiment reported in the following Chapter (Experiment 5) empirically assesses the relative contribution of lexical and contextual information to the establishment of Instrument Discourse Roles.

Semantic-associative information plays an important role in language comprehension. It influences a range of comprehension processes from low level lexical priming to higher level comprehension strategies. McKoon & Ratcliff (1992) discussed the contribution of semantic-associative information to general inference processing. Therefore, it is not surprising that semantic-associative information should play a significant role in the establishment of Instrument Discourse Roles. The contribution of semantic-associative information to the encoding of implicit instruments has been extensively discussed by Garrod & Sanford (1982) and Cotter (1984) who suggested that only semantically related instruments would be immediately inferred (cf. Chapter 5). Cotter's work is particularly important as it forces us to distinguish between semantic relations and general associative information, and recognise that they may make a different contribution to the establishment of discourse coherence.

Cotter (1984) differentiates semantically related instruments from associated instruments on the basis of a Dictionary Exercise and emphasises the importance of stringent selection procedures when examining the encoding of implicit instruments (cf. 5A. 3. 2). The viability of Cotter's related/association hypothesis is assessed with respect to the General verbs used in Experiments Three and Four. The degree of association/relatedness was assessed in a Dictionary Exercise and questionnaire tasks. The off-line tasks reported in this chapter differ from those previously used in that they assess the degree of both forward (verb-instrument) and backward (instrument-verb) association. The inclusion of a context free condition (the default condition) allows us to assess the relationship between a verb and an instrument without context, i.e., "to cut" rather than the standard use of a verb phrase "to cut hair". By leaving the context "open", it is possible to assess whether the verb has a preference for a particular instrument, regardless of context. The finding that General verbs have a preference for a particular instrument (a default instrument) provides a possible explanation for the differential context effects found in Experiments Three and Four. The possibility that a verb's default instrument is initially encoded regardless of context offers a viable explanation for the conflicting evidence for the encoding of implicit instruments. The viability of this explanation is discussed in the following chapter. The current chapter explores the nature of the relationship between Verbs and Instruments.

7.1.1 Semantic Relatedness and Semantic Association

The use of semantic-associative information in the inference process has been extensively discussed by McKoon & Ratcliff (1989, 1992) within their "minimal inference framework". They regard semantic-associative information as an important variable which influences the strength (degree to which the inference is encoded) and specificity (level of detail) of an inference. If an inference is supported by semantic-associative information then it will be strongly encoded. The question is how semantic associative information can play such an important role in the inference process. Before discussing the possible ways in which semantic-associative information can assist the inference process, it is important to distinguish between semantic and associative relations.

There is a strong tendency for semantic and associative information to be confounded. Lupker (1984) demonstrated that actual semantic information

may play a limited role in what is generally termed "semantic priming". When assessing the contribution of semantic and associative information to the process of instrument inference, it is especially important that they are distinguished. Cotter (1984) suggested that only Instruments semantically related to Verbs will be inferred when the Verb is read.

It is important to differentiate between semantic association and semantic relatedness. Consider the following word pairs: ROBIN - HOOD, these words are simply associated, there is no semantic relationship between them. In contrast the words, HAT - SHIRT are semantically related by virtue of the membership of the common semantic category, "clothes". However, the words SHIRT - BUTTON are both semantically related and semantically associated. Often, it is the fact that words can be both semantically related and semantically associated that causes the two concepts to be confounded. For instance, items may be semantically related but not associated: PIG - HORSE; semantically related and associated: DOG - CAT. In addition words may simply be associated: STORK - BABY, having no relationship between them, except association. As subsequent discussion will show, this confound is particularly prevalent with respect to Verb-Instrument pairs.

In this chapter, the terms Semantic Relatedness or Semantic Information are used to refer to information contained either within a word's lexical entry, or to the method by which words are semantically related to other words, i.e., category membership. In contrast, the term Association is used to describe co-occurrence relations: words that are related by sole virtue of their association. For example, there is no semantic relationship between "ELBOW-GREASE", the relationship is simply association based.

7.1.2 The Nature of Verb-Instrument Relations

Generally the relationship between Verbs and Instruments is one of verb-argument or verb-adjunct relations (cf. Chapter 4). Given the nature of verb-argument relations, it is inevitable that there is a high degree of association between Verbs and Instruments, since Verbs and their arguments co-occur. It is important to note how this relationship differs from the general relations of association and relatedness discussed in the literature on semantic priming. Verb-argument relations are very different from Noun-Noun relations such as category membership.

Even when a distinction between semantic and associative information is made; we still need to distinguish inference processes from processes involved in word recognition- semantic priming. When reading example 1,

- (1) MARY SEWED THE DRESS.
THE NEEDLE WAS SHARP.

is the concept "needle" activated because of an inferential process or because of associations evoked by the verb "sew"? This is an important and complex issue, as it seems that association is essential for the immediate encoding of instruments (McKoon & Ratcliff, 1981). The issue is whether this information is available because of activation-based priming or the product of inferencing. The issue is further complicated because, priming-based activation may support the inference process.

It is interesting to note that in example 1, the definite reference to "the needle" is easily resolved despite the fact that it has no explicit antecedent. It appears to be integrated by virtue of its relationship with the verb "sew" which implies the use of a "needle". The question is whether this relationship between the verb "sew" and the instrument "needle" is one of semantic association or semantic relatedness?

The distinction between association and relatedness between verb and instruments is perhaps easiest to make with respect to verbs that convey inherent instrumentality, i.e., verbs like "drive" and "sew" where the instrument seems to be expressed by the meaning of the verb. In such cases it is tempting to assume that the relationship is one of semantic relatedness

rather than semantic association. But even here, there are problems because the verb and instrument are highly associated, as are all verb-arguments pairs.

General Verbs pose the additional problem of contextual influence and highlight the need to examine the relationship between Verbs, Objects and Instruments. It is possible that the concept of semantic relatedness may not apply to the relationship between General Verbs and their instruments. Instead, the relationship between General Verbs and Instruments may be one of association. Lupker (1984) discusses the possible use of sentence frames, rather than single words, as members of an association pair, "the carpenter used the hammer to drive the __ - nail". However, he regards this simply as an extension of general word priming, with a phrase rather than word being used as a prime. He fails to recognise that verb-argument relations and the processes they support may differ from that of Nouns. In addition, he uses a verb phrase and an instrument to prime a probable object, rather than a Verb-object pair to prime an instrument.

The viability of using the concepts of semantic relatedness and semantic association as a description of the nature of the Verb-Instrument relations are empirically assessed in this chapter. Before discussing this empirical work, it is interesting to examine the availability of semantic and associative information during comprehension.

2.2 The Availability of Semantic and Associative Information

Lexical priming studies have investigated the nature of the semantic information that becomes available when a word is accessed. The results suggests that a range of semantic information becomes available when a word is encountered: information about the semantic category to which the word belongs, its relation to other members of that category, and information about its perceptual and functional properties. Reliable priming effects have been shown for members of the same semantic category: CAT-DOG (Hines, Czerwinski, Sawyer, & Dwyer, 1986; Moss et al., 1995), Super ordinate-subordinate category relations: BIRD-ROBIN (Neely, Keefe & Ross, 1989), Functional properties and relations: BROOM-FLOOR (Moss et al, 1995) and Perceptual properties: CHERRY-BALL (Schreuder, Flores d'Arcais & Glazenborg, 1984). These results suggest that an elaborate set of default

information is available when a word is accessed and it is not surprising that this information may assist the comprehension process.

The empirical data also indicates that associative information is rapidly available. Numerous experiments using the lexical decision paradigm have shown that associative information is immediately available and influences both word-to-word priming (Meyer & Schvaneveldt 1976) and sentence-to-word priming (Seidenberg et al., 1982). Furthermore, information that cannot be derived from direct associations takes longer to process (Neely, 1977; Seidenberg et al., 1982).

McKoon & Ratcliff (1989), in a series of experiments, illustrated the rapid availability of associative information and its contribution to the inference process. Using the word recognition paradigm, they demonstrated that the degree of encoding of an inference is dependent on the amount of associative information available during processing. Even after a relatively short time period, 250 ms after text had been presented, recognition task performance was dependent on associative information, rather than textual information. McKoon & Ratcliff interpreted this as suggesting "that it is the fast availability of semantic information that allows it to support inference processes" (McKoon & Ratcliff, 1989, P. 326).

7.2.1 Semantic Association and Inference

Since semantic-associative information is readily available, it is likely to influence inference processing. The question is, how such information assists the inference process.

Semantic-associative information may interact with new information during reading in two ways. Firstly, it may help to establish the relationship between two pieces of explicitly stated information and this relationship may then assist the construction of an inference. The data suggests that the higher the semantic association between the words in a text, and the words to be related in that text, the easier the processing. For example, Garrod & Sanford (1977) and Corbett (1984) demonstrated that the difficulty of interpretation of a category anaphor is dependent on the typicality of the alternative referents. The typicality of exemplars (typical or atypical) was varied and the time taken to read a sentence containing the exemplar was measured:

- (2) THE TREES WERE SHATTERED BY THE STORM.
THE OAKS WERE WRENCHED FROM THE GROUND. (Typical)
- (3) THE TREES WERE SHATTERED BY THE STORM.
THE PALMS WERE WRENCHED FROM THE GROUND. (Atypical)

The results show that non-typical exemplars receive a longer reading time, suggesting that lexical based information concerning semantic relations (category membership) assists the process of reference resolution.

Interestingly, the influence of semantic information can be mediated by context. Roth & Shoben (1983) demonstrated the dependence of relative typicality on context. They examined the effect of context on the time taken to resolve an anaphoric reference for an exemplar to a category term. The results suggest that context can serve to make a given exemplar more suitable by restricting the set of likely referents. Consider, "The bird walked across the barnyard". The most representative example of a bird in this context is "chicken", yet "robin" is generally regarded as being a more typical bird. Reading time was shown to be related to typicality in relation to context, rather than to representativeness of the category in general. A reference to "chicken" would be read faster than "robin" following a context such as "The bird walked across the barnyard" despite the fact that a "robin" is a more typical bird. Roth & Shoben suggest that context may alter the relationship between an exemplar and a category by making an exemplar more representative.

The results of Roth & Shoben (1983) illustrate that semantic information is open to the influence of context and that contextually appropriate semantic information can assist the process of reference resolution. This is reminiscent of the influence of context on the instruments of General Verbs where the nature of the instrument is dependent on the context: a hairdresser cutting hair is likely to use scissors, while a gardener cutting grass is likely to use a lawnmower.

Secondly, semantic associative information may contribute to the process of elaborative inferencing. Elaborative inferences are not required to connect explicitly stated information; instead they add new, never stated information and therefore may require extra effort on the part of the reader. Since elaborative inferences, by their nature are elaborative and probabilistic, a high degree of association between words, and the concepts or events they evoke,

may make the inference more probable and consequently more likely to be encoded.

Weak associations - Target Test Word is "dead"

Predicting

The director and the cameraman were ready to shot the close-ups when suddenly the actress fell from the 14th storey.

Control

Suddenly the director fell upon the cameraman, demanding that he get a close-up of the actress on the 14th storey.

Strong Associations - Target Test Word is "sew"

Predicting

The housewife was learning to be a seamstress and needed practice so she got out the skirt she was making and threaded her needle.

Control

The housewife was a careless seamstress, and when she dropped an unthreaded needle on the floor, she didn't find it until she stepped on it days later.

Table 7.1 Example of Materials used by McKoon & Ratcliff (1989)

McKoon & Ratcliff (1989) used delayed speeded item recognition to examine the influence of association in the encoding of elaborative inferences about predictable events. They manipulated the amount of associative information available (see Table 7. 1) and demonstrated that the degree of association could influence the degree to which an inference was encoded. In addition, the results of McKoon & Ratcliff (1981) suggest that the encoding of implicit instruments is mediated by the degree of association between the verb and instrument. However, the instrument was explicitly presented in their experimental materials, so all the inference process has to do is connect the instrument stated at one point in the text with a verb stated at a later point. To avoid this problem, McKoon & Ratcliff (1989) investigated whether association

affects inference processes even when the to-be-inferred information is never stated in the text. The method (delayed, speeded item recognition) was developed to separate forward elaborative mechanisms from backward context-checking mechanisms that occur at the time of test. The rationale behind delayed, speeded item recognition is that backward context-checking is ruled out because the test is delayed by the presentation of other material and construction at the time of test is ruled out because the retrieval process is fast and automatic and test items relevant to the inferences under investigation are presented with a low probability. The results show that the strength of the associative relationship between the words influences the degree to which the inference is encoded.

Semantic associative information has also been shown to influence high level integrative processes. Keenan, Baillet & Brown (1984) demonstrated that causal relations between sentences are easier to process when the sentences are highly associated. They monitored the reading time for a target sentence with different degrees of relatedness and found that the target sentence in the least related passage received the longest reading time.

Since semantic-association information plays an important role in the comprehension and inference process, it is not surprising that associative information plays an important role in the encoding of implicit instruments.

7.2.2 Associative Information and Instrument Inferences

McKoon & Ratcliff (1981) suggest that the encoding of implicit instruments may depend on the degree of association between the instrument and the verb. However, the instrument was explicitly stated so the inference process only had to connect an instrument stated at one point in the text with a verb presented at a later point in the text. McKoon & Ratcliff assume that the prior mention of the instrument increases association between the verb and instrument. The results of McKoon & Ratcliff (1989) are interesting as they demonstrate that associative information can affect the inference process even when the to-be-inferred information is never stated in the text. This suggests that the degree of association that exists between a verb and the instrument it is thought to imply may determine if and when an instrument inference is made. The question is whether the information is associative in nature or

information about semantic relations. The priming data discussed earlier (section 7. 1. 1) indicates that a wide range of information, both semantic and associative in nature, becomes available when a verb is accessed. If functional information (Moss et al., 1995) becomes available then we would expect information about the instruments of verbs to become available when the word is accessed. Such a lexical explanation is consistent with the work of Garrod & Sanford (1982) and Cotter (1984) who suggest that lexical semantic information is the major motivation for the encoding of implicit instruments.

7.2.2.1 Instrument Inference: Relatedness or Association?

Cotter (1984) explained the differential ability of the verbs used by Garrod & Sanford (1982) and Singer (1979) to support instrumental inference with reference to the semantic structure of the verbs involved: distinguished between semantic association and semantic relatedness (cf. 5A.3.1). Cotter (1984) regarded an instrument as related if it was part of the meaning of the Verb (present in dictionary definition), and associated if it was given as a response in the questionnaire task. Cotter assessed association (whether verb implied instrument) by a questionnaire task (asked for three instruments to be provided in response to a verb phrase). She found no differences between the verb sets on the questionnaire task but differences were apparent in the Dictionary Exercise.

Cotter regarded dictionary definitions as reflecting the information present in a verb's lexical entry. She further assumes that information contained in a lexical entry will become available during reading and support inference processes. Dictionary Definitions are important for Cotter, as she accepts Gentner's (1982) "central components model" which assumes that the representation of a verb in semantic memory determines the pattern of inferences that may occur during comprehension. If, as Cotter suggests, an instrument is included as a central component in a verb's lexical representation, then it is more likely to support the encoding of implicit instruments and assist the creation of Instrument Discourse Roles. In contrast, a verb may have numerous associations and it would not be viable to draw inferences based on them all. Since, Singer-Instruments were found only to be associated, and not related to their verbs, instruments associated with Singer-verbs are not likely to be inferred during reading.

The difference in the strength of the relationship between instruments and Garrod & Sanford Verbs and Singer Verbs is apparent in the reading task and Dictionary exercise but not the questionnaire task for two main reasons. There were no constraints on time and processing resources for the questionnaire task, suggesting that the information about instruments is not available as the text is read but will be available when there is no time pressure. Secondly, the questionnaire task differed from the dictionary exercise in that the questionnaire task included verb phrases ("dress the baby") and therefore does not address the relationship between the verb and the instrument, but rather the relationship between a verb phrase and an instrument. In contrast, the dictionary exercise (due to nature of task) does not include verb phrases and is therefore devoid of any contextual influence. Consequently, the Dictionary Exercise is thought to reflect the semantic relationship between verbs and instruments.

Garrod & Sanford (1982) also explain the discrepancy between their results and those of Singer (1979) in terms of verb-instrument relations. They assume (as did Cotter) that the contents of a decomposed lexical representation can assist the inference process (cf. Chapter 5). Garrod & Sanford proposed that all their instruments were implied as part of the meaning of the verb and view these instruments as necessary parts of the verb's lexical structure. In contrast, Singer instruments were not regarded as being part of the verb's meaning; instead they are implied by "action descriptions". Consider, the verb-instrument pair, "clear snow"- "shovel", since the instrument is not derived from the verb ("clear") it will not be part of the decomposed representation of the verb and will therefore not be inferred in the normal course of language processing. Since, "shovel" is an optional instrument it will not be specified in the representation of the sentence unless explicitly mentioned in the text. Therefore, it is unlikely that the instrument will be inferred during comprehension. However, the instrument may be produced in an instrument generation task where time is not limited and the verb is given in context which strengthens the association.

The Priming literature, discussed earlier, and the proposals of Garrod & Sanford (1982) and Cotter (1984) highlight the importance of distinguishing between relationships based on semantic relatedness and those based on association. It is relatively simple to make such clear distinctions between relatedness and association for Nouns. However, the distinction is not always so simple with respect to verbs and their arguments or adjuncts. It may be the

case that verbs and instruments are associated or related to different degrees and the direction of the relationship (verb-instrument or instrument-verb) needs to be considered. The nature and direction of the semantic-associative relationship between verbs and instruments was assessed using an extended Dictionary Exercise and a series of Questionnaire tasks in order to evaluate the viability of association and relatedness as an explanation of the differential ability of verbs to support the establishment of Instrument Discourse Roles.

7.3 Assessing the Nature of Verb-Instrument Relations

7.3.1 Types of Association

The direction of the relationship between Verbs and Instruments was assessed: Forward Association (Verb-Instrument), Backward Association (Instrument-Verb), Association with Verb or the Verb in Context (Verb-Instrument, or Verb+Obj-Instrument and Instrument-Verb or Instrument-Verb+Obj).

(i) Forward Association

Forward Association (Verb-Instrument association) is defined as the degree to which a verb implies the use of an instrument. For example, whether reading the verb "cut" implies the use of a "knife" or "scissors". This relationship was examined by Cotter (1984), who concluded that only verbs which strongly imply instruments (present in their lexical representation) will support forward inferencing.

(ii) Backward Association

Backward Association (Instrument-Verb association) is defined as the degree to which an Instrument is associated with a Verb. For instance, the extent to which the instruments "knife" or "scissors" are associated with the verb "cut".

The degree of Instrument-Verb association may have an important impact on the process of inference and the establishment of discourse roles. A highly associated instrument may be resolved more quickly. Recall the data on

semantically related anaphors (Corbett, 1984) where more typical and presumably higher associates, or at least more frequent associates, are resolved faster.

(iii) Associated with Verb or Associated with the Verb in Context

In addition to examining whether the instrument is related to a Verb or a Verb + Object pair, the direction of the relationship is also considered: forward association (Verb-Instrument, or Verb+Obj-Instrument) or backward (Instrument-Verb or Instrument-Verb+Obj).

This category examines whether the Instrument is implied by the Verb alone, or by a Verb + Object pair. For example, does reading the verb "cut" imply the use of "scissors", or are "scissors" more strongly implied by the Verb + Object pair "cut hair". The extent of backward association between an Instrument and a Verb or a Verb + Object pair is also examined. For example, are "scissors" associated with the verb "cut" or with the Verb + Object pair "cut hair".

Does the fact that an Instrument is implied by a Verb or a Verb + Object pair have an effect on the availability of information about instruments? Cotter (1984) suggested that only instruments semantically related to a verb (contained in verb's lexical entry) will be inferred when the verb is read. Given this, we would expect instruments associated with a verb + object pair to be less likely to be inferred. Cotter's explanation may apply to Garrod & Sanford and Singer Verbs but it is not an adequate explanation for the results concerning General Verbs (cf. Chapters 6 & 8) where instruments associated with Verb + Object pairs are inferred. The results of the questionnaire task (cf. 7. 4. 4. 4) show that the degree of association with a Verb or a Verb + Object pair is an important factor, but the relationship is not quite as simple as Cotter suggested.

The degree and the direction of the associative relationship between verbs and instruments, and the viability of the distinction between semantic association and semantic relatedness as an explanation for the differential ability to support instrument inferences was assessed using an extended Dictionary Exercise and a series of Questionnaires.

7.3.2 The Dictionary Exercise

If a distinction is to be made between information that is contained in the verb's lexical structure (semantic relatedness) and information associated with the verb, then we need a means to differentiate between these relationships. We require a means to assess whether instruments are semantically related, or simply associated, with their respective verbs. In short, we need to examine the "independent meanings" of Verbs and Instruments in order to assess relatedness.

It is generally assumed that important aspects of "meaning" (what we need to know to understand the word) will be present in the dictionary definition of the word. In fact, the Collins Cobuild Dictionary (1987, P. 390) defines a dictionary as "a book in which the words of a language are listed alphabetically and their meanings explained".

Dictionary definitions are often criticised because they tend to separate "meaning" from "general knowledge". For present purposes, this is an advantage rather than a disadvantage as it allows the examination of independent meaning in order to distinguish between aspects of inferencing that are solely lexically-based (semantic relatedness) and those that are derived from context or general co-occurrence (semantic association).

7.3.2a Forward Association: Verb-Instrument Relations

The rationale behind the task is similar to that of Cotter (1984). Dictionary Definitions were used to assess the strength of the relationship between a Verb and its Instrument; in order to assess the likelihood that the Instrument would be inferred when the Verb was read. Following Cotter, if the Instrument is cited in definition of Verb, then the Verb and Instrument are regarded as being highly related. Therefore, information about the instrument is likely to be available to support inference processes and assist the establishment of discourse coherence.

As outlined earlier, Dictionary definitions are thought to reflect meaning, hence the Dictionary Exercise can be regarded as indicating how central Instruments are to the meaning of the Verb. It was predicted that a Garrod &

Sanford Verb would mention an instrument more often than either a Singer or General Verb. In fact, every Garrod & Sanford Verb was expected to mention an instrument in its dictionary definition.

The results of Cotter's Dictionary exercise suggest that since Singer Instruments are associated with an action description (verb + object) rather than a Verb, the instrument is not likely to be mentioned in the definition of the Verb. Given this, few Instruments were expected to be mentioned for General Verbs as their instruments are mediated by the context and determined by a Verb + Object pair rather than a Verb.

7.3.2a.1 Procedure

The dictionary entries for the Garrod & Sanford, Singer, and General Verbs used in Experiments 1 - 4 were referenced in the Collins Cobuild English Language Dictionary (1987). The definitions were classified into three categories, similar to those used by Cotter (1984).

(i) Instrument Explicitly Mentioned in the Definition of the Verb

Consider the verb "bake" and its implied instrument "oven".

"bake" was defined as, "when you bake food, or when it bakes, it is cooked in an oven without using extra liquid or fat". In its definition the Verb "bake" explicitly mentions the instrument "oven", in its dictionary definition.

(ii) Category that Includes the Instrument or Implies an Instrument is Needed

Consider the verb-instrument pair, "chop vegetables" - "knife".

"chop" was defined as: "if you chop something, you cut with energetic movements, usually with a sharp tool ". A "sharp tool" was regarded as category that included the implied instrument - "knife".

An example of a verb that implies the use of an instrument is shown in the definition of the verb "cover": "If you cover something, you place or spread something else over it in order to protect it or hide it". Definitions of this type

were regarded as implying that an instrument is needed to accomplish the task.

(iii) No Instrument Mentioned or Implied

In the definition of the verb "light" no instrument is mentioned or implied: "if you light something you make it start burning".

7.3.2a.2 Results

Verb Type	Instrument Mentioned	Category incl./implying Instrument	No Instrument Mentioned
Garrod & Sanford	100%	0%	0%
Singer	58%	0%	42%
General	40%	15%	45%

Table 7.2 Percentage of Verb Definitions that Mentioned Instrument, by Verb Type and Category Assigned

As expected, a Garrod & Sanford Verb was more likely to cite its associated Instrument in its dictionary definition than either a Singer or General Verb. Chi-square comparisons confirmed this prediction: there was a significant difference between the Verb Types in the frequency with which the Instrument was cited in the Verb's Dictionary definition. A Garrod & Sanford Verb was more likely to mention its Instrument in its dictionary definition than either a Singer Verb ($X^2 = 7.6705$, $df = 2$, $p < .0006$) or a General Verb ($X^2 = 11.0486$, $df = 2$, $p < .001$). In addition, Chi-square comparisons revealed no difference between General and Singer verbs, ($X^2 = 0.3581$, $df = 2$, $p = 0.6$) suggesting that a General Verb was no more likely to mention its associated Instrument in its dictionary definition than a Singer Verb.

7.3.2a.3 Discussion

The fact that a Garrod & Sanford Verb was most likely to cite its associated instrument is consistent with Cotter (1984) but her explanation is not sufficient to explain the empirical data reported in this thesis. If the degree of Verb-to-Instrument association is the determining factor in the encoding of instrument inferences, then why was there an explicitness effect for Singer Verbs (cf. Experiment 2) and no explicitness effects with General Verbs (cf. Experiment 4) when the results of the Dictionary Exercise show no difference in the degree of verb-to-instrument association of General and Singer verbs.

The fact that a Garrod & Sanford Verb is most likely to cite its associated instrument is consistent with Cotter's proposal that a "Garrod & Sanford instrument" seems to be associated with the Verb alone rather than a verb+object pair. This fact may explain the discrepancy between the Garrod & Sanford and Singer results. Cotter does suggest that there is a difference in the association strength of Garrod & Sanford and Singer Verb-Instrument pairs. Perhaps association relates to relationship between an Instrument and a Verb+Object pair, and relatedness applies to the relationship between a Verb and an Instrument, in that if the instrument is contained in the verb's lexical entry then it is related.

In general, the results of the Verb-Instrument Dictionary Exercise are consistent with those of Cotter, in that Garrod & Sanford Verbs are most likely to mention Instruments in their dictionary definition. As expected, General verbs performed poorly on forward association, as their instruments are related to Verbs in context. However, the results of Experiments 3 & 4 suggest that General verbs can support instrument inferencing, therefore the relationship between a Verb and its Instrument may not be the sole predictor of a verb's ability to support inferential processing. Such a proposal is consistent with there being no difference between Singer & General Verbs. Yet the results of Experiment 2 clearly show that Singer Verbs do not support instrument inferencing or establish discourse roles that assist subsequent reference. These results suggest that the relationship between Verbs and their Instruments is more complicated than Cotter's proposal suggests and that the degree of association between a Verb and its Instrument is not the sole predictor of its ability to establish Instrument Discourse Roles.

7.3.2b Backward Association: Instrument-Verb Relations

7.3.2b.1 Rationale

If Association is an important factor then the degree of association between an Instrument and a Verb may be equally as important as the relationship between a Verb and an Instrument. The Instrument-Verb Dictionary Exercise was used to assess the degree of Instrument-to-Verb association.

The definitions of Instruments associated with the Verbs, in the three Verb Sets (Garrod & Sanford, Singer, & General Verbs), were checked, in order to check how often the Verb or the Verb in context was cited. It was necessary to reference the instrument because "General Verbs" and their associated instruments are determined by their context of use, and not simply by the Verb itself. It was also thought that Singer Verbs would be associated with a Verb + Object pair rather than a Verb.

It was predicted that General Instruments would be more associated with a Verb+Object pair than either Singer or Garrod & Sanford Instruments. With Singer Instruments being more associated with Verb+Object pair than Garrod & Sanford Instruments; and Garrod & Sanford Instruments being most associated with the Verb alone, regardless of the nature of the object or context.

7.3.2b.2 Procedure

The procedure was similar to that used when the Dictionary Exercise was used as a selection procedure (cf. Chapter 6), except that the classification of definitions was expanded. The Collins Cobuild English Language Dictionary (1987) was used to reference the definitions of the Instruments.

The definitions were assigned to one of the following five categories:

(i) Explicit Mention of Verb

Take for instance, the verb "ride" with its implied instrument "horse".

A "horse" was defined as "a large animal which people ride for enjoyment or getting from one place to another".

In this example, the verb "ride" is explicitly mentioned in the definition of the instrument.

(ii) Explicit Mention of Verb+Object

For example, "cut grass" and its instrument, "lawnmower".

"lawn-mower" was defined as "a machine for cutting grass on lawns". In this example, the verb+object was explicitly mentioned in the definition of the instrument.

(iii) Category that Includes Verb

Consider "chop vegetables" - "knife", with "knife" being defined as "an object that you hold in your hand and use to cut things or as a weapon".

In this example, "cut" is regarded as category that includes "chop". As "chop" is defined as "cut ... roughly into smaller pieces".

(iv) Category that Includes Verb+Object

For example, "chop wood" - "axe", with axe being defined as "a tool used for cutting wood, for example for cutting down trees or for chopping logs" Here, again, "cut" is taken to imply "chop" and "trees or logs" taken to include "wood".

(v) No Mention of Verb or Category that Included Verb

Consider "spread butter" - "knife". "knife" was defined as "an object that you hold in your hand and use to cut things or as a weapon". In this definition there is no mention of either the verb ("spread") or a category that includes or implies it.

7.3.2b.3 Results and Discussion

Initial inspection of the data suggests there may be differences between the Verb Types in their degree of Instrument-Verb Association.

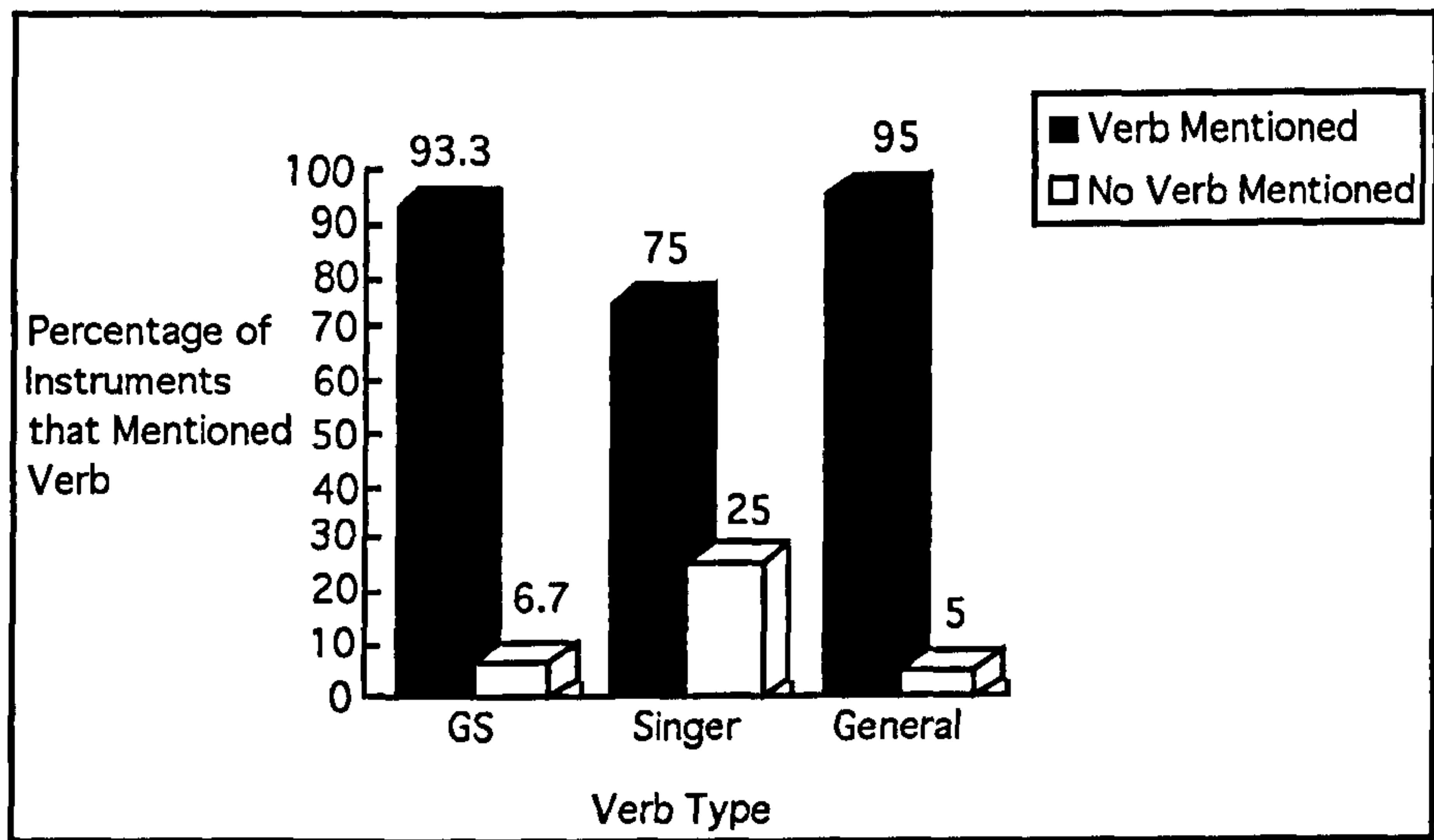


Fig. 7.1 Percentage of Instruments that Mentioned Verb in Dictionary Definition

The data suggests that Singer Instruments are least likely to cite their associated Verb in their Dictionary Definition. Statistical analysis revealed that Garrod & Sanford Instruments were marginally more likely to mention their associated verbs in their dictionary definitions than Singer Instruments: $X^2=3.1418$, $df=1$, $p<.08$.

General-Verb-Instruments were more likely to mention their associated Verbs in their dictionary definitions than Singer Instruments: $X^2=7.2599$, $df=1$, $p<.008$. However, there was no difference between General and Garrod & Sanford Instruments in the probability of the Instrument mentioning the Verb in its dictionary definition: $X^2=.0588$, $df=1$, $p=.8072$.

These results indicate that General Instruments and Garrod & Sanford Instruments are equally likely to mention their associated Verbs in their dictionary definition. This is surprising, as the Verb-Instrument Dictionary Exercise revealed a difference between General and Garrod & Sanford Verbs in the likelihood that the verb would cite the instrument (forward association), yet there appears to be no difference in the degree of Instrument-Verb

association (backward association). These results also suggest that Singer Instruments are less associated with their Verbs than Garrod & Sanford or General Instruments. It is also interesting to note that the Verb-Instrument Dictionary Exercise revealed no difference between Singer and General Verbs, but the Instrument-Verb measure of association does. Suggesting that General and Singer Verbs are equally associated with their instruments, but that General Instruments are more associated than Singer Instruments to their Verbs (higher degree of forward association).

As discussed earlier, there were thought to be differences with respect to whether the Instrument is associated with the Verb itself or associated with a Verb+Object pair. This was thought to be the case for General-Verb-Instruments but not for Instruments associated with Garrod & Sanford Verbs. Singer Verbs are also thought to be more associated with a Verb+Object pair than Garrod & Sanford Verbs. These possible differences were investigated by checking whether an Instrument mentioned its associated Verb or the associated Verb + Object pair.

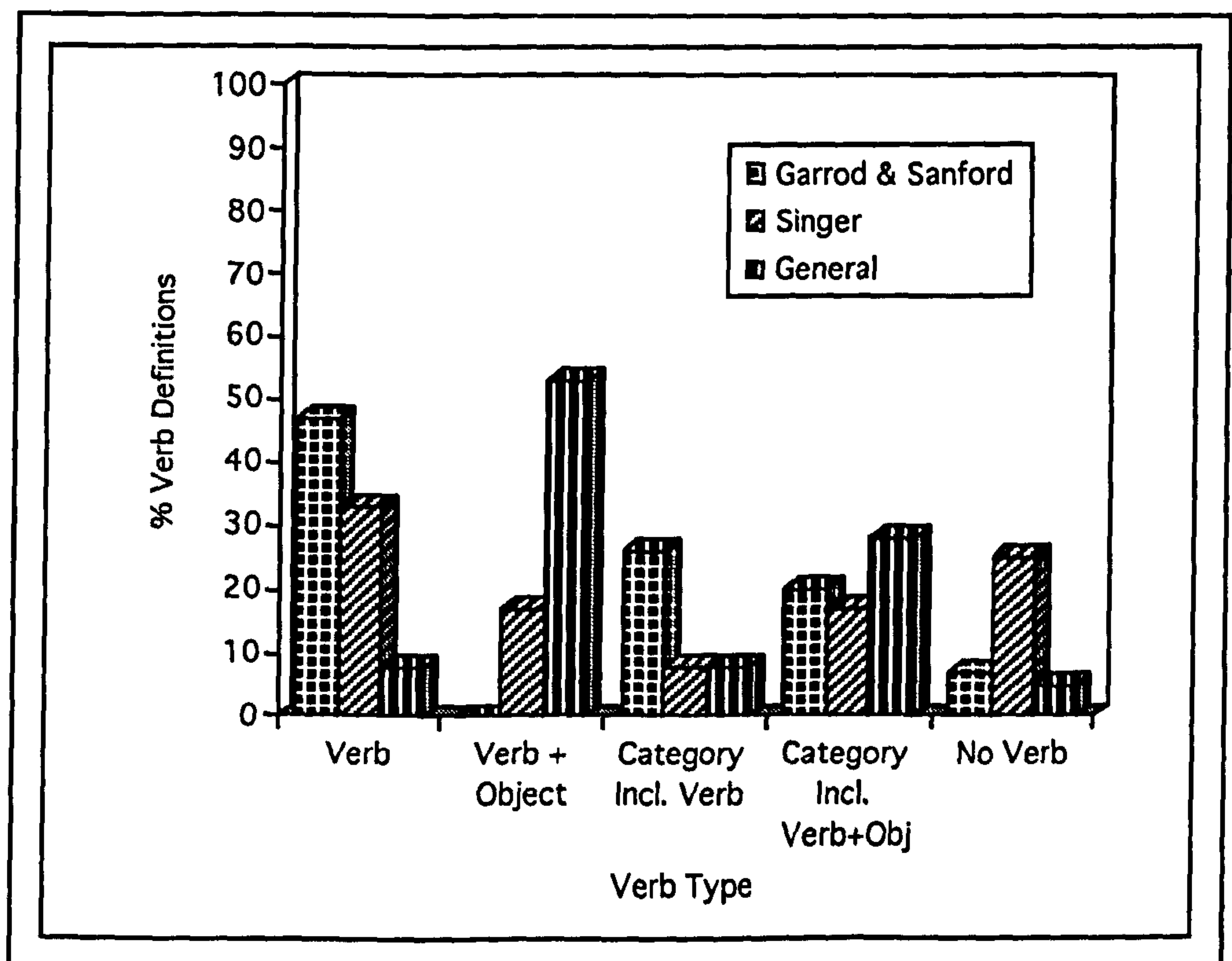


Fig. 7.2 Percentage of Verb Definitions by Verb Type, & Category Assigned

Statistical analysis revealed a significant effect of Verb Type and Category to which instrument assigns its associated verb: $X^2 = 20.09$, $df = 4$, $p < .01$.²

Further analysis revealed differences between the Verb sets with respect to which category the instrument would assign its associated verb. As expected, Instruments associated with General Verbs were more likely to cite a verb + object pair, than the verb alone, in their dictionary definition than either a Garrod & Sanford Instrument: $X^2 = 18.9875$, $df = 1$, $P = .0000$ or a Singer Instrument, $X^2 = 10.2958$, $df = 1$, $P < .002$. Surprisingly, there was no significant difference between Garrod & Sanford and Singer Instruments, although Garrod & Sanford Instruments do cite the Verb in their definition more often than Singer Instruments.

When analysis is extended to include categories that imply Verbs and Objects a similar pattern of results emerges. General-Verb-Instruments are more likely to cite a verb+object or category that includes an object than either a Singer Instrument: $X^2 = 23.7754$, $df = 1$, $p = .0000$, or a Garrod & Sanford Instrument: $X^2 = 18.3260$, $df = 1$, $p = .0000$. Again, there was no difference between instruments associated with Garrod & Sanford Verbs and those associated with Singer Verbs: $X^2 = .6629$, $df = 1$, $p = .4131$. This suggests that Garrod & Sanford and Singer Instruments are equally well associated with their Verb or Verb + object pair and that they can only be differentiated on the basis of forward association: extent to which the Verb implies the instrument. The results of the Instrument-Verb Dictionary Exercise suggest that Singer Instruments are least likely to mention their associated Verb in their dictionary entry, indicating that Singer Instruments are least associated with their verbs.

In summary, the difference between the Verb sets with respect to which category an Instrument would assign its Verb: Verb or Verb+Object, confirms the prediction that General-Verb-Instruments are more associated with a Verb + Object pair than a Verb alone. Surprisingly, there is no difference between Garrod & Sanford Instruments and Singer Instruments in their degree of association with either a Verb or a Verb+Object pair. This is unexpected, as Garrod & Sanford (1982) and Cotter (1984) suggested that the failure of Singer verbs to support Instrument Inferences was due to the fact that Singer Instruments were thought to be implied by action descriptions rather than the Verb alone. If they are implied by action descriptions it was thought that they

² Chi-square analyses were calculated on the actual frequency of data. Percentage scores are presented in Fig. 7. 2 for the sake of clarity and ease of comparison.

were more likely to be associated with a Verb+Object pair than a Verb. However, Garrod & Sanford (1982) examined forward association, not backward association; these results suggest that both the nature and the direction (backward or forward association) of the relationship must be considered. Overall, the results support the experimental predictions and suggest that General Instruments are highly associated with their Verb + Object pair and confirms the intuition that General Verbs and their Instruments are highly associated in their appropriate contexts.

7.3.3 Concluding Remarks on The Dictionary Exercise

The Verb-Instrument Dictionary Exercise distinguishes between Garrod & Sanford and Singer Verbs and the results are consistent with Cotter (1984). It seems that Garrod & Sanford Verbs strongly imply their instruments and the relationship between Garrod & Sanford Verbs and Instruments may be one of semantic relatedness. Interestingly, there was no difference between Singer and General Verbs, yet the experimental results (experiment 2) suggest that Singer Verbs are less likely to support the encoding of implicit instruments.

In contrast, the Instrument-Verb Dictionary Exercise does not distinguish between Garrod & Sanford and Singer Verbs, with their instruments being equally well associated. Hence, Verb-Instrument association may be a more reliable predictor of a Verb's ability to support the encoding of implicit instruments and the establishment of Instrument Discourse Roles that assist the creation of discourse coherence.

The Instrument-Verb Dictionary Exercise illustrates the importance of the relationship between an Instrument and either a Verb or a Verb+Object pair. As predicted, General Instruments were more associated with their Verb + Objects than the Verb alone, with the General Verb set having the highest degree of Instrument-Verb+Object association.

The results of the Instrument-Verb Dictionary Exercise also suggest that Singer Instruments are less associated with their Verbs than Garrod & Sanford or General Instruments. It is also interesting to note that the Verb-Instrument Dictionary Exercise revealed no difference between Singer and General Verbs, but the Instrument-Verb measure of association does. Suggesting that General and Singer Verbs are equally associated with their instruments, but that

General Instruments are more associated than Singer Instruments to their Verbs (have a higher degree of forward association). These subtle differences in the amount of forward and backward association may explain the discrepancy in the ability of these Verbs to support the encoding of implicit instruments.

In general, the results of the Dictionary Exercise suggest that the relationship between the Verb and its Instrument (forward association) especially for instruments associated with a Verb rather than a Verb + Objects pair, may be the best predictor of a Verbs' ability to establish instrument discourse roles. Although the results of the Dictionary Exercise are informative, before any definite conclusions can be drawn their Psychological validity has to be assessed. This was accomplished in a series of questionnaire tasks.

7.4 Questionnaire Tasks

7.4.1 An Improved Technique

The main objective of the questionnaire tasks was to validate the results of the Dictionary Exercise. Like the Dictionary Exercise, the Questionnaire Task was in two sections. Questionnaire One assessed the relationship between Verbs and Instruments (forward association). Questionnaire Two assessed the degree of association between Instruments and Verbs (backward association). Questionnaire tasks have been extensively used (Singer 1979; Cotter, 1984) in the selection of Verb-Instrument pairs for the empirical study of instrument inferences. However, the questionnaire described here differs in a number of important respects.

Firstly, the relationship between both Verbs and the Instruments they are thought to imply (Verb-Instrument) and the relationship between Instruments and their associated Verbs (Instrument-Verb) were examined. Previous studies have only examined the degree of forward association between Verbs and Instruments.

Secondly, the instructions given in these questionnaires differ from those generally used. The majority of researchers have assessed the degree to which a verb implies its instrument by using an instrument generation task (cf. questionnaire used in selection of Verbs in Experiments 3 & 4). However, explicitly asking for an Instrument to be provided may overestimate the degree to which the Instrument is associated with the Verb: it may increase the likelihood of the instrument being mentioned. Consequently, instrument generation tasks may not provide a true measure of the degree of association between Verb and Instruments because explicitly asking for an Instrument to be provided may inflate the likelihood that the Instrument is used for the task.

The third difference between the current questionnaire tasks and those previously used, is the inclusion of a Default Condition ("wash something"). This Default Condition was included as a means of assessing the relationship between the Verb and the Instrument that it is thought to imply regardless of context. Previous questionnaires provided a Verb phrase, "sweep the floor". However, as is the case with General verbs, the nature of the Instrument that can be used (and therefore possibly implied) can vary depending on the context in which the Verb is used. Consequently, Instrument generation data derived

from Verb Phrases may only provide information about the degree to which the verb may imply the Instrument in that particular context, and not provide an independent measure of whether the Verb would imply the Instrument regardless of context. The "default condition" is thought to be comparable to the Verb-Instrument Dictionary Exercise.

7.4.2 Questionnaire 1: Forward Association (Verb-Instrument Association)

The rationale was the same as that used in Verb-Instrument Dictionary Exercise; except that Subjects responses rather than Dictionary Definitions were used to assess Verb-Instrument relations.

Association was defined as the probability that an Instrument would be given in response to a Verb.

7.4.2.1 Method

7.4.2.1a Design & Procedure

There were three versions of the questionnaire (see Appendix Six). Each questionnaire contained a mixture of General, Singer and Garrod & Sanford Verbs. Each Verb could appear in either its normal context, or a Default context. For example, the verb "write" appeared in the following contexts: "write letter", "write on blackboard", or "write something" (default context). Each verb occurred only once within a given questionnaire.

As previously discussed, Subjects were not explicitly asked to provide an Instrument. Instead, they were instructed to "specify what you would need to carry out the listed actions".

7.2.2.1b Subjects

90 volunteer Subjects (30 on each version of the questionnaire), all undergraduates at the University of Glasgow, completed the questionnaires. There was no time limit imposed on completion, but questionnaires were generally completed in twenty minutes.

7.4.2.1c Results

The responses were classified with respect to whether Subjects stated the expected Instrument associated with a Verb. The percentage of subjects who mentioned the expected instrument for each verb, was calculated and is shown below (Table 7. 3).

Verb Type	Instrument Mentioned	No Instrument Mentioned
Garrod & Sanford	84%	26%
Singer	79%	31%
General	78%	32%

Table 7.3 Percentage of Subjects who Mentioned Expected Instrument
by Verb Type

A one way Analysis of Variance (Verb Type with 3 levels: Garrod & Sanford, Singer, and General) revealed a significant difference between the Verb Types in their ability to elicit instruments: $F(2,58) = 3.246$, $MSe = 110.009$, $p < .04$. Planned means comparisons revealed a significant difference between Garrod & Sanford and Singer Verbs $F(2, 58) = 4.025$, $MSe = 442.817$, $p < .05$. Suggesting that subjects are more likely to provide the expected instrument for a Garrod & Sanford Verb than a Singer Verb. Means comparisons also revealed that subjects were more likely to provide the expected instrument for a Garrod & Sanford Verb than a General Verb: $F(2, 58) = 5.585$, $MSe = 614.4$, $p < .03$. There was no difference between Singer & General Verbs, $F(2, 58) = .127$, $MSe = 14.017$, $p = .7224$. Suggesting that Subjects are equally likely to cite an Instrument associated with either a Singer or a General Verb.

To conclude, the results of the Verb-Instrument questionnaire suggest that a Garrod & Sanford Verb is most likely to imply its expected instrument. These results are consistent with those of the Dictionary Exercise. Also, like the Dictionary Exercise, the questionnaire measure of forward association indicates no difference in the degree of association between General and Singer Verbs with their Instruments.

7.4.3 Questionnaire 2: Backward Association

As outlined earlier, the degree of association between Instruments and the Verbs thought to imply them is not generally examined. However, given the results of the Dictionary Exercise the relationship was assessed using subject responses to Instruments, rather than dictionary definitions.

7.4.3.1 Method

7.4.3.1a Design and Procedure

The questionnaire contained the Instruments thought to be implied by Garrod & Sanford, Singer and General Verbs (see Appendix Seven). Subjects were asked to "list the possible uses for the listed items". It is important to note that subjects were not explicitly asked to provide a Verb.

7.4.3.1b Subjects

30 volunteer subjects, all undergraduates at the University of Glasgow, completed the questionnaires. There was no time limit imposed on completion, but questionnaires were generally completed within twenty minutes.

7.4.3.1c Results

The questionnaires were scored for the citation of the expected verb. The responses ("verb mentions") were allocated to the same categories as those used in the Instrument-Verb Dictionary Exercise, i.e., Verb Explicitly Mentioned, Category Including Verb, Verb+Object Mentioned, Category Including Verb + Object, and No Verb Mentioned.

Firstly, the results were examined to see if there was any effect of Verb Type, i.e., was an Instrument associated with any particular Verb Set more likely to mention its associated verb. Any differences would be assumed to reflect differences in the degree of association between Instruments and Verbs between the three verb sets. Remember that stating the verb is regarded as a

measure of association: if the verb is mentioned by a large number of subjects it is assumed to be highly associated. If it is not mentioned, then this is assumed to reflect a low degree of association between the Instrument and Verb.

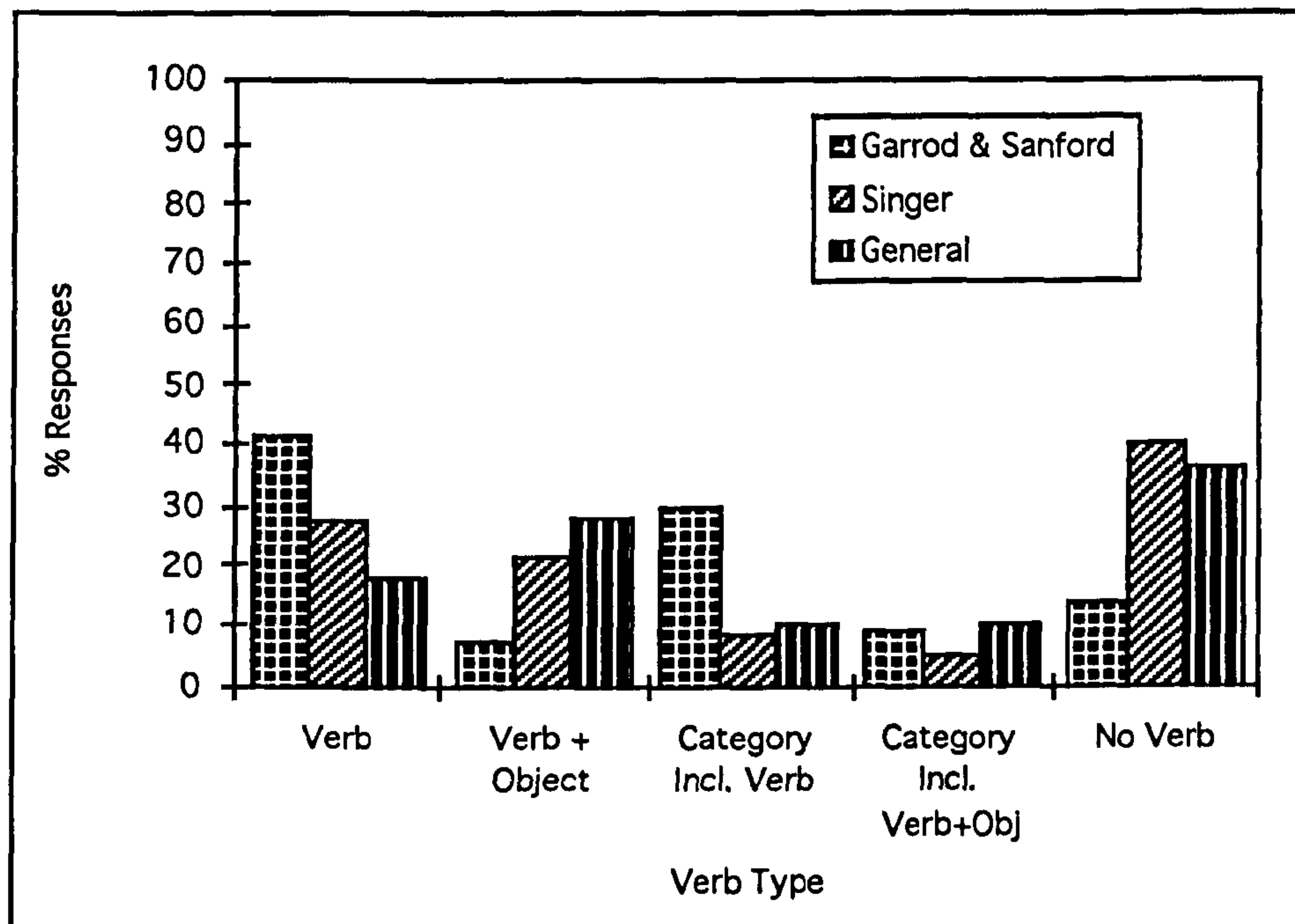


Fig. 7.3 Percentage of Subjects who mentioned Instrument in Response to Verb, by category assigned

A one way Analysis of Variance (Verb Type with 3 levels: Garrod & Sanford, Singer, and General) revealed a significant difference between the Instruments of the different Verb Types in their ability to elicit the associated verb: $F(2,58) = 60.847$, $MSe = 68.85$, $p < .01$. Planned means comparisons revealed that subjects stated a Garrod & Sanford Verb in response to a Garrod & Sanford Instrument significantly more often than they cited the expected Verb in response to either a Singer Instrument: $F(2,58) = 43.724$, $MSe = 3010.417$, $p < .0002$, or an Instrument associated with a General Verb: $F(2,58) = 119.974$, $MSe = 8260.267$, $p < .0002$. However, subjects produced Verbs associated with Singer Instruments more often than those associated with General Instruments: $F(2,58) = 18.843$, $MSe = 1297.350$, $p < .0002$.

These results suggest that Garrod & Sanford Instruments are more closely associated with their Verbs than either Singer or General Verbs. This finding is consistent with the results of the Instrument-Verb Dictionary Exercise.

However, examining the responses of the Verb alone may be misleading as this measure excludes categories that include or imply the verb, and instances where a Verb and its Object were mentioned together. Therefore, it is worthwhile checking if there are any differences in an instrument's ability to elicit the appropriate verb or category that includes a verb across the three Verb Sets. To do so, the responses were pooled across categories and assigned to one of two categories: Verb mentioned (includes category that implies verb, and category that included verb + object mentioned together) or No verb mentioned (see Table 7. 4)

Verb Type	Verb Mentioned	No Verb Mentioned
Garrod & Sanford	86 %	14 %
Singer	60 %	40 %
General	65 %	35 %

Table 7. 4 Percentage of Subjects who Mentioned Verb (or category including verb) in Response to Instrument

A one way Analysis of Variance (Verb Type with 3 levels: Garrod & Sanford, Singer, and General) calculated on the mean number of "verbs mentioned" revealed a significant difference between the Instruments of the different Verb Types: $F(2,58) = 73.98$, $MSe = 76.225$, $p < .01$.

Planned means comparisons revealed that subjects stated a Garrod & Sanford Verb in response to a Garrod & Sanford Instrument significantly more often than they cited the expected Verb in response to either a Singer Instrument: $F(2,58) = 128.63$, $MSe = 9804.817$, $p < .01$, or an Instrument associated with a General Verb: $F(2,58) = 89.84$, $MSe = 6848.017$, $p < .01$. However, subjects produced Verbs associated with "General Instruments" marginally more often than those associated with "Singer Instruments": $F(2,58) = 3.471$, $MSe = 264.6$, $p = .06$. Again, the data suggests that Garrod & Sanford Instruments are most highly associated with their Verbs. In addition, this results suggest that

General Instruments are more associated with their Verbs than Singer Instruments.

The results of the Instrument Dictionary Exercise indicated differences between the verb sets in their degree of Instrument-Verb+Object association. On the basis of these results it was predicted that General Verbs should be more associated with (therefore subjects more likely to mention) the Verb + Object pair rather than the Verb alone. In order to check this assumption, the number of Verb and Verb+Object responses were compared across the three sets of verbs (see Table 7. 5).

Verb Type	Verb	Verb + Object
Garrod & Sanford	41 %	7 %
Singer	27%	21 %
General	18 %	27 %

Table 7. 5 Percentage of Subjects who Mentioned Verb or Verb + Object in Response to Instrument

A 3 (Verb Type) x 2 (Mention Type: Verb or Verb + Object) revealed no overall effect of Verb Type ($F < 1$), a significant effect of Mention Type: $F(2,58) = 56.616$, $MSe = 85.418$, $p = .0001$ and a significant interaction between Verb Type and Mention Type: $F(2,58) = 75.799$, $MSe = 98.795$, $p = .0001$.

As expected, planned means comparisons revealed that subjects were more likely to cite the associated Verb alone rather than the Verb+Object pair in response to the Instrument associated with a Garrod & Sanford Verb: $F(2, 58) = 179.32$, $MSe = 17716.017$, $p = .0001$.

Planned means comparisons also support the intuition that General Instruments are associated with their Verb+Object pair rather than the Verb alone. A Verb+Object pair was more often cited in response to a General Instrument than the Verb alone: $F(2, 58) = 14.681$, $MSe = 1450.417$, $p = .0003$. General Instruments elicited more Verb+Object responses than Instruments associated with Singer Verbs: $F(2, 58) = 7.654$, $MSe = 756.15$, $p < .008$ or Garrod & Sanford Verbs, $F(2, 58) = 65.267$, $MSe = 6448.067$, $p < .0002$. However, Singer Instruments elicited more Verb+Object responses than instruments associated with Garrod & Sanford Verbs: $F(2, 58) = 28.22$, $MSe = 2788.017$, $p < .0002$.

Also in line with the results of the Dictionary Exercise, a Singer Instrument was more likely to produce the Verb alone than a Verb+Object pair:

$F(2, 58) = 6.547$, $MSe = 646.817$, $p < .02$.

The results of the Verb and Verb+Object comparisons suggest that the Instruments associated with General Verbs are most associated with a Verb + Object pair, than the instruments of Singer or Garrod & Sanford Verbs. It is important to remember that even though Garrod & Sanford Instruments have the lowest Verb+Object association, they have the highest level of association with the Verb alone. This data is consistent with the results of the Dictionary Exercise, in that General Verbs have the highest degree of association with a Verb + Object pair. In addition, the questionnaire results differentiate between Garrod & Sanford and Singer Verbs, the Dictionary Exercise did not.

The instructions of the questionnaire were rather open (didn't explicitly ask for a verb to be produced) and because subjects tend to answer questionnaires in note format, it is informative to pool across categories. The previous discussion referred to comparisons between Verb and Verb+Object. The following discussion includes categories that imply the Verb and categories that imply a Verb+Object in addition to explicit mentions of the Verb and Verb + Object. This means that the "all verb" category includes responses from the categories that explicitly mentioned verb and the category that implied verbs. The "all verb + object" category includes not only responses in the category "verb + object" but also the "category that includes Verb + object" (see initial coding of responses).

Verb Type	All Verb	All Verb + Object
Garrod & Sanford	70 %	16 %
Singer	35 %	27 %
General	28 %	37 %

Table 7. 6 Percentage of Subjects that Stated a Verb or a Verb object in Response to an Instrument

The relationship between Instruments and their associated Verbs or Verb-Object pairs was further investigated using a 3 (verb type) \times 2 (mention type: Verb+Cat or Verb+Obj/Cat+Obj) ANOVA. Analysis shows a significant main effect of Verb Type: $F(2, 29) = 83.019$, $MSe = 35.927$, $p = .0001$. A significant main effect of Mention Type (Verb or Verb+Obj): $F(1, 29) = 116.790$, $MSe = 135.058$, $p = .0001$, and a significant interaction between Verb Type and Mention Type: $F(2, 58) = 115.330$, $MSe = 136.112$, $p = .0001$.

As expected, planned means comparisons revealed that subjects were more likely to cite the associated Verb, rather than the Verb + Object pair, in response to the Instrument associated with a Garrod & Sanford Verb: $F(2, 58) = 327.33$, $MSe = 44553.75$, $p = .0001$.

Planned means comparisons also support the intuition that General Instruments are associated with their Verb+Object pair rather than the Verb alone. A Verb+Object pair was more often cited in response to a General Instrument than a Verb alone: $F(2, 58) = 7.9$, $MSe = 1075.267$, $p = .0067$.

General Instruments elicited more Verb + Object responses than Instruments associated with Singer Verbs, $F(2, 58) = 17.128$, $MSe = 2331.267$, $p = .0001$; or Garrod & Sanford Verbs, $F(2, 58) = 49.374$, $MSe = 6720.417$, $p = .0001$. However, Singer Instruments elicited more Verb + Object responses than instruments associated with Garrod & Sanford Verbs, $F(2, 58) = 8.341$, $MSe = 1135.35$, $p = .0054$. Despite this, a Singer Instrument was more likely to produce the Verb alone than a Verb + Object pair: $F(2, 58) = 11.316$, $MSe = 1540.267$, $p = .0014$.

The results of the Instrument-Verb Questionnaire task indicate, as expected, that Garrod and Sanford Instruments are most closely associated with their Verbs than either Singer or General Instruments. It also confirmed the intuition that Instruments associated with General Verbs are most closely associated with a Verb + Object pair than Instruments from the other two Verb sets.

It is also interesting to note that the Instrument-Verb Questionnaire differentiates between Garrod & Sanford Verbs and Singer Verbs in that in line with Garrod & Sanford (1982) discussion, Singer Instruments elicit more Verb+Object responses suggesting they are more associated with a Verb+Object pair than a Verb. Such a difference, in conjunction with their generally low

level of forward association may explain the discrepancies in the experimental results.

7.4.4 Concluding Remarks on the Questionnaire Tasks

The Verb-Instrument Questionnaire Task results are consistent with those of the Verb-Instrument Dictionary Exercise in showing that Garrod & Sanford Verbs have the highest degree of Verb-Instrument association. These Verbs and Instruments are most likely to be semantically related in addition to their high degree of association.

The Instrument-Verb Questionnaire indicates, like the Dictionary Exercise, that Garrod & Sanford Instruments are more closely associated with their Verbs than either Singer or General Instruments; and that General Instruments appear more closely associated to their Verbs than Singer Instruments. In total, the results suggest that Garrod & Sanford Instruments are most closely associated with their Verbs alone than either Singer or General Instruments.

In addition the Instrument-Verb Questionnaire provides some interesting information about the relationship between Instruments and Verbs or Verb + Object pairs. As expected, General Instruments show the highest degree of association with Verb + Objects, followed by Singer Instruments, with Garrod and Sanford Instruments being least associated with a Verb + Object pair. These results are consistent with Garrod & Sanford observation that Singer Instruments are implied by action descriptions (Verb + Object) rather than Verbs; and Garrod & Sanford Instruments being implied by Verbs. So although General Instruments show a relatively low degree of association with a Verb, they are highly associated with a Verb+Object pair.

The questionnaire tasks have an advantage over the Dictionary Exercise in that they address the issues of general subject variability and differences in general knowledge. Both these factors influence experimental tasks that explore the encoding of implicit instruments. Despite this, it is reassuring to note that the results from both the Dictionary Exercise and the questionnaire tasks are comparable.

7.5 The Contribution of Associative Information

The results of both the Dictionary Exercise and the Questionnaire Tasks suggest that the relationship between a Verb and its instrument (forward association) is the best predictor of a verb's ability to support the encoding of implicit Instruments and the establishment of Instrument Discourse Roles.

Whether this relationship is between the Verb alone or a Verb + Object pair is also important. The results of the Instrument-Verb questionnaire suggest that if the instrument is implied by a Verb + Object pair there must be high degree of association between the Verb + Object pair and the Instrument. The low degree of association for Singer Verbs both with Verbs and Verb + Object pairs may explain their failure to support instrument inferencing and establish Instrument Discourse Roles to support subsequent reference. The question is whether this associative information is semantic (lexically-based) or simply due to word association (co-occurrence). There is no simple answer, as the nature of verb argument relations means that there is a high degree of association between the Verb and the implied Instrument. However, the results suggest that if the association is low then it is unlikely that the Verb will imply the Instrument.

The results of the "default condition" of the Verb-Instrument questionnaire are interesting in that they seem to support the idea that the relationship may be more than simple association, it may be one of semantic relatedness and suggests that lexically based information may play a crucial role. Subjects were more likely to produce the Instrument thought to be implied by a Garrod and Sanford Verb when it was presented in its default context than either a Singer or General Verb. These result are consistent with Cotter's predictions that Instruments are semantically related to Garrod and Sanford Verbs. The default condition also produced some interesting results with respect to Singer and General Verbs. It seems that subjects have a preferred/default instrument for each Verb, and that the Instrument thought to be implied by Singer Verbs was not always the default Instrument associated with the verb.

The results from the "default instrument condition" were most striking for General Verbs. For example, subjects seem to prefer "pen" as the default instrument for the verb "write", yet "chalk" would frequently be produced as the instrument implied by the Verb + Object pair "write on a blackboard". The existence of a possible preferred instrument has important implications for the

encoding of implicit instruments. A Verb's preference for a default instrument only became apparent because the "default condition" was included in the Questionnaire task. Without the inclusion of the default condition it would have been, and frequently has through the use of Verb phrases to assess the relationship between Verbs and Instruments, that "chalk" and "Pen" are equally likely to be inferred when "write letter" and "write on the blackboard" are read.

The existence of a preferred Instrument highlights the important contribution of lexically-based information to comprehension. The availability of such information is consistent with the priming data discussed earlier. The empirical data suggests that information about functional properties and relations become available when the word is accessed (Moss et al., 1995). If this is so, then information about instruments should become available when the Verb is accessed. Since this information will initially be connected with the Verb; it is likely that information about the preferred (default instrument, regardless of context) instrument will become available. If such information is available it seems plausible to assume that it will assist comprehension. The contribution of Verb-based default information to comprehension is empirically assessed in the following chapter.

Chapter Eight

Lexical and Contextual Factors in the Establishment
of Instrument Discourse Roles

8.1 The Contribution of Lexical and Contextual Information

Discourse Roles may be established in two ways: either by a verb that identifies a stereotypical situation that supports the role or, more generally, from the stereotypical situation described in the text (Sanford & Garrod, 1981). The general contribution of verb-based and contextual information to the establishment of Instrument Discourse Roles was empirically assessed in Chapters Five and Six, respectively. The question remains as to which source of information is most important in the establishment of Instrument Discourse Roles. Can Instrument Discourse Roles be established by both Lexical and Contextual factors? The results of the questionnaire tasks suggest that lexical default information about Instruments may be the determining factor in the encoding of Instrument Discourse Roles. The experiment reported in this Chapter was designed to assess the relative contribution of Lexical and Contextual information to the establishment of Instrument Discourse Roles.

8.1.1 The Contribution of Lexical Information

Cotter (1984) attributed the ability to establish Instrument Discourse Roles to the lexical structure of the verb (cf. Chapter 5). Initially, such an explanation does not seem applicable to "general verbs" where instruments appear context dependent. However, the differential ability of context (cf. Chapter 6) to support the establishment of Instrument Roles suggests that lexically-based information may make an important contribution to the encoding of Instrument Roles associated with General Verbs. The importance of lexical information, specifically the degree of semantic association and semantic relatedness between verbs and instruments is illustrated by the Questionnaire Task and Dictionary Exercise.

The results of the questionnaire task suggest that General Verbs have a preference for one particular verb-instrument pairing over another. For example, "pen" was more often associated with "writing a letter", than "chalk" for "writing on a blackboard". In fact, the verb may have a preference for a particular instrument, a default instrument, regardless of context. In this example, "pen" would be the preferred (default) instrument for the general verb "write". Thus, contrary to previous assumptions, a restrictive context may not be sufficient to establish an Instrument Discourse Role as there may

be some degree of lexical influence that biases the verb to prefer one instrument over another i.e., the verb "write" may initially prefer the instrument "pen", rather than "chalk", regardless of context. However, context has been shown to play some role (cf. Chapter 6) in the creation of Instrument Roles. Therefore we must ask if this default preference is open to contextual influence; and if so, when and how are these contextual effects realised.

8.1.2 The Contribution of Context

There are numerous reasons why context may make an important contribution to the establishment of Instrument Discourse Roles. Firstly, context plays an important role in comprehension generally (Bartlett, 1932; Dooling & Lachman, 1971). More specifically, Garrod & Sanford (1983) demonstrated how a stereotypical context can establish discourse roles that assist the process of reference resolution. Secondly, the empirical data (Lucas et al., 1990) suggests that context is a crucial factor in the encoding of instrument inferences. Since the encoding of implicit instruments is sensitive to contextual factors, then the establishment of Instrument Discourse Roles is expected to be open to contextual influence.

The contribution of context to the encoding of Instruments was empirically assessed in Chapter Six. The results of Experiments Three and Four indicate that a consistent context can facilitate the integration of a reference to an instrument with an implicitly introduced antecedent via an Instrument Discourse Role. However, the results of Experiments One and Two illustrate the important contribution of verb-based information to the process. Taken together with the results of the Questionnaire tasks and the Dictionary Exercise, it appears that lexically-based information may make the strongest contribution to the establishment of Instrument Discourse Roles.

Empirical studies of the influence of context generally differentiate between Local and Global context. It is interesting to note that information regarded as being verb-based throughout this Thesis has often been termed Local Context.

8.1.2.1 Local and Global Context

Although it is widely acknowledged that the time taken to respond to a word embedded in continuous text is strongly influenced by the context preceding the word, with the decrease in response time being assumed to reflect contextual facilitation for the processing of the word. There is less agreement as to the source of this facilitation.

Contextual facilitation during reading may be derived from various sources. It may occur at the lexical level by facilitation of identification processes, or at the discourse level by facilitating the integration of the word into the discourse representation, or both. In general, lexical level facilitation is thought to be derived from local context and facilitated integration from global context (higher level, discourse influences). In short, it is assumed that local (lexical) and global context (discourse) produce facilitation at different levels and by different mechanisms.

Although it is agreed that both local and global context can influence lexical processing, and that it is highly likely that this influence will be exerted by different mechanisms; there is less agreement as to which source of facilitation is the most important. Two experiments which explore the relative impact of local and global context on lexical processing and integration are reviewed below. They were chosen because of their methodological rigour, the contextual factors they explore, and because they come to conflicting conclusions regarding the source of contextual facilitation.

Schustack, Ehrlich, & Rayner (1987) suggest that contextual facilitation during reading may be derived from two sources and that these sources produce facilitation by different routes. Schustack et al. claim that in normal reading there is a lexical, spreading activation process that acts early, is automatic, and affects word recognition. In addition, there is a later, more global process that affects the speed of integration. These two processes are thought to be independent. Using a multiple task approach (naming, eye tracking and sentence completion) assumed to tap different components of processing, they explored the relative influence and way in which local and global aspects of context facilitate processing.

Schustack et al. manipulated both local and global aspects of context. Local context was defined as "lexical aspects of context". A high level of semantic

relatedness to a closely preceding word has been shown to facilitate word recognition. For instance, the lexical decision time for "butter" is faster following "bread" than following an unrelated word (Meyer, Schvaneveldt & Ruddy, 1975). This local aspect of context was defined "as the degree of semantic restriction imposed by the verb". For example, whether the verb was general and could take a large set of possible objects including the target noun or whether the verb was more restrictive, with strong semantic constraints favouring the target word, especially within the context of the rest of the passage. For example, the verb "make" was considered general in relation to the target noun "cake". In contrast, the verb "bake" was considered restrictive with respect to "cake".

Schustack et al. also explored the influence of more global aspects of context. For them, global context refers to structural aspects of the discourse such as the recency of prior mention of a word. Global context was manipulated by varying the distance between a previous mention of the target word and the target word. The previous mention could either occur in the second or third sentence, with the target word always occurring in the fourth sentence. The results suggest that a prior mention of the target word within the discourse speeds reading by allowing faster integration of the target into the discourse representation rather than speeding the lexical level identification of the word. Global contextual facilitation appears to be realised at the discourse rather than the lexical level.

The results of the Naming task, where integration of the target word is not required by the task, suggest that only local context (degree of semantic constraint from the verb) facilitates processing and propose that such facilitation comes from facilitation at the lexical level (word identification). In contrast, the results of the eye tracking task, which requires both identification and integration, indicate that both local and global aspects of context (constraints from the verb and recency of the prior mention) influence processing of the target word. Consequently, Schustack et al. proposed two separate sources of facilitation. Local lexical information initially assists the process of word identification (only local context influences naming) but if the task requires integration, as does the eye tracking task, this integration process can be facilitated by both local and global factors (an earlier mentioned word is available in the discourse representation and can assist the integration of the target). It is important to note that local and global context influence processing in different ways. Local context (lexical information) influences

processing at the lexical level by assisting identification, whereas global context facilitates integration of the word at the discourse level.

Hess, Foss & Carroll (1995) also explored the impact of Global and Local context on lexical processing. In contrast to Schustack et al. (1987) who proposed two different types of contextual facilitation, Hess et al. (1995) propose that the major and perhaps sole source of context effects is the relationship between the lexical item and its global or discourse context. Supportive evidence for the primary contribution of global context comes from the work of Foss & Ross (1983) and Foss & Speer (1991). They assume that context effects are the product of facilitated integration of the target word into the discourse representation. In this view, the locus of context effects is primarily outside of the lexicon, in processes that determine semantic relationships among incoming words and the discourse representation.

Foss & Ross (1983) manipulated the relationship between a critical word and the general topic of the discourse which they termed Global Context. For example, if the critical word was "surfboard", the context is globally related when the setting is "at the beach", and globally unrelated when the setting is "an airport runway". They also manipulated whether the word prior to the critical word, the Local Context, was related or unrelated. For instance, if "surfboard" is the critical word, the local context is related when the previous word is "surfer's", and unrelated if the word is "pilot's". Subjects performed the phoneme monitoring task for the initial phoneme in the word following the critical word. The results indicate that processing of the critical word is not always speeded when it is immediately preceded by a related word, although such an effect would be predicted by a lexical priming account. When the global context is unrelated no priming was found for the local related case (surfer's surfboard) relative to the local unrelated case (pilot's surfboard). The most important finding is that facilitation of the critical word depends on its relationship with the global context. In fact, Foss & Speer (1991) found that when the global context is related to the target word, there was no difference between the local related and local unrelated conditions. These results were interpreted as showing that discourse models best account for context effects and as evidence against proposals that ascribe the effect to local processes (local context) such as intralexical spreading activation.

Hess, Foss & Carroll (1995) in series of experiments provide further evidence that local associative factors (local context) are not the main source of context effects. Specifically global topic and not the immediately preceding word (local context) determines the processing time for a word. By using a naming task (which is thought to reflect the operation of processes that have their effects very early in lexical processing) Hess et al. (1995) correct for methodological flaws in the earlier work of Foss & Ross (1983) and Foss & Speer (1991). Their results are open to question on methodological grounds: they used phoneme monitoring, with the target phoneme occurring on the word-initial phoneme after the critical word. It is possible that there was enough time for post-lexical processes to influence phoneme-monitoring performance. If this is the case, then the task may not have been sensitive enough to pick up priming due to spreading activation from local context because it was overwhelmed by discourse factors.

Hess et al. (1995) manipulated the overall topic or global context: it was either related or unrelated to the target word. Secondly the final phrase, called the local context, contained words that were either associatively related or unrelated to the target word. The local contexts were constructed such that the combination of the agent and verb either predicted (local related) or did not predict (local unrelated) the target word (see Table 8. 1).

Global-related-local-related

The English major met a woman who he was very fond of. He had admired her for a while but wasn't sure how to express himself. He always got nervous when trying to express himself verbally so *the English major wrote the poem.*

Global-related-local-unrelated

The computer science major met a woman who he was very fond of. He had admired her for a while but wasn't sure how to express himself. He always got nervous when trying to express himself verbally so *the computer science major wrote the poem.*

Global-unrelated-local-related

The English major was taking a computer science class that she was struggling with. There was a big project that was due at the end of the semester which she had been putting off doing. Finally, last weekend *the English major wrote the poem.*

Global-unrelated-local-unrelated

The computer science major had a lot of projects to do before the end of the semester and was worried whether or not she would be able to finish all of them. She decided to take care of one thing at a time. For starters, last weekend *the computer science major wrote the poem.*

Control

In this experiment you must name the last word of each passage. For this passage the last word is *poem.*

Neutral

The boy listened to the *poem.*

The alternative completion is "program". Local context appears in italics.

Table 8.1 Example of Materials Used by Hess et al. (1995).

The results of Hess et al. indicate that local context makes no contribution to contextual facilitation, unless the local context is consistent with the global context. The results are all the more surprising given the nature of their methodology: they used naming which is assumed to reflect early processing,

therefore most likely to reflect local based lexical effects. Their results suggest that global context has a rapid effect on naming and processing the target word. Therefore, they conclude that "the sole determinant of the immediate facilitation effect is the target word's relationship to the ongoing discourse representation (Hess, Foss, & Carroll, 1995, P. 77).

The conflicting results of Schustack et al. (1987) and Hess et al. (1995) are interesting as they highlight different sources of contextual facilitation, their time course, and the relative impact that local and global context have on processing. Schustack et al. found that global context assisted integration. However, their definition of global context (recency of prior mention of target word) differs from the global context used by Hess et al. (1995) where relatedness was determined with respect to discourse topic. In addition, Hess et al. found evidence for the facilitative effect of global context using a naming task which does not require integration but is thought to reflect early lexical processing. It is interesting to note that Hess et al. found evidence for the use of local context when the sentences were presented alone but not when they were included in a discourse context. Hess et al. regard this as illustrating the importance of global context, with global context overriding local context. Recall that in the discourse context, local context only had an effect if it was consistent with the global context.

Since both local and global contextual factors have been shown to influence processing, it is important to explore the influence of local and global context on the encoding of implicit instruments and Instrument Discourse Roles.

8.1.2.2 Local and Global Context and Instrument Discourse Roles

Both lexical and contextual factors influence the instruments associated with verbs. Consider the verb "write", in the context of "writing a letter" the most likely instrument is "pen". However in the context of "writing on a blackboard" the most likely instrument is "chalk". The question is whether verb-based or context-based information, is responsible for determining the instrument. To illustrate this point assume that the default instrument associated with the verb "write" is "pen". If the verb is used in a consistent context, "write letter" then there is no conflict between the contextual and lexical default values. However, if the verb is used in the context "write on

blackboard" then the contextual and lexical default values conflict: "chalk" rather than "pen".

The experimental results reported in this Chapter indicate that if the lexical based default information is consistent with the contextual default then the instrument is more rapidly integrated compared to examples where there is a conflict between lexical and contextual information. In addition, the results suggest that the preferred instrument of a verb (the value thought to be the basic verb schema default instrument) is initially preferred (first pass effect) until contextual information shows it to be inappropriate. These results suggest that lexical default information is rapidly available and assists the processing of a reference to the instrument before contextually appropriate information. Suggesting that local context in the form of strong semantic constraints from the verb are initially more important than the global context. A finding at odds with the results of Hess et al. (1995).

The influence of verb-based constraints is consistent with the work of Schustack et al. (1987) who manipulated local context by varying the degree of semantic constraint imposed by the verb ("make"/"bake" - "cake"). However, unlike Schustack, it is proposed that this verb-based information can assist integration by establishing Discourse Roles that assist resolution of a subsequent reference. The ability of verb-based constraints to assist processing is consistent with the work of Schustack et al. (1987), but differs in that the verb is not presented immediately preceding the target word. Instead, the verb is presented earlier in the discourse and its influence exercised through the Roles it establishes in the discourse representation.

The ability of high associates to prime is well established (Meyer & Schvaneveldt, 1976) and has influenced the selection procedures used in this Thesis. In addition, the results of Experiment Two and those of McKoon & Ratcliff (1981) demonstrate that Verbs and Instruments with low association do not support the encoding of implicit instruments. The proposal being tested is whether highly associated lexically-based information concerning instruments (default information) is rapidly available, regardless of context, and assists discourse integration by facilitating the resolution of a reference to the default instrument.

8.2 Lexical Default Information

8.2.1 Evidence of a Preferred Instrument

As outlined earlier, the questionnaire tasks discussed in Chapter 7 indicate that General Verbs have a preferred instrument. This preference is apparent in the "default condition" of the Verb-Instrument questionnaire task. On the basis of these results, Verb-Instrument pairs are classified as being Dominant or Non-Dominant. The Verb-Instrument pair that obtained the highest score on the Verb-Instrument questionnaire was regarded as having the highest degree of Verb-to-Instrument association and hence, the Verb's Dominant (preferred) Instrument.

The Verb-Instrument Questionnaire results were used as the basis for classification for two reasons. Firstly, the Verb-Instrument Questionnaire is assumed to provide a valid indication of verb-instrument relations because subjects were not directly asked to provide an instrument. Most previous attempts to assess verb-instrument relations, specifically asked subjects to name an instrument. However, explicitly asking for an instrument may provide an inflated measure of how well the verb implies the instrument. Secondly, the "Default Condition" of the Verb-Instrument questionnaire allows us to assess whether the verb has a default instrument. It gives an indication of the instrument that is most closely associated with the verb (indicates verb-instrument relations regardless of context) and which use of the verb is most stereotypical. As we shall see, the verb-instrument pair that was selected as being dominant is consistent with the instrument produced in response to the "default context".

The proposal that verbs may have a preferred instrument, and that this information influences the processing of a reference to the instrument is consistent with a range of data from the literature on lexical priming. Barsalou (1982) demonstrated that a full range of information or at least the typical or context independent (default) information associated with the word becomes available when the word is encountered. In addition, Moss et al. (1995) demonstrated that functional information becomes available when a word is recognised. If this is so, then information about instruments should become available when the Verb is accessed. It is likely that information about a verb's preferred (default) instrument will become available regardless of

context. If such information is available, it seems plausible to assume that it will assist discourse processing.

8.2.2 Dominant and Non-Dominant Assignment Procedure

General Verbs and their associated Instruments were classified as being Dominant or Non-Dominant on the basis of the Verb-Instrument Questionnaire and the "Default Condition" results. When classifying default instruments, and responses in general, body-part instruments were ignored. Body-part instruments were not used as they may behave differently from tool-instruments. This possibility was examined by Doshier & Corbett (1982) who suggested that body-part instruments may behave differently because body-parts are generally properties of the agent (hands, feet, eyes, etc.) not of the verb or the action described by the verb.

The Verb+Object pair that received the highest percentage of subject responses was regarded as the dominant use (most highly associated pair). This high degree of verb-instrument association was thought to be necessary if the verb was to imply its instrument in a discourse context. Although a distinction is made between these verb-instrument pairs; it should be remembered that even the Non-Dominant verb-instrument pairs were highly associated: cited by at least 60% of subjects on both questionnaire tasks and fulfilled the requirements of the Dictionary Exercise.

To illustrate the allocation procedure consider the responses to the verb "carve":

Carve Meat - Knife 94% (Dominant).

Carve Stone - Chisel 64% (Non-dominant).

Carve Something - Knife was the most frequently cited response: 74%.

Chisel only cited in 36% of the responses.

The higher score is assumed to reflect a higher degree of association between the verb and that particular instrument. An interesting point to note is the relationship between the Dominant Verb-Instrument pair and the response given to the default condition ("carve something"). In general, with the

exception of cases that produced a body-part as opposed to a tool-instrument, the Dominant Instrument was also the Instrument cited in response to the default use of the verb.

A T-test calculated on the means (Table 8. 2) of the Verb-Instrument Questionnaire responses for the verbs revealed a significant difference between the responses given to Dominant and Non-Dominant Verbs:

$t(1,11) = 4.244, p < .01$; indicating that subjects were more likely to cite the instrument associated with the Dominant use of the Verb, than the Instrument associated with its Non-Dominant use.

VERB TYPE	MEAN	S. E.
Dominant	91.217	2.731
Non-Dominant	78.392	4.367

Table 8. 2 Mean Number of Expected Instruments Produced in Response to Dominant and Non-Dominant Uses of Verbs

These results are surprising, as it was initially assumed that both contexts were equivalent, and that the verbs were equally well associated with the instrument in that context. However, the results are consistent with the data from Experiment three which suggested that context can differentially support the encoding of implicit instruments. In order to assess this explanation, the data from Experiment 3 was re-analysed in an attempt to evaluate whether a possible lexical preference for a particular instrument could explain the results. Recall that the results of the Experiment 3 suggested that there may be a context difference between the verbs and that the context in which the verb appears seems to influence the encoding of the instrument. However, there was no principled allocation to context that could explain the results. In the data reported below, the Verb-Instrument pairs used in Experiment 3 were assigned as Dominant (preferred) or Non-Dominant (non-preferred).

8.2.3 Re-analysis of Experiment 3

8.2.3.1 Dominant Context Results

Condition	FP Reading Time (S. E)	Total Time (S. E)
Explicit Anaphoric	31.347 (2.936)	36.673 (3.078)
Explicit Non-Anaphoric	32.787 (3.415)	51.074 (4.578)
Implicit Anaphoric	31.997 (3.398)	39.932 (3.930)
Implicit Non-Anaphoric	28.737 (2.745)	41.919 (4.418)

Table 8.3 Reading Time Data for Target Instrument in Dominant Context

Statistical analysis on the First-pass subject and item³ reading time means revealed no significant main effects or interactions.

A 2 (explicitness) \times 2 (anaphoricness) repeated measures ANOVA calculated on Total Subject and Item reading time means revealed a significant main effects of anaphoricness: $F_1(1,23) = 7.932, p < .01, MSe = 203.170$; $F_2(1,13) = 3.26, p = 0.9, MSe = 244.493$. There was no other significant main effect (explicitness: both $F_s < 1$) or interaction ($F_1(1,23) = 1.726, p = .2019, MSe = 535.739$; $F_2(1,13) = 1.648, p = .2217, MSe = 307.391$).

The results for the Dominant Verb-Instrument pair show no effect of explicitness, suggesting that there is no advantage in having an explicitly introduced antecedent for a Verb's Dominant instrument.

³ Six verbs: carry, play, fill, spread, listen and take, previously used in Experiment 3 were excluded from the reanalysis as they failed to meet the selection criteria (60%) of the questionnaire tasks reported in Chapter Seven.

8.2.3.2 Non-Dominant Context Results

Condition	FP Reading Time (S. E)	Total Time (S. E)
Explicit Anaphoric	26.885 (2.649)	35.367 (3.539)
Explicit Non-Anaphoric	25.548 (3.092)	41.675 (4.137)
Implicit Anaphoric	29.345 (3.094)	42.354 (3.802)
Implicit Non-Anaphoric	31.587 (2.106)	46.010 (3.507)

Table 8.4 Reading Time Data for Target Instrument in Non-Dominant Context

Analysis (2 x 2 repeated measures ANOVA) of the First Pass reading time data revealed a marginally significant main effect for explicitness by subjects, $F_1(1,23) = 3.470, p < .08, MSe = 124.891$; and a significant explicitness effect by items $F_2(1,13) = 8.045, p < .02, MSe = 51.030$. There was no other significant main effect or interaction.

Statistical analysis of the Total Reading Time data revealed significant main effects for explicitness: $F_1(1,23) = 2.945, p = .09, MSe = 261.158$; $F_2(1,13) = 5.696, p < .04, MSe = 92.665$, and anaphoricness: $F_1(1,23) = 3.481, p < 0.7, MSe = 171.148$; $F_2(1,13) = 1.386, p = .2603, MSe = 211.30$, and a non-significant interaction (both $F_s < 1$).

The reading time data for Non-Dominant Target Instruments shows a significant explicitness effect, suggesting that readers experience difficulty integrating a reference to a Non-Dominant Instrument with an implicitly introduced antecedent.

The re-analysis data clearly illustrates differences in the behaviour of Dominant and Non-Dominant Verb-Instrument pairs. The most important difference is the significant explicitness effect for Non-Dominant Target Instruments; with a reference to an implicitly introduced instrument receiving a longer reading time than a reference with an explicit antecedent. Suggesting that an Instrument Discourse Role is not available to assist

integration. Unfortunately, the re-analysis data does not allow us to distinguish between lexical and contextual factors. Is a verb's preference for a particular instrument the determining factor in the establishment of Instrument Discourse Roles, i.e. will the "default" instrument always be preferred even if it is inconsistent with respect to the context? This issue is assessed in Experiment Five. Before discussing this empirical work it is important to consider how verb-based default information about instruments can assist the process of reference resolution and contribute to the establishment of discourse coherence.

8.3 Lexical Default Information and Discourse Integration

8.3.1 Referential Processing: Bonding and Resolution

Sanford & Garrod (1989) regard reference resolution as a two stage process and distinguish between anaphor bonding and anaphor resolution. They suggest that anaphors may immediately set up "bonds" with potential antecedents without necessarily forcing commitment to referential resolution at that stage in processing. Their proposal is motivated by the phenomena of "false bonding" (also known as the "sounds-like effect"; Sanford, 1985). Consider example 1 below,

- (1) SAILING TO IRELAND WAS EVENTFUL FOR HARRY.
IT SANK WITHOUT TRACE.

The second sentence sounds odd with the pronoun ("it") even though a potential referent ("boat") is easily inferred from the context. There is a compelling impression ("sounds-like effect") that it was Ireland that sank without trace, even though this is ruled out in the final interpretation.

The empirical data (Sanford, Garrod, Lucas & Henderson, 1983) indicates that sentences, like 1 above, which permit false bonding receive longer reading times than sentences in which bonding is ruled out by gender and number cues (example 2), therefore no false bonding occurs.

- (2) BEING ARRESTED WAS EMBARRASSING FOR ANDY.
THEY TOOK HIM TO THE STATION IN A VAN.

Sanford & Garrod (1989) proposed that a sentence may be bonding enabling if there is a suitably foregrounded element which can serve as a false antecedent for a pronoun, by virtue of a match in number and gender. Now it might be supposed that (1) creates a problem compared to (2) because there is an incorrect but immediate resolution of the pronoun "it", constituting a semantic garden path. However, there is no such problem with

- (3) SAILING TO IRELAND WAS EVENTFUL FOR JIM.
IT WAS A REALLY WINDY DAY.

To account for the difference between (1) & (3) the distinction between resolution and bonding was proposed. In order to explain the "sounds-like effect" in (1) we have to assume that the possibility of co-reference was entertained at some point. Since there is no such an effect with sentences such as (3), immediate false reference resolution is ruled out. On encountering the pronoun, and in most examples even later, the processor has no way of knowing that (1) and (3) are different syntactic and semantic forms. Therefore, it is proposed that "bonding" occurs when a pronoun is encountered that has a suitable (but possibly false) antecedent. The "bond" simply associates the pronoun with the antecedent word, without assigning any specific semantic relation to the association, hence the term bond. If the predicate indicates that the pronoun is being used co-referentially, as in example (1), the association is tested as a probable site for instantiation of the anaphor. If it is not being used co-referentially, as in example (3), then further processing of the bond does not occur. It is only in the first instance, where the bond is checked, that the "sounds-like effect" (false bonding) occurs. In general, where an anaphoric relation is intended, bonding will facilitate the process of resolution by providing early identification of the antecedent.

8.3.2 Verb and Instrument Bonding

Recall that Bonding is best regarded as a low level automatic matching process which highlights a possible anaphor-antecedent link without committing the processor to any particular semantic interpretation at that point. In contrast, reference resolution is the process of incorporating a particular semantic interpretation of the anaphor into the semantic representation of the sentence. In processing terms, bonding amounts to locating where in the representation relevant information may be found, whereas, resolution involves

commitment to one particular interpretation at that point in the process. As outlined earlier, the two stage process of reference resolution was initially proposed to explain the false-bonding ("sounds-like effect") associated with pronouns. However, this two stage process, specifically the concept of bonding may explain why Dominant Target Instruments are integrated faster than Non-Dominant Target Instruments.

First consider how bonding applies to pronoun resolution in sentences containing Instrumental Verbs.

(4) KEITH DROVE TO LONDON₁ LAST WEEK.
IT₁ WAS A BEAUTIFUL CITY.

(5) KEITH DROVE TO LONDON₁ LAST WEEK.
* IT₁ KEPT BREAKING DOWN.

(6) KEITH DROVE TO LONDON LAST WEEK.
IT WAS A BEAUTIFUL DAY.

In examples 4 and 5, it appears that the pronoun initially bonds onto "London" as a potential antecedent but whether the bond is actually cashed in depends on what happens later in the sentence. In example 4 the pronoun bonds with "London", the appropriate antecedent. In example 5, the pronoun also bonds with "London", but the bond is false ("sounds like effect"). In example 6, there is no false bonding as the pronoun is not being used co-referentially.

8.3.3 Bonding and Discourse Roles

Since Discourse Roles can function as antecedents, they should allow bonding.

(7) KEITH DROVE TO LONDON LAST WEEK.
THE CAR KEPT BREAKING DOWN.

In example 7, there is no problem integrating the reference to "the car" because the verb "drive" establishes an Instrument Discourse role that serves as an antecedent. In this example, the bonding is "true" rather than false and thereby facilitates the process of reference resolution.

Since Discourse Roles allow bonding, they should also allow False bonding. The phenomena of false bonding is most apparent with respect to verbs that have a preference for a particular instrument, especially when the verb default instrument and the contextually appropriate default instrument are incompatible. Consider the Verb "write" and its associated context-dependent instruments: "write letter - pen" and "write blackboard - chalk". Recall that "pen" was classified as being the preferred (default) instrument for "write". It is proposed that if the phenomena of false bonding occurs with Verb established Discourse Roles it will be manifested in the pattern of reading times and regressive eye movements. It is predicted that Dominant Target Instruments will be resolved faster than Non-Dominant Instruments because Dominant referents are more likely to bond with an antecedent Discourse Role. In addition, since verb-based information is thought to make the earliest and strongest contribution to the establishment of Instrument Discourse Roles; the Verb's preference for its default (dominant) instrument should initially be exercised regardless of context. Hence, bonding should occur regardless of contextual appropriateness. Consider the following examples:

- (8) WHILE JANE WAS WRITING A LETTER TO HER FRIEND
SHE ACCIDENTALLY DROPPED THE PEN ON THE FLOOR.

It is predicted that the verb "write" establishes an Instrument Discourse Role that assists the integration of the reference to "the pen". The discourse role supports antecedent bonding and reference resolution.

- (9) WHILE JANE WAS WRITING THE EXERCISE ON THE BLACKBOARD
SHE ACCIDENTALLY DROPPED THE PEN ON THE FLOOR.

As before, it is predicted that the verb "write" establishes an Instrument Discourse Role that assists the integration of the reference to "the pen". It is predicted that the Dominant Instrument will bond with a Discourse Role regardless of context; therefore "pen" bonds with the Role present in the discourse representation. The ability of Verbs to establish Discourse Roles that permit "false bonding" is explored in Experiment Five.

8.4 Experiment Five: Instrument Discourse Roles: Lexical or Contextual?

The main objective was to empirically assess the relative contribution of lexical and contextual information to the establishment of Instrument Discourse Roles. General verbs were used because the associated instruments are context dependent: certain instruments will be used to perform certain actions in specific contexts. For instance, the instruments used to perform various acts of "cutting" vary according to the context i.e., to "cut cake" you would generally use a "knife", but to "cut hair" you would normally use "scissors". The questionnaire data indicates that verbs have a preferred (default) instrument regardless of context: the default instrument for "cut" is "knife". If the verb is used in the context of "cut hair" then the contextual and lexical defaults conflict, "scissors" rather than "knife". This clash is interesting as it highlights how context can influence a possible default value. However, the question remains as to whether context is constraining the default value of an existing verb-based Role or creating a new contextually defined Role. The experiment presented below evaluates this proposal and illustrates the advantages that can be gained when contextual and verb default information are consistent.

8.4.1 Method

8.4.1.1 Design

The relative contribution of lexical and contextual information to the establishment of Instrument Discourse Roles was explored by manipulating the nature of the context and the nature of the target instrument. The context was either consistent or inconsistent with the verb-instrument pair; and the nature of the target instrument was varied by using either the Dominant or the Non-Dominant Instrument of the verb. These manipulations permitted us to probe not only for a possible lexical preference for a particular instrument, but also whether contextual factors would over-ride a lexical preference.

There were three factors, each with two levels:

- 1) Context Type: Appropriate or Inappropriate with respect to the Instrument.
- 2) Explicitness of Antecedent Introduction: Explicit or Implicit.
- 3) Target Type: Dominant or Non-Dominant Instrument.

These factors were combined into a mixed design with one between subjects factor with two levels (Target Type) and two within subjects factors (Context Type and Explicitness), each with two levels.

8.4.1.2 Experimental Predictions

The main aim was assess the relative contribution of lexical and contextual factors to the establishment of Discourse Roles. If lexical factors make the primary contribution then a reference to a Dominant Target Instrument should be read faster than a reference to a Non-Dominant Target Instrument, irrespective of context. Therefore an interaction between Target Type and Explicitness is predicted. However, if contextual factors make the strongest contribution then we would expect an interaction between Context and Explicitness, irrespective of Target Type.

8.4.1.3 Stimuli

Twelve Verbs and twenty four context appropriate Instruments were selected on the basis of the Dictionary Exercise and Questionnaire tasks described in Chapter 7. All Verbs and Instruments fulfilled the requirements of the both the Dictionary Exercise and obtained a minimum score of 60% on both Questionnaire Tasks. Consequently, both Verbs and Instruments were highly related. The Verb-Instrument pairs were then assigned as being Dominant or Non-Dominant on the basis of the selection procedures outlined in section 8.2.2.

A list of the Verbs, Instruments, and their classification is given below.

Dominant

Drink Tea - Cup
Chop Vegetables - Knife
Wash Hair - Shampoo
Decorate Cake - Icing
Steer Car - Wheel
Hit Ball - Bat
Catch Mouse - Trap
Write Letter - Pen
View Bacteria - Microscope
Shoot Bullets - Gun
Eat Salad - Fork
Carve Meat - Knife

Non-Dominant

Drink Wine - Glass
Chop Wood - Axe
Wash Clothes - Powder
Decorate Tree - Tinsel
Steer Boat - Rudder
Hit Nail - Hammer
Catch Fish - Rod
Write Board - Chalk
View Stars - Telescope
Shoot Arrows - Bow
Eat Corn Flakes - Spoon
Carve Stone - Chisel

These Verbs and their two context dependent Instruments were used to generate the stimulus materials. In order to increase the number of experimental materials, each verb-instrument pair was used twice. For example, the Verb-Instrument pair "view bacteria - microscope" was used to generate two different sets of stimulus passages (a full list of the experimental materials is included in Appendix 8).

The stimulus passages all conformed to a standard format. Each had an introductory sentence that established the context for interpretation: either appropriate or inappropriate with respect to the target instrument (Context Type). The second sentence mentioned the verb and either explicitly stated or implied the target instrument (Explicitness of Antecedent Introduction). The third sentence contained an anaphoric reference to the previously introduced instrument which was either the dominant or non-dominant instrument for the verb (Target Type). The final sentence was simply a concluding sentence to make the passage more coherent.

There were eight experimental conditions, two within subjects factors derived from the factors of Context Type (appropriate or inappropriate context) and Explicitness of the Introduction of the Antecedent (Explicit or Implicit) and one between subjects factor: Target Type. The context could either be

appropriate or inappropriate with the use of the target instrument. The target instrument was either mentioned explicitly earlier in passage as being used to accomplish the task or simply implied. The target instrument was either the dominant or non-dominant instrument associated with the verb.

Eight experimental list of materials were compiled for presentation, with each set containing six passages in each of the four within subject experimental conditions. This meant that each passage in each condition was read by six subjects. The stimuli were presented in a fixed random order.

Consider the verb "view" with its corresponding context dependent instruments: "view bacteria - microscope" (dominant) and "view stars - telescope" (non-dominant). An example of all eight experimental conditions is given below:

Explicit Appropriate Context Dominant Target Instrument

The biologist carefully monitored the progress of the virus as it travelled through the water supply. Samples were viewed with a microscope at regular intervals. The microscope was new and very powerful. The scientist collected lots of important data.

Explicit Inappropriate Context Dominant Target Instrument

The astronomer carefully monitored the progress of the comet as it travelled through the solar system. The trail was viewed with a microscope at regular intervals. The microscope was new and very powerful. The scientist collected lots of important data.

Implicit Appropriate Context Dominant Target Instrument

The biologist carefully monitored the progress of the virus as it travelled through the water supply. Samples were viewed and analysed at regular intervals. The microscope was new and very powerful. The scientist collected lots of important data.

Implicit Inappropriate Context Dominant Target Instrument

The astronomer carefully monitored the progress of the comet as it travelled through the solar system. The trail was viewed and analysed at regular intervals. The microscope was new and very powerful. The scientist collected lots of important data.

Explicit Appropriate Context Non-Dominant Target Instrument

The astronomer carefully monitored the progress of the comet as it travelled through the solar system. The trail was viewed with a telescope at regular intervals. The telescope was new and very powerful. The scientist collected lots of important data.

Explicit Inappropriate Context Non-Dominant Target Instrument

The biologist carefully monitored the progress of the virus as it travelled through the water supply. Samples were viewed with a telescope at regular intervals. The telescope was new and very powerful. The scientist collected lots of important data.

Implicit Appropriate Context Non-Dominant Target Instrument

The astronomer carefully monitored the progress of the comet as it travelled through the solar system. The trail was viewed and analysed at regular intervals. The telescope was new and very powerful. The scientist collected lots of important data.

Implicit Inappropriate Context Non-Dominant Target Instrument

The biologist carefully monitored the progress of the virus as it travelled through the water supply. Samples were viewed and analysed at regular intervals. The telescope was new and very powerful. The scientist collected lots of important data.

8.4.1.4 Subjects

48 students from the University of Glasgow participated in the experiment. All were native speakers of English. Some subjects had previously participated in other eye tracking studies. Each subject was paid £5.

8.4.1.5 Procedure & Apparatus

As before

8.4.1.6 Regions

Three regions were selected for analysis: the Target Instrument (noun), the Post Target region: the Verb following the Target Instrument, and the combined Noun + Verb region. Post-target regions was examined to probe for any spill-over and discourse integration effects (Inhoff & Rayner, 1986). Recent evidence (Garrod, Freudentahl & Boyle, 1994) indicates that anaphor resolution effects may be manifested on the verb following the anaphor, therefore it is important that the post anaphor region is examined. In addition, the Noun + Verb region was also examined. Since it is a larger region it is more likely to be fixated and less prone to distortion from any transformations.

8.4.2 Results

8.4.2.1 Overview of Results

The experimental data indicates that lexical factors make the earliest contribution to the integration process. The First Pass reading time data indicates that Verbs exhibit a preference for their Dominant Instrument. Dominant Target Instruments were read faster than Non-Dominant Target Instruments. There is a significant First Pass interaction between Explicitness and Target Type with a reference to a Non-Dominant Instrument with an implicitly introduced antecedent receiving the longest fixation time.

As expected, Verbs exhibit a preference for their Dominant Instrument regardless of context. Statistical analysis on the First Pass reading times of

Dominant and Non-Dominant Target Instruments indicates that a reference to a Dominant Instrument with an implicitly introduced antecedent (implicit inappropriate dominant target condition) did not receive an increased reading time because the Verb's preference for its Dominant Instrument assists the integration of the reference. In contrast, a reference to a Non-Dominant Instrument with an implicitly introduced antecedent in an inappropriate context did receive a long reading time; suggesting that verb-based default information is not available to assist the integration process. The differential availability of verb-based information is reflected in a significant effects of explicitness for Non-Dominant but not Dominant Instruments.

In total, the First Pass eye movement data indicates that Verbs initially exert a preference for their preferred (default) instrument regardless of context. Suggesting that verb-based default information makes an immediate contribution to the integration of a default instrument.

However, the influence of context is manifested in the Total Reading Time. The impact of lexical default information is no longer apparent, with ease of integration now being determined by contextual factors. There is no effect of Target Type; instead there is significant interaction between Explicitness and Context Type with explicitness of antecedent introduction having its main impact in the inappropriate context. The pattern of regressive eye movements is consistent with the reading time data, suggesting that contextual rather than lexical factors finally determine the ease of integration.

In conclusion, the experimental results indicate that lexical information makes the earliest contribution to the integration process. In order to evaluate this proposal a detailed discussion of the experimental data is presented in the following section.

8. 4. 2. 2 Experimental Results

The eye movement data was analysed using a 2 x 2 x 2 mixed design ANOVA with one between subjects factor (target type) with 2 levels, and 2 within subjects factors (explicitness and context type), each with two levels.

Statistical analysis was carried out on all regions, but results for a single region are reported for the sake of clarity.

First Pass Reading Time

Condition	Mean First Pass Fixation Time	S. E.
Explicit Dominant Target	25.922	1.100
Explicit Non-dominant Target	25.402	1.161
Implicit Dominant Target	24.761	1.251
Implicit Non-Dominant Target	28.209	0.900

Table 8. 5 First Pass Reading Time Means & Standard Errors for the Noun + Verb Region by Explicitness and Target Type

A mixed design ANOVA with 2 within subjects factors (Explicitness and Context Type) and one between subjects factor (Target Type) calculated on the mean first pass reading times by subjects and items for the Noun + Verb Region revealed no effect of Target Type ($F_1(1,46) < 1$, $F_2(1,46) = 1.218$, $p = .2755$, $MSe = 64.247$), no effect of Explicitness ($F_1(1,46) = 1.277$, $p = .2738$, $MSe = 26.476$, $F_2(1,46) < 1$), no effect of Context Type (both $F_s < 1$), and a significant interaction between Explicitness and Target Type: $F_1(1,46) = 7.134$, $p < .02$, $MSe = 26.476$; $F_2(1,46) = 4.368$, $p < .05$, $MSe = 37.702$ ⁴ .

⁴ Statistical analysis on the Noun Region yielded no significant results: Target Type ($F_1(1,46) = 1.02$, $p = .3177$, $MSe = 286.927$; $F_2(1,46) = 1.823$, $p = .1836$, $MSe = 129.499$), Explicitness (both $F_s < 1$), Context Type ($F_1(1,46) = 1.933$, $p = .1711$, $MSe = 101.596$; $F_2(1,46) = 2.167$, $p = .1478$, $MSe = 91.924$), no interaction between Explicitness and Target Type ($F_1(1,46) < 1$; $F_2(1,46) = 2.24$, $p = .9881$, $MSe = 90.78$).

Statistical analysis on the Verb Region revealed no significant effects of Target Type, Explicitness, Context Type (all $F_s < 1$) and a marginal interaction between Explicitness and Target Type ($F_1(1,46) = 2.242$, $p = .0923$, $MSe = 113.719$; $F_2(1,46) = 2.868$, $p = .0971$, $MSe = 97.588$).

Such an interaction is consistent with the experimental prediction that these Verbs have a preference for a particular instrument which assists the integration of a reference to that instrument. As predicted, a reference to a non-preferred (non-dominant) Instrument with an implicitly introduced antecedent received the longest fixation time.

In addition, the data suggests that a Verb's preference for a particular instrument operates regardless of context. As expected, subjects experienced little difficulty resolving a reference to a Dominant Instrument in an inappropriate context (implicit inappropriate context condition). However, they did experience difficulty integrating a reference to a Non-Dominant Instrument in an inappropriate context. It is proposed that subjects initially experience little difficulty integrating a Dominant Target Instrument because verb-based information assists the integration process; even although the instrument is inappropriate with respect to the context. The different behaviour of Dominant and Non-dominant Instruments is clearly shown by the data presented below.

Condition	Dominant Target Instrument	Non-Dominant Target Instrument
Explicit Appropriate Context	25.676 (1.713)	26.128 (1.531)
Implicit Appropriate Context	23.463 (1.659)	27.983 (1.200)
Explicit Inappropriate Context	26.167 (1.417)	24.676 (1.767)
Implicit Inappropriate Context	26.058 (1.871)	28.434 (1.366)

Table 8. 6 First Pass Reading Time (ms/pc) and Standard Errors on the Noun+Verb Region for Dominant & Non-Dominant Target Instruments

Statistical analysis (2 (explicitness) x 2 (context type) repeated measures ANOVA) calculated on the first-pass subject and item reading time means for Dominant Target Instruments on the Noun + Verb region revealed no significant main effects (explicitness: $F(1,23) = 1.012$, $p = .3249$, $MSe = 31.969$;

$F2(1,23) = .687, p = .4157, MSe = 26.408$; context type: $F1(1,23) = 1.167, p = .2912, MSe = 48.941$; $F2(1,23) = 1.669, p = .2092, MSe = 29.925$), or interaction ($F1(1,23) = .870, p = .3607, MSe = 30.521$; $F2(1,23) = 1.107, p = .3038, MSe = 32.131$).

On the whole, the First Pass reading time data for Dominant Target Instruments suggests that neither Explicitness of antecedent introduction or Context Type has any impact on the integration of a reference to a preferred instrument. Specifically, in line with the experimental predictions, there is no advantage in having an explicitly introduced antecedent in either an appropriate or an inappropriate context (no difference in the reading time of the dominant target instrument in the explicit appropriate and the implicit appropriate or the inappropriate contexts). Suggesting that Verb-based information is available to assist the integration of the Instrument. It is particularly important to note that explicit and implicit Dominant Instruments are integrated equally well, regardless of context; suggesting that lexical default information makes the earliest and strongest contribution to the integration of the instrument by establishing Instrument Discourse Roles.

In contrast, statistical analysis on First-Pass subject and item reading time means of Non-Dominant Instruments on the Noun + Verb Region revealed a significant main effect of explicitness: $F1(1,23) = 9.002, p < .007, MSe = 20.983$; $F2(1,23) = 4.578, p < .05, MSe = 36.966$. There was no other main effect or interaction (all $Fs < 1$).

The First Pass Reading Time data for Non-Dominant Target Instruments is consistent with the experimental predictions in that there is a significant main effect of explicitness, with a reference with an implicit antecedent receiving a longer fixation time than a reference with an explicit antecedent.

The First Pass reading times for Non-Dominant Target Instruments differs from that of Dominant Target Instruments, in that, Non-Dominant Target Instruments show an explicitness effect suggesting that verb-based default information does not influence the integration of a Non-Dominant Target Instrument. Recall that subjects experience no difficulty integrating a Dominant Target Instrument in the "implicit inappropriate context condition", suggesting that verbs have a preference for their default instrument regardless of context and this information is available to assist the integration process.

First Pass Regression Data

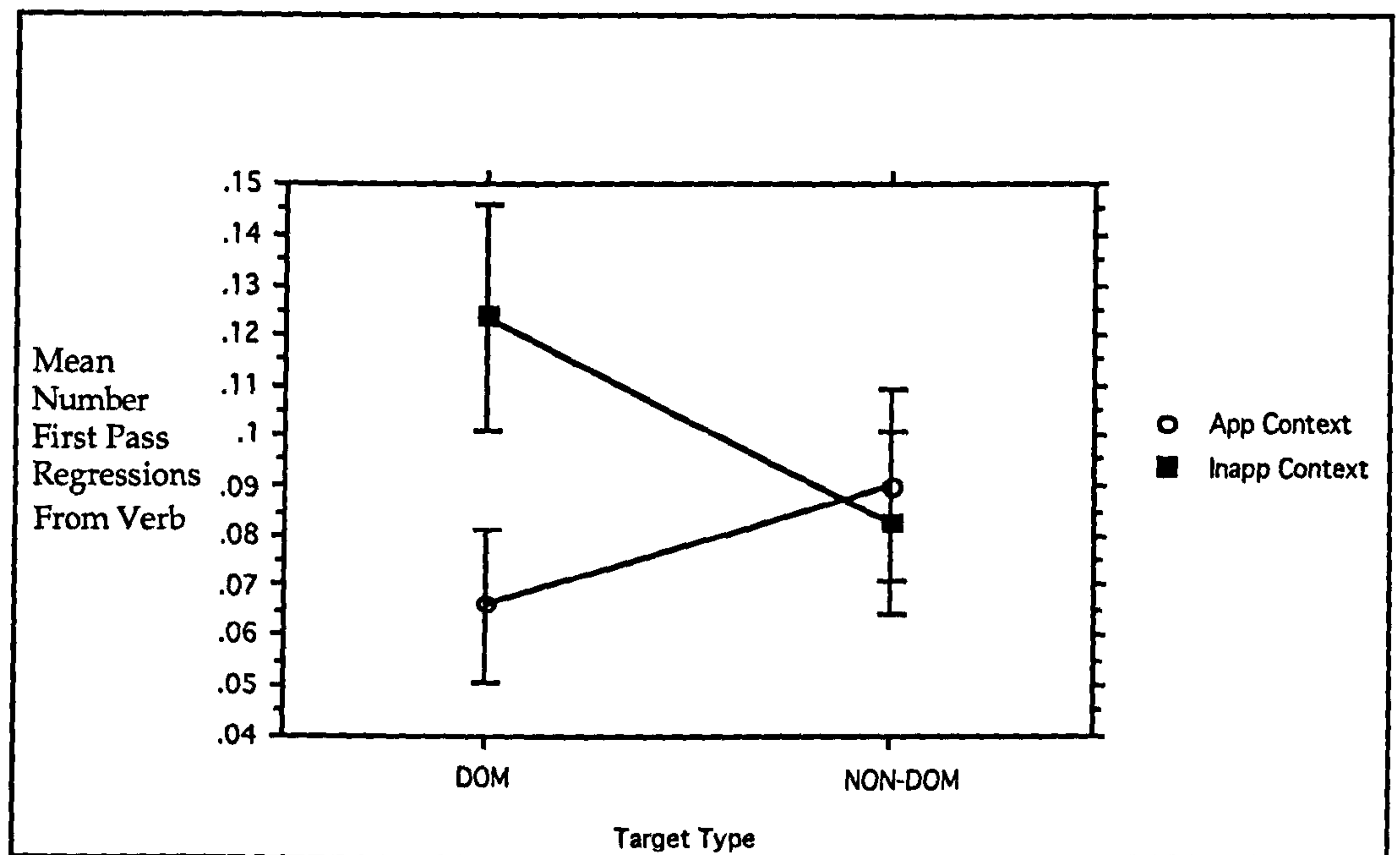


Fig. 8. 1 First Pass Regression Means & Standard Errors from the Verb by Context Type and Target Type

A mixed design ANOVA with 2 within subjects factors (Explicitness and Context Type) and one between subjects factor (Target Type) calculated on the mean number of first pass regressions from the Post Target region (Verb) by subjects and items revealed a significant main of explicitness, $F_1(1,46) = 6.229$, $p < .02$, $MSe = .188$; $F_2(1,46) = 8.09$, $p < .07$, $MSe = 4.78$.

A significant interaction between explicitness and context type: $F_1(1,46) = 6.175$, $p < .02$, $MSe = .007$; $F_2(1,46) = 8.201$, $p < .07$, $MSe = .013$; and a marginal interaction between Context Type and Target Type: $F_1(1,46) = 3.923$, $p < .06$, $MSe = .13$; $F_2(1,46) = 3.457$, $p < .07$, $MSe = .013$; with the Post Target region (verb) following a Dominant Instrument in an Inappropriate Context producing the greatest number of regressions.

The fact that Dominant Target Instruments in an inappropriate context evoked most regressions, is consistent with the proposal that Discourse Roles can support bonding. If the Dominant Instrument bonds with the Discourse Role (considers it as a possible antecedent) then the bond must be checked; hence the increased number of regressions. The pattern of regressions for

Non-Dominant Targets is different because bonding does not occur with Non-Dominant Instruments. The difference in the pattern of regressions evoked by Dominant and Non-Dominant Instruments is clearly shown when the results are examined by Target Type.

Condition	Verb Following Dominant Target Instrument	Verb Following Non-Dominant Target Instrument
Explicit Appropriate Context	.070 (.020)	.081 (.026)
Implicit Appropriate Context	.062 (.024)	.099 (.028)
Explicit Inappropriate Context	.071 (.023)	.042 (.018)
Implicit Inappropriate Context	.176 (.036)	.124 (.031)

Table 8.7 First Pass Regression Means and Standard Errors from the Verb Following Dominant & Non-Dominant Target Instruments

Statistical analysis (2 x 2 repeated measures ANOVA) calculated on the mean number of First Pass Regressions from the Post Dominant Target Region by subjects and items reveals significant effects of Explicitness: $F_1(1,23) = 3.14$, $p < .09$, $MSe = .019$; $F_2(1,23) = 4.367$, $p < .05$, $MSe = .012$; Context Type: $F_1(1,23) = 8.687$, $p < .008$, $MSe = .009$; $F_2(1,23) = 4.202$, $p < .06$, $MSe = .018$, and a significant Interaction between Explicitness and Context Type: $F_1(1,23) = 4.458$, $p < .05$, $MSe = .017$; $F_2(1,23) = 8.354$, $p < .009$, $MSe = .011$.

Planned means comparisons indicate that the Explicitness effect is due to significantly more regressions from the verb in the implicit inappropriate context condition compared to that from the verb in the explicit inappropriate context condition: $F_1(1,23) = 7.837$, $p < .02$, $MSe = .134$; $F_2(1,23) = 12.855$, $p < .002$, $MSe = .144$.

Planned means comparisons also show that the significant Context effect was due to more regressions from the verb in the implicit inappropriate context condition compared with that evoked by the verb in the implicit appropriate context: $F_1(1,23) = 9.129$, $p < .007$, $MSe = .156$; $F_2(1,23) = 14.894$, $p < .0009$, $MSe = .167$.

Planned means comparisons also indicate that the interaction is due to explicitness of antecedent introduction having its main impact in the inappropriate context: there are significantly more regressions from the verb in the implicit inappropriate context condition compared to that in any other condition: implicit inappropriate context condition compared to the explicit appropriate context condition: $F_1(1,23) = 8.036, p < .01, MSe = .137$; $F_2(1,23) = 11.285, p < .003, MSe = .127$, the implicit appropriate context condition: $F_1(1,23) = 9.129, p < .007, MSe = .156$; $F_2(1,23) = 14.894, p < .0009, MSe = .167$, and the explicit inappropriate context condition: $F_1(1,23) = 7.837, p < .02, MSe = .134$; $F_2(1,23) = 12.855, p < .002, MSe = .144$.

In contrast with the First Pass reading time data (where the verb region did not receive a long reading time) the Verb in the implicit inappropriate context produces the highest number of regressions. This high number of regressions is consistent with the prediction that a Dominant Target Instrument bonds with a Discourse Role, with the high number of regressions reflecting the checking of this bond with respect to context. The fact that bonding does not occur with Non-Dominant Instruments is shown by the different pattern of regressions they evoke.

Statistical analysis (2 x 2 repeated measures ANOVA) calculated on the mean number of First Pass Regressions from the Post Non-Dominant Target region revealed a marginal effect for explicitness: $F_1(1,23) = 3.09, p = .0921, MSe = .019$; $F_2(1,23) = 3.85, p < .07, MSe = .018$. There was no effect of Context Type ($F_s < 1$) and a non-significant interaction ($F_1(1,23) = 1.861, p = .1857, MSe = .013$; $F_2(1,23) = 1.556, p = .2248, MSe = .014$). Planned means comparisons suggest that the explicitness effect is due to significantly more regressions from the verb in the implicit inappropriate context condition compared to that in the explicit inappropriate context condition: $F_1(1,23) = 6.003, p < .03, MSe = .018$; $F_2(1,23) = 6.082, p < .03, MSe = .083$, suggesting that readers found it more difficult to integrate an antecedentless noun into the discourse than a noun with an explicit antecedent in an inappropriate context.

Means comparisons also indicate marginally more regressions from the verb in the implicit appropriate context compared to that from the verb in the explicit inappropriate context: $F_1(1,23) = 2.902, p = .1019, MSe = .039$; $F_2(1,23) = 3.134, p < .09, MSe = .043$. All other planned comparisons were non-significant ($F_s < 1$).

These results clearly illustrate the differences between the pattern of regressions evoked by Dominant and Non-Dominant Instruments. The main difference is that for the later there is no significant effect of Context Type or a significant interaction suggesting that it is only Dominant Instruments that evoke a significantly higher number of regressions when they are used to refer to an implicitly introduced antecedent in an inappropriate context. The high number of regressions are assumed to reflect the checking and realisation that the initial bond between the Dominant Instrument and the Discourse Role is false.

In general, the First Pass data supports the predictions that Verbs have a preference for their Default Instrument regardless of context and that this preference will initially facilitate the integration of a reference to the Instrument even in an inappropriate context. The significant interaction between Context Type and Target Type in the pattern of First Pass regressions evoked by the Verb supports the assumption that the Dominant (default) Instrument may be integrated into the inappropriate context via the process of bonding. The First Pass data demonstrates the important contribution of lexical information and illustrates how verb-based information about instruments makes an early contribution to the process of discourse integration. These results suggest that verb-based information makes the most important contribution to the establishment of Instrument Discourse Roles.

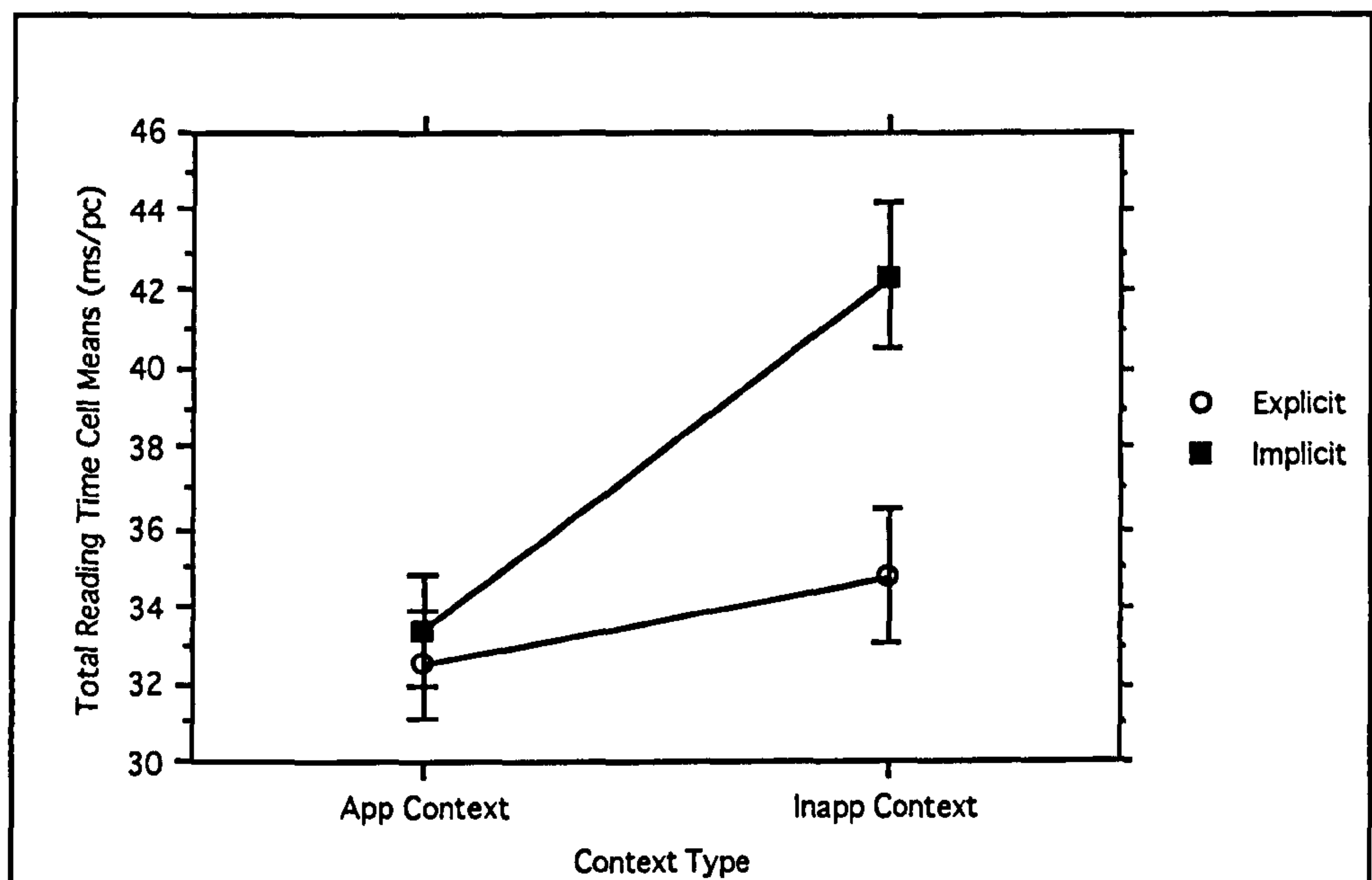
Total Reading Time

Fig. 8. 2 Total Reading Time (ms/pc) and Standard Errors on the Noun + Verb Region by Explicitness & Context Type

A mixed design ANOVA with two within subjects factors (explicitness and context type) and one between subjects factor (target type) calculated on the Total Reading Time means on the Noun + Verb Region by subjects and items revealed a significant effect of explicitness: $F(1,46) = 15.317, p < .01$, $MSe = 56.527$; $F(1,46) = 16.505, p < .01$, $MSe = 54.539$, a significant effect of context type: $F(1,46) = 24.713, p < .01$, $MSe = 60.943$; $F(1,46) = 19.122, p < .01$, $MSe = 78.618$, and a significant interaction between explicitness and context type: $F(1,46) = 7.104, p < .02$, $MSe = 73.932$; $F(1,46) = 7.789, p < .01$, $MSe = 73.928$ ⁵.

⁵ A similar pattern of results were obtained for both the Noun and Verb Regions.

Noun Region: significant effect of explicitness: $F(1,46) = 5.114, p < .03$, $MSe = 158.254$; $F(1,46) = 5.039, p < .03$, $MSe = 147.053$, a significant effect of context type: $F(1,46) = 20.946, p < .001$, $MSe = 160.845$; $F(1,46) = 22.962, p < .001$, $MSe = 152.097$, and an interaction between explicitness and context type: $F(1,46) = 3.607, p < .07$, $MSe = 143.33$; $F(1,46) = 3.198, p < .09$, $MSe = 175.586$).

Verb Region: significant effect of explicitness: $F(1,46) = 5.446, p < .03$, $MSe = 153.204$; $F(1,46) = 7.639, p < .009$, $MSe = 101.668$, a non-significant effect of context type: $F(1,46) = 2.606, p = .1133$, $MSe = 124.291$; $F(1,46) = 1.536, p = .2215$, $MSe = 153.409$, and a significant interaction between explicitness and context type: $F(1,46) = 2.99, p = .09$, $MSe = 193.098$; $F(1,46) = 6.004, p < .02$, $MSe = 128.744$).

Planned means comparisons revealed the significant explicitness effect is attributable to a significant difference between the total fixation times on the Noun + Verb region in the explicit inappropriate context condition compared to the implicit inappropriate context condition, with the implicit inappropriate context condition receiving a significantly longer reading time:

$F(1,46) = 18.529, p < .001, MSe = 1369.880$; $F_2(1,46) = 19.722, p < .001, MSe = 1458.008$.

Planned means comparisons also indicate that the significant effect of context type is attributable to a significant difference between the total fixation times on the Noun + Verb region in the implicit appropriate context condition compared to the implicit inappropriate context condition, with the implicit inappropriate context condition receiving a significantly longer reading time:

$F(1, 46) = 25.767, p < .001, MSe = 1905.029$; $F_2(1,46) = 26.648, p < .001, MSe = 1970.015$.

Planned means comparisons show that the significant interaction between explicitness and context type is due to the differential impact of Context Type on Target Instruments with implicitly introduced antecedents, with explicitness of antecedent introduction having its main impact on Target Instruments in an inappropriate context. The Noun + Verb region in the implicit inappropriate context condition received a significantly longer reading time than the same region in the implicit appropriate condition:

$F(1, 46) = 25.767, p < .001, MSe = 1905.029$; $F_2(1,46) = 26.648, p < .001, MSe = 1970.015$; the explicit inappropriate condition: $F(1, 46) = 18.529, p < .001, MSe = 1369.880$; $F_2(1,46) = 19.722, p < .001, MSe = 1458.008$, and the explicit appropriate condition: $F(1,46) = 31.487, p < .001, MSe = 2327.919$; $F_2(1,46) = 31.991, p < .001, MSe = 2365.048$.

Statistical analysis by Target Type shows a similar pattern of results.

Condition	Dominant Target Instrument	Non-Dominant Target Instrument
Explicit Appropriate Context	30.938 (1.925)	34.082 (1.899)
Implicit Appropriate Context	31.311 (2.107)	35.587 (1.886)
Explicit Inappropriate Context	35.196 (2.412)	34.411 (2.460)
Implicit Inappropriate Context	40.864 (2.708)	43.853 (2.560)

Table 8.8 Total Reading Time (ms/pc) and Standard Errors on the Noun+Verb Region for Dominant & Non-Dominant Target Instruments

Statistical analysis (2 x 2 repeated measures ANOVA) calculated on Total subject and item reading time means on the Noun + Verb region for Dominant Target Instruments revealed significant main effects of Explicitness: $F_1(1,23) = 3.816$, $p < .07$, $MSe = 57.396$; $F_2(1,23) = 5.803$, $p < .03$, $MSe = 45.942$; and Context Type, $F_1(1,23) = 17.958$, $p < .0004$, $MSe = 63.735$; $F_2(1,23) = 16.625$, $p < .0006$, $MSe = 64.721$; and a non-significant interaction between Explicitness and Context Type ($F_1(1,23) = 2.492$, $p = .1281$, $MSe = 67.519$; $F_2(1,23) = 2.374$, $p = .1370$, $MSe = 94.102$).

These main effects and trend towards an interaction together with planned means comparisons confirmed the prediction that explicitness of introduction would produce the longest reading times in the implicit inappropriate context condition. Planned means comparisons revealed the explicitness effect is attributable to a significant difference between the total fixation times for the explicit inappropriate context compared to the implicit inappropriate context conditions; with the Noun+Verb Region in the implicit inappropriate condition receiving a significantly longer reading time than the same region in the explicit inappropriate condition: $F_1(1,23) = 5.711$, $p < .03$, $MSe = 385.605$; $F_2(1,23) = 5.197$, $p < .04$, $MSe = 489.034$.

Planned comparisons also indicate that the context type effect is present for both explicitly and implicitly introduced antecedents. Subjects spent

significantly longer reading the target region in the implicit inappropriate context condition compared to the implicit appropriate context condition: $F1(1,23) = 16.211, p < .0006, MSe = 1095.194$; $F2(1,23) = 12.114, p < .003, MSe = 1139.97$. Subjects spent marginally longer fixating the target region in the explicit inappropriate context condition compared to the explicit appropriate context condition: $F1(1,23) = 3.222, p < .09, MSe = 217.575$; $F2(1,23) = 1.694, p = .206, MSe = 159.41$.

Although the Interaction between explicitness and context type failed to reach significance, planned comparisons support the prediction that the target region in the implicit inappropriate condition should receive the longest reading time. The implicit inappropriate condition received a significantly longer reading time than the implicit appropriate condition ($F1(1,23) = 16.211, p < .0006, MSe = 1095.194$; $F2(1,23) = 12.114, p < .003, MSe = 1139.97$), the explicit appropriate context condition ($F1(1,23) = 17.513, p < .0005, MSe = 1182.484$; $F2(1,23) = 12.825, p < .002, MSe = 1206.86$) and the explicit inappropriate condition ($F1(1,23) = 3.222, p < .09, MSe = 217.575$; $F2(1,23) = 1.694, p = .206, MSe = 159.41$).

The Total Reading Time data from the Noun + Verb region for Dominant Instruments supports the experimental prediction that explicitness of introduction would result in an increased reading time for the Instrument in the implicit inappropriate context condition. In addition, it is interesting to note that subjects do not experience difficulty integrating a reference to an instrument with an implicitly introduced antecedent in an appropriate context. The fact that Target Type has no impact on the Total Times is shown by the similar pattern of results for Non-Dominant Target Instruments.

Statistical analysis on the Total Reading Time data for Non-Dominant Target Instruments revealed significant main effects of Explicitness: $F1(1,23) = 12.918, p < .002, MSe = 55.659$; $F2(1,23) = 10.792, p < .004, MSe = 63.135$; and Context Type, $F1(1,23) = 7.622, p < .01, MSe = 58.151$; $F2(1,23) = 5.246, p < .04, MSe = 92.516$. There was also a significant interaction between Explicitness and Context Type: $F1(1,23) = 4.703, p < .05, MSe = 80.345$; $F2(1,23) = 6.709, p < .02, MSe = 53.755$.

Planned means comparisons indicate that the Explicitness effect is due to a significant difference between the reading time on the Noun + Verb region in

the explicit inappropriate context condition compared to the implicit inappropriate context condition: $F_1(1,23) = 13.314, p < .002, MSe = 1069.675$; $F_2(1,23) = 18.914, p < .0003, MSe = .1016.720$, with the implicit inappropriate context condition receiving a significantly longer reading time. The Context Type effect was apparent only with implicitly introduced antecedents: the Noun+Verb region received a longer reading time in the implicit inappropriate context condition compared to the implicit appropriate context condition, $F_1(1,23) = 110.203, p < .005, MSe = 819.789$; $F_2(1,23) = 15.652, p < .0007, MSe = 841.361$.

The significant interaction illustrates the differential impact of Explicitness and Context Type: explicitness interacts with references to implicitly introduced antecedents only in the inappropriate context (Noun+Verb region in the implicit inappropriate context receives a significantly longer reading than the same region in the explicit inappropriate context condition: $F_1(1,23) = 13.314, p < .002, MSe = 1069.675$; $F_2(1,23) = 18.914, p < .0003, MSe = .1016.720$). Context Type also has its main impact on references with implicitly introduced antecedents suggesting that contextual factors make their most important contribution when called upon to expand on information implicit in the text (Noun + Verb region in the implicit inappropriate context condition received a significantly longer reading time than the same region in the implicit appropriate context condition: $F_1(1,23) = 110.203, p < .005, MSe = 819.789$; $F_2(1,23) = 15.652, p < .0007, MSe = 841.361$). In addition, the Noun+Verb region in the implicit inappropriate context condition received a longer reading time than the explicit appropriate context condition: $F_1(1,23) = 14.258, p < .002, MSe = 1145.581$; $F_2(1,23) = 21.55, p < .0002, MSe = 1158.436$. These results suggest that readers find a reference to an implicitly introduced antecedent in an inappropriate context the most difficult to integrate.

The Results for Non-Dominant Target Instruments are consistent with the experimental predictions; in that subjects experienced little difficulty integrating an instrument with an implicitly introduced antecedent in an appropriate context, but experienced considerable if the reference was included in an inappropriate context.

In general the Total Reading Time data for both Dominant and Non-Dominant Targets is consistent with the experimental predictions in that a

Verb's lexical preference for a particular Instrument does not influence the Total Reading Time. Instead, Contextual factors mediate the ease with which a target instrument is integrated; with contextual factors exercising their main impact on references to implicitly introduced contextually inappropriate instruments. The difficulty integrating a reference with an implicitly introduced antecedent in an inappropriate context is also manifested in the pattern of Total Time regressions.

Total Time Regression Data

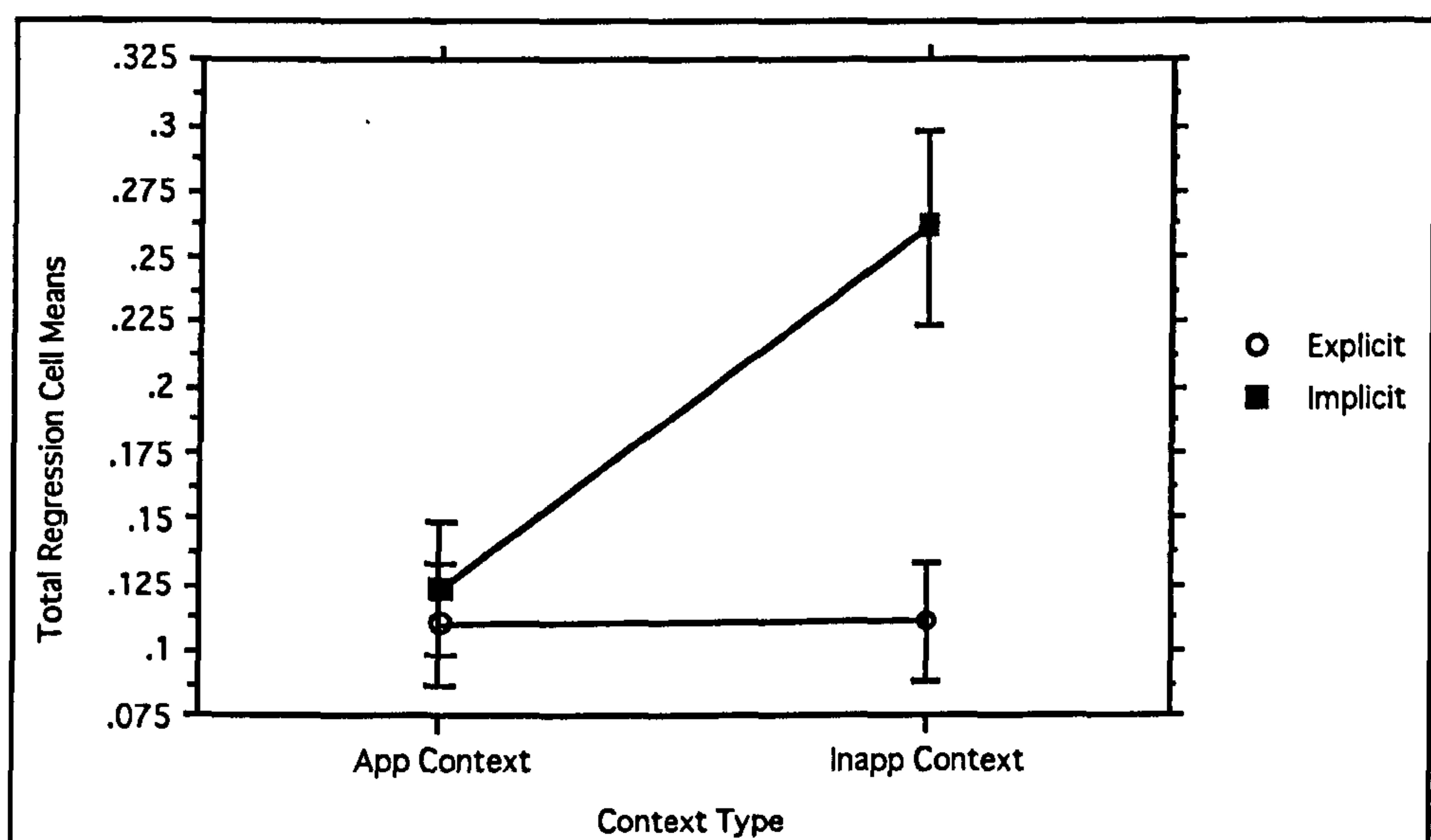


Fig. 8. 3 Total Regressions Means and Standard Errors from the Verb by Explicitness and Context Type

A mixed design ANOVA with two within subjects factors (Explicitness and Context Type) and one between subjects factor (Target Type) calculated on the mean number of Total regressions from the Verb Region by subjects and items revealed a significant effect of explicitness: $F_1(1,46) = 6.921, p < .02, MSe = .047$; $F_2(1,46) = 14.949, p < .01, MSe = .025$, a significant effect of context type: $F_1(1,46) = 8.389, p < .01, MSe = .028$; $F_2(1,46) = 9.212, p < .01, MSe = .027$, and a significant interaction between explicitness and context type: $F_1(1,46) = 6.483, p < .02, MSe = .035$; $F_2(1,46) = 9.578, p < .01, MSe = .027$.

Planned means comparisons indicate that the significant effect of explicitness is attributable to significantly more regressions being evoked by the Verb in the implicit inappropriate context condition compared to that from the Verb in the explicit inappropriate context: $F_1(1,46) = 15.644, p < .002, MSe = .545$; $F_2(1,46) = 23.579, p < .001, MSe = .628$.

Planned means comparisons also indicate that the significant effect of context type is attributable to significantly more regression being evoked by the Verb in the implicit inappropriate context condition compared to that from the Verb in the implicit appropriate context: $F_1(1,46) = 13.172, p < .002, MSe = .459$; $F_2(1,46) = 18.797, p < .001, MSe = .501$.

Planned means comparisons also show that the significant interaction between explicitness and context type is due to the differential impact of Context Type on Target Instruments with implicitly introduced antecedents, with explicitness of antecedent introduction having its main impact on Target Instruments in an inappropriate context. The Verb region in the implicit inappropriate context condition evoked significantly more regressions than the same region in the implicit appropriate condition: $F_1(1,46) = 13.172, p < .002, MSe = .459$; $F_2(1,46) = 18.797, p < .001, MSe = .501$; the explicit inappropriate condition: $F_1(1,46) = 15.644, p < .002, MSe = .545$; $F_2(1,46) = 23.579, p < .001, MSe = .628$ and the explicit appropriate condition: $F(1, 46) = 15.870, p < .001, MSe = .553$; $F_2(1,46) = 23.180, p < .001, MSe = .618$.

The significantly higher number of regressions evoked by the verb in the implicit inappropriate context is consistent with the experimental predictions that a reference to an implicitly introduced instrument that is inappropriate with respect to context would prove difficult to integrate. Like the Total Reading Time, the pattern of regression data shows no effect of Target Type, suggesting that lexical default information no longer assists the integration of a Dominant Target Instrument into an inappropriate context. The fact that both Dominant and Non-Dominant Target Instruments behaviour in similar fashion is illustrated by analysis by Target Type.

Condition	Verb Following Dominant Target Instrument	Verb Following Non-Dominant Target Instrument
Explicit Appropriate Context	.083 (.022)	.137 (.041)
Implicit Appropriate Context	.106 (.036)	.142 (.038)
Explicit Inappropriate Context	.124 (.038)	.099 (.025)
Implicit Inappropriate Context	.275 (.048)	.249 (.057)

Table 8.9 Total Regression Means and Standard Errors from the Verb Following Dominant & Non-Dominant Target Instruments

Statistical analysis (2 x 2 repeated measures ANOVA) calculated on the mean number of Total Regressions from the verb following a Dominant Target Instrument by subjects and items revealed an effect of Explicitness:

F1 (1,23) = 5.478, $p < .03$, MSe = .033; F2 (1,23) = 10.473, $p < .004$, MSe = .018; an effect of Context Type, F1 (1,23) = 11.448, $p < .003$, MSe = .023; F2 (1,23) = 10.826, $p < .004$, MSe = .022; and an Interaction between Explicitness and Context Type: F1 (1,23) = 2.521, $p = .1260$, MSe = .04; F2 (1,23) = 6.017, $p < .03$, MSe = .024.

As predicted, planned means comparisons indicate that the explicitness effect is due to significantly more regressions from the Verb in the implicit inappropriate context condition compared to that from the Verb in the explicit inappropriate context: F1 (1,23) = 6.916, $p < .02$, MSe = .275; F2 (1,23) = 14.057, $p < .002$. MSe = .333.

Planned means comparison also show that the Context effect is due to significantly more regressions from the Verb in the implicit inappropriate context condition compared to the Verb in the implicit appropriate context condition: F1 (1,23) = 8.678, $p < .008$, MSe = .345; F2 (1,23) = 16.004, $p < .0007$, MSe = .379.

Planned means comparison indicates that the Verb in the implicit inappropriate context condition evokes significantly more regressions than the same Verb in the other three conditions: it produced significantly more than the Verb in the explicit appropriate context condition: F1 (1,23) = 11.087,

$p < .003$, $MSe = .441$; $F2 (1,23) = 18.325$, $p < .0004$, $MSe = .435$, the explicit inappropriate context: $F1 (1,23) = 6.916$, $p < .02$, $MSe = .275$; $F2 (1,23) = 14.057$, $p < .002$. $MSe = .333$ and the Verb in the implicit appropriate context condition: $F1 (1,23) = 8.678$, $p < .008$, $MSe = .345$; $F2 (1,23) = 16.004$, $p < .0007$, $MSe = .379$. Suggesting that explicitness of introduction has its main impact in an inappropriate context.

A 2 (explicitness) \times 2 (context type) repeated measures ANOVA calculated on the Total Regression means by subjects and items for Non-Dominant Target Instruments revealed an effect of Explicitness: $F1 (1,23) = 2.378$, $p = .1367$, $MSe = .06$; $F2 (1,23) = 5.771$, $p < .03$, $MSe = .032$. No effect for Context Type ($F_s < 1$), and a marginally significant interaction between Explicitness and Context Type: $F1 (1,23) = 4.226$, $p < .06$, $MSe = .03$; $F2 (1,23) = 3.833$, $p < .07$, $MSe = .03$.

The interaction between Explicitness and Context Type suggests that explicitness of antecedent introduction has its main impact in the inappropriate context. There was no significant difference between any of the other conditions, yet they all differed significantly from the implicit inappropriate condition. The Verb in the implicit inappropriate context evoked more regressions than that in the explicit appropriate context condition: $F1 (1,23) = 5.021$, $p < .04$, $MSe = .15$; $F2 (1,23) = 6.914$, $p < .02$, $MSe = .204$, the implicit appropriate context condition: $F1 (1,23) = 4.593$, $p < .05$, $MSe = .137$; $F2 (1,23) = 5.007$, $p < .04$, $MSe = .148$, and the explicit inappropriate context condition: $F1 (1,23) = 9.029$, $p < .007$, $MSe = .27$; $F2 (1,23) = 9.99$, $p < .005$. $MSe = .295$.

In general the Total Time regression data is consistent with the experimental predictions in that a Verb's lexical preference for a particular instrument is an early effect and that contextual factors finally mediate the ease with which a reference is integrated. The importance of contextual factors is shown by the difficulty (reflected in the high number of regressions) that subjects experience integrating references to implicitly introduced contextually inappropriate instruments.

The Total Time data, both reading time and regressions is consistent with the experimental predictions and illustrates that contextual information makes

the final contribution to the discourse integration with any early lexically-based effects (such as false bonding) being evaluated with respect to context.

8.4.2.3 Summary of Results

The experimental results are consistent with the proposal that lexical default information about instruments is available and assists the integration of a reference to the default instrument. Firstly, the First Pass reading time data indicates that Verbs exhibit a preference for their Dominant (default) Instrument, in that Dominant Target Instruments were integrated more easily and more quickly than Non-Dominant Target Instruments. This is shown by the significant First Pass interaction between Explicitness and Target Type with a reference to a Non-Dominant Instrument with an implicitly introduced antecedent receiving the longest fixation time.

As expected, Verbs exhibit a preference for their Dominant Instrument regardless of context. A reference to a Dominant Instrument with an implicitly introduced antecedent (implicit inappropriate dominant target condition) did not receive an increased First Pass reading time because the Verb's preference for its Dominant Instrument supports bonding which assists the integration of the reference. In contrast, a reference to a Non-Dominant Instrument with an implicitly introduced antecedent in an inappropriate context did receive a long reading time; suggesting that verb-based information is not available to assist the integration process. These differences (ability to benefit from Verb-based information via bonding) are manifested in a significant effect of explicitness for Non-Dominant but not Dominant Instruments.

The proposed bonding effects for Dominant Target Instruments are further supported by the First Pass Regression data. There is a significant interaction between Context Type and Target Type with a reference to a Dominant Target Instrument in an inappropriate context evoking the most regressions. It is assumed that this high number of regressions reflect the checking of the proposed "bond" with the verb established Discourse Role. In contrast, the Non-Dominant Instrument evokes a different pattern of First Pass Regressive eye movements, suggesting that bonding does not occur with Non-Dominant Instruments.

In general, the First Pass eye movement data indicates that Verbs initially exert a preference for their default instrument regardless of context. Suggesting that verb-based default information makes an immediate contribution to the integration of a default instrument regardless of context.

However, lexical default information makes no impact on the Total Reading Time data (no effect of Target Type). The integration process now appears to be utilising contextual information. The influence of context is shown by the significant interaction between Explicitness and Context Type, with explicitness of antecedent introduction having its main impact in the inappropriate context. The pattern of regressive eye movements is consistent with the reading time data, suggesting that contextual rather than lexical factors are now assisting reference resolution and integration.

In conclusion, the results indicate that lexical information makes an early contribution to the integration process by facilitating the process of reference resolution. It is proposed that lexical default information assists the integration of a reference by establishing an Instrument Discourse Role that supports the processes of anaphor bonding and resolution. The implications of these results are discussed in the remainder of this thesis.

8.5 The Contribution of Lexical and Contextual Information to the Establishment of Instrument Discourse Roles

8.5.1 The Primacy of Lexical Information

The results of Experiment Five suggest that lexical semantic information can influence the integration of references to implicitly introduced instruments. Since these references have no explicit antecedent they must be resolved at the discourse level. It is proposed that verb-based information about instruments assists the establishment of discourse coherence by establishing Discourse Roles that function as antecedent sites for reference. Since these Roles function as antecedents they can support the process of anaphor bonding. It is proposed that a Dominant Instrument, but not a Non-dominant Instrument, with a implicitly introduced antecedent will always consider an Instrument Discourse Role as a possible antecedent. If this is so, then lexical information appears to have a rapid impact on discourse level processes. The use of verb-based information to assist integration is consistent with current proposals that emphasis the contribution of verb-based information to the establishment of discourse coherence (Carlson & Tanenhaus, 1988).

The contribution of verb-based information to the integration of instruments has been discussed in detail by Cotter (1984). The results of Experiment Five support and extend her proposals concerning the importance of lexical information and the need for a high degree of association, if not semantic relatedness, between a Verb and the Instrument it implies. The results show that even "general verbs" whose instruments appear to be context dependent, still have a lexically-based preference for a particular instrument, and that this default information can assist the integration of a reference to the preferred instrument.

The rapid availability of verb default information that assist integration is consistent with a range of data from the literature on lexical priming. Barsalou (1982) demonstrated that a full range of information or at least the typical or context independent (default) information associated with the word becomes available when the word is encountered. In addition, Moss et al. (1995) demonstrated that functional information becomes available when a word is recognised. If this is so, then information about instruments should become available when the Verb is accessed. The experimental results

demonstrate that Verb-based information about instruments is rapidly available and can assist their integration. However, it must be noted that the ability of lexical items to rapidly establish Discourse Roles is limited. One possible constraint, explored in detail in this Thesis, is that of semantic relatedness.

8.5.2 The Influence of Context

Garrod & Sanford (1983) demonstrated how context can either facilitate or hinder the process of discourse integration: a supportive context assists the process of reference resolution; whereas an inappropriate context fails to support referential processing and assist discourse integration. The results of Experiments Three and Four (cf. Chapter 6) illustrate how context can assist the process of reference resolution and contribute to the establishment of discourse coherence through the creation of Instrument Discourse Roles. The results of Experiment Five are consistent with this proposal, but extend it by showing that context does not influence the integration of a reference to an implicitly introduced instrument until Total Time.

The fact that context can influence the encoding of implicit instruments is interesting given the results of McKoon & Ratcliff (1981) who suggested that only highly related instruments would be inferred and the experimental results reported in Chapter 5 (Experiments 1 & 2) that demonstrated the important contribution of verb-based information and the nature of the relationship between the verb and instrument to the establishment of instrument discourse roles. Sanford & Garrod (1981) suggested that discourse roles may be derived either from lexical or contextual information. The question, then, is what is the origin of Instrument Discourse Roles: lexical or contextual? The data from Experiments One and Two highlights the important contribution of verb-based information; in contrast the data from Experiments Three and Four suggests that context can also establish Instrument Discourse roles. The data from Experiment 5 resolves this question by illustrating that both sources of information are important, but that lexical-based information makes the earliest and strongest contribution.

8.5.3 Verb-based Discourse Roles: A Mechanism to Establish Coherence

The question is how lexical and contextual information can assist the integration process and what allows lexical information to make the primary contribution. It is proposed that integration is assisted by Discourse Roles that support the processes of anaphor bonding and resolution (Sanford & Garrod, 1989).

8.5.3.1 Reference Resolution: A Two Stage Process

Sanford & Garrod (1989) proposed that reference resolution is a two stage process: the first stage being anaphor bonding, the second anaphor resolution. Bonding is best regarded as a low level automatic matching process which highlights a possible anaphor-antecedent link without committing the processor to any particular semantic interpretation at that point. In contrast, anaphor resolution is the process of incorporating a particular semantic interpretation of the anaphor into the semantic representation of the sentence. In processing terms, bonding amounts to locating where in the representation relevant information may be found, whereas, resolution involves commitment to one particular interpretation at that point in the process.

Consider how the distinction between Bonding and Resolution can explain the experimental results. Assume that a preferred (dominant) instrument will always bond with an Instrument Discourse Role regardless of context. If this is the case, it explains the faster reading times that Dominant Target Instruments receive in relation to Non-Dominant Target Instruments and explains why a reference to a Dominant Target Instrument initially causes no disruption when it appears in an inappropriate context. The bonding behaviour of dominant instruments is illustrated by the following examples.

- (10) WHILE JANE WAS WRITING A LETTER TO HER FRIEND
SHE ACCIDENTALLY DROPPED THE PEN ON THE FLOOR.

Assume that the verb "write" establishes an Instrument Discourse Role that assists the integration of the reference to "the pen". The discourse role supports antecedent bonding and reference resolution.

- (11) WHILE JANE WAS WRITING THE EXERCISE ON THE BLACKBOARD
SHE ACCIDENTALLY DROPPED THE PEN ON THE FLOOR.

Again assume that the verb "write" establishes an Instrument Discourse Role that assists the integration of the reference to "the pen". It is predicted that the preferred instrument will bond with a discourse role regardless of context; therefore "pen" bonds with the role present in the discourse representation. This bonding explains why subjects initially experience little difficulty integrating the reference to "the pen" (no increase in First Pass reading time). However in this example, "pen" is not the contextually appropriate instrument (difficult to integrate "pen" as it not the instrument expected to be used), so the initial bond is shown to be false when evaluated with respect to the context, hence the high number of regressions and the long Total Fixation Time.

The longer reading times received by Non-Dominant Instruments can also be explained in terms of bonding with Discourse Roles. Recall that Non-Dominant Instruments are not expected to automatically bond with Discourse Roles.

- (12) WHILE JANE WAS WRITING THE EXERCISE ON THE BLACKBOARD
SHE ACCIDENTALLY DROPPED THE CHALK ON THE FLOOR.

- (13) WHILE JANE WAS WRITING A LETTER TO HER FRIEND
SHE ACCIDENTALLY DROPPED THE CHALK ON THE FLOOR.

Assume that the verb "write" establishes an Instrument Discourse Role with its preferred value being the Dominant Target Instrument, "pen". Since the constraints on the Role bias it to accept "pen" as a filler, this Discourse Role is not available to function as an antecedent for the reference to "the chalk". As a result, no bonding occurs (false or otherwise) and readers experience difficulty integrating the reference. This difficulty is reflected in the long fixation time that this region receives.

The ability of verbs to establish Discourse Roles that permit bonding, and the assumption that a preferred instrument will always bond with the Discourse Role explains the advantage that Dominant Target Instruments have in relation to Non-Dominant Target Instruments and explains why a reference to

a Dominant Target Instrument initially causes no disruption when it appears in an inappropriate context. The experimental results indicate that a Dominant Target Instrument was equally well processed across all contexts and conditions. In contrast, references to Non-Dominant Instruments with implicitly introduced antecedents received longer fixation times suggesting they are more difficult to integrate. In fact, statistical analysis reveals a significant interaction between explicitness and target type with an implicit Non-Dominant Target Instrument receiving the longest reading time. These results are consistent with the proposal that Verbs have a preference for a particular instrument, a default instrument, regardless of context and that this default information contributes to the process of discourse integration and reference resolution through the process of anaphor bonding. The question, then, is why do Default Instruments always bond with Discourse Roles?

8.5.3.2 Instrument Discourse Roles and Variable Binding

Instrument Discourse Roles, like all Discourse Roles are simply variables in the developing representation of the discourse that take their values from the text being read. On encountering the Verb, a Role is established in the discourse representation for a possible instrument. Like all roles, the content of this role must be constrained. These constraints can be derived from the verb or the general context. It is proposed that the Verb initially constrains the content of an Instrument Discourse Role. If the verb has a preferred (default) instrument, then the constraints will be closest to this. However, since constraints are flexible the role may also accommodate the non-preferred instrument if it supported by context. Since default instruments will always fulfil the constraints (best fit) the dominant instrument is more likely to be considered (bond) as a possible filler for the role. Such a proposal is consistent with the conception of bonding as a low level automatic matching process which highlights a possible anaphor-antecedent link with a dominant instrument always fulfilling the constraints on the role and therefore considered as a possible filler for the Instrument Role regardless of its contextual suitability.

Recall that constraints on Roles serve two functions. Firstly, to assist the assignment of values to variables by specifying the sorts of things than can fill the various roles. Secondly, when assignment can not be made they generate default values that satisfy the constraints. It should be noted that variable

constraints are seldom absolute. It is rare that a variable cannot ever accept a value of a certain sort. Instead it is useful to think of variable constraints as representing distributions of possible values, with some values being more typical than others. The variable constraints prefer values closer to the average of the distribution, but will accept deviant values if no other interpretation can be made. For example, compare:

(14) JOHN CUT THE PAPER WITH SCISSORS.

(15) JOHN CUT THE PAPER WITH A RAZOR-BLADE.

(16) * JOHN CUT THE PAPER WITH A BRICK.

In example (14) "scissors" are a more stereotypical value than "razor blade" (15) for the instrument used in the action of "cutting paper". Yet, we can still understand how John can cut paper with a razor blade because a razor-blade fulfils the basic constraints on a an instrument associated with cutting, i.e., must have a sharp edge. In contrast, sentence (16) is difficult to understand because "brick" does not possess these qualities and hence does not satisfy the variable constraints associated with instruments for the verb "cut".

Implicit instruments, like all other implicit information may be treated as variables (roles) which can accept as a value, any reference that satisfies their associated constraints. Differences in satisfying these constraints may explain the acceptability or unacceptability of the occurrence of instruments and verbs. Differences in the degree of satisfaction of these constraints may explain why certain verbs initially retain a preference for a particular instrument in the presence of a strong biasing context and why some instruments are more stereotypical than others (i.e., scissors rather than razor blade).

For instance, the Instrument role associated with the verb "drive" will only accept references that satisfy the constraints on a motor vehicle:

(17) KEITH DROVE TO LONDON.

THE CAR/ THE LAND-DROVER/ THE BUS/ THE MOTORCYCLE

(18) KEITH DROVE TO LONDON.

* THE AEROPLANE/ THE BICYCLE/.....

In contrast the verb "travel" does not impose such restrictive constraints on the method of transport:

(19) KEITH TRAVELLED TO LONDON.

THE CAR/ THE LAND-DROVER/ THE BUS/ THE MOTORCYCLE/
THE AEROPLANE/ THE BICYCLE/ THE TRAIN

By representing implicit entities as variables with the appropriate constraints, it is possible for implicitly introduced information to assist subsequent processing in a principled manner.

If the filling of Roles is based on satisfying the associated constraints, and if this matching process takes a proportionate amount of time, then some items may be a better and quicker fit than others. If a reference perfectly matches the variable specifications it may be integrated faster than one that does not. Such a proposal may explain why the preferred instrument of a verb is easier to integrate than a non-preferred instrument. It is proposed that preferred instruments match the associated variable constraints better than the non-preferred instruments. Consider the preferred and non-preferred instruments associated with the verb "write": "pen" and "chalk". If a variable matching perspective is taken, then "pen" would always be integrated faster because it is most consistent with the constraints associated with the Instrument Role despite the fact that in the context of "writing on a blackboard" "chalk" is the most appropriate instrument. Such a proposal suggests that verb-based default information initially constrains the content of an Instrument Discourse Role.

A constraint satisfaction approach suggests that certain verbs may place stricter constraints on their associated variables than others. From the perspective of Instrument Roles, these constraints may be derived from the verb or from the context. The fact that references to preferred (dominant) instruments are integrated faster and are considered as possible fillers for instrument roles even when they are contextually inappropriate suggests that lexical-based constraints, most likely those associated with Verb default information initially constrain the content of an Instrument Role with contextual constraints making a later contribution.

8.5.3.3 The Instantiation of Implicit Arguments

The fact that lexical default information initially constrains the content of an Instrument Role is inconsistent with the proposals of Mauner et al. (1995). Mauner et al. offer a threefold classification for implicit arguments depending on the degree of contextual support they require: obligatory anaphoric, non-obligatorily anaphoric, and optionally anaphoric arguments (cf. Chapter 4). They propose that implicit instruments are "optionally anaphoric implicit arguments" which may or may not take their interpretation from the context. This suggests that the encoding of implicit instruments should be sensitive to contextual factors. The empirical data suggests that they are sensitive to contextual factors and their optional anaphoric nature, may or may not use context, explains the conflicting results. Mauner et al. propose that implicit instruments are always encoded, but not always instantiated, with instantiation being dependent on contextual factors.

The results of Experiment Five demonstrate, in line with Mauner et al., that verb-based information about instruments is encoded in a discourse representation. However, the results also show that lexical default information contributes to the instantiation of an implicit instrument. Lexically-based default information rather than context initially constrains the content of an Instrument Role. The fact that an implicit argument can initially support a reference to a contextually inappropriate filler is at odds with the proposal of Mauner et al. who suggested that the instantiation of an implicit instrument is determined by contextual factors. However, consistent with Mauner proposals, contextual information does make the final contribution to the instantiation of the Role, with Instrument Discourse Roles only functioning as antecedents for contextually appropriate referents.

The proposals of Mauner et al. are interesting as they allow verb-based roles to be elaborated by context. They suggest that the implicit semantic arguments associated with verbs, specifically the implicit agent associated with a short passive, can be further defined by context. Such a proposal illustrates how verb-based information can provide the basis for more elaborate processing and assist discourse integration. Their work also suggests that a Role needs only to be encoded, not instantiated, to provide discourse benefits. These proposals are similar to the assumptions concerning Instrument Discourse Roles. The difference is that Verbs seem not only to establish roles but also to constrain their possible content. This preference for a particular filler (the

dominant instrument) initially supports the integration of a reference to this instrument regardless of context. It is important to note that it is not proposed that Discourse Roles are established with their content instantiated. Instead it is proposed that Roles have constraints and these constraints can be provided by both the verb and the context. For Instrument Discourse roles the primary source of constraint is that provided by the Verb, but even here contextual factors can influence the nature of the constraints. Hence the value assigned to the Role is finally determined by the context.

8.5.4 Alternative Explanations

It may be argued that subjects experience little difficulty integrating a Dominant Instrument in an inappropriate context (pen in the context of writing on blackboard) because they fail to detect the anomaly or because the methodology used is not sensitive enough to detect any difficulties they experience.

8.5.4.1 Methodological Problems

It is argued that a lack of methodological sensitivity is not a viable explanation because the same method detects effects in relation to Non-Dominant Instruments. However, it is true that subjects consistently fail to experience any difficulty (detect the anomaly) when Dominant Instruments appear in an inappropriate context. There appears to be a systematic failure to experience any difficulty that can not be attributed to any methodological weakness in the experiment. It is proposed that subjects fail to experience difficulty because the Dominant Instrument always considers a Discourse Role as possible antecedent which assists its integration into the discourse.

8.5.4.2 Anomaly Detection

A well-known example of a failure to detect an anomaly is the "Moses Illusion" (Erickson & Mattson, 1981).

(20) HOW MANY ANIMALS OF EACH KIND DID MOSES PUT ON THE ARK?

Surprisingly many people answer, two. However, it was Noah who loaded the Ark with animals not Moses. Sanford and Moxey (1995) suggest that subjects fail to detect the anomaly because the text is only superficially processed because Moses and Noah share sufficient semantic features to allow the processor to accept Moses as an appropriate filler for the role of agent.

Such an explanation, is similar to the proposals concerning variable binding and Discourse Roles and may be interpreted as an explanation as to why subjects fail to detect the anomaly when a Dominant Target Instrument appears in an inappropriate context. Since the Dominant Target Instrument always satisfies the constraints associated with the role, subjects may fail to notice that it is contextually inappropriate. However, the fact that a Dominant Target Instrument always satisfies the constraints associated with the discourse role is consistent with the proposals concerning bonding. The goodness of fit between Dominant Target Instruments and Discourse Roles generally assists the integration of a reference. It is only in cases where the bond turns out to be false, that bonding proves to be a disadvantage.

If discourse processing is conceptualised as a process of variable binding, then the failure to detect the anomaly associated with the occurrence of a contextually inappropriate Dominant Instrument is simply the byproduct of the comprehension system's general strategy of variable binding. Rather than subjects failing to properly process the reference (recall that failure to detect an anomaly is generally attributed to superficial processing in which a general variable match is made) subjects do not notice that the reference is anomalous because the constraints are entirely consistent with the default restrictions on the Discourse Role. Since the bonding process initially operates regardless of context, it appears that an anomaly has failed to have been detected; when in fact, a consistent match has been made. Therefore, it is unlikely that subjects experience little difficulty integrating a reference to a Dominant Instrument in an inappropriate context because it is only superficially processed. Instead

subjects experience little difficulty because the reference is being integrated due to its consistency with the constraints associated with the verb-based Discourse Role.

8.5.5 The Impact of Local and Global Context

The results of Experiment Five contradict the findings of Hess et al. (1995). Hess et al. demonstrated that local context only assisted processing when it was compatible with the global context and propose that the major and perhaps sole source of context effects is the relationship between the lexical item and its global or discourse context. However, the empirical data reported in this chapter indicates that lexical information can initially override contextual information suggesting that local rather than global context is more important in the integration of implicit instruments.

Generally, lexical factors (local context) are assumed to assist integration by facilitating word identification. Unfortunately the methodology used in Experiment Five is not sensitive enough to determine whether identification is facilitated. However, verb-based default information appears to be influencing processing at the discourse level rather than the lexical level. Despite this, it must be acknowledged that speeded identification may allow default information to become more rapidly available and therefore available to influence discourse level processes, i.e., establish an Instrument Discourse Role.

Although the results of Hess et al. are at odds with the results reported here their proposals concerning discourse integration are interesting. Hess et al. posit the operation of a mechanism that permits global factors to be long lasting and to over-ride strictly local relationships. However such a mechanism can not explain the fact that global context does not override lexical information or the fact that a Verb exerts a preference for its Dominant Instrument regardless of context.

The mechanism Hess et al. propose requires some assumptions about naming. They assume that naming occurs subsequent to recognition of the lexical item. Since words typically occur in noisy environments and since there is a high degree of variability within speech, there is often uncertainty. Thus even if recognition is primarily a bottom-up process, there may be scope for top-down

contextual influence. Hess's proposed mechanism for this contextual influence is derived from general processes used by the comprehender. The comprehender constructs a semantic representation: sets up discourse entities and their relationships with each other. This representation is updated as the text progresses. Since adding new entities to a discourse representation requires resources (Murphy, 1984) it is plausible that a very early process in word recognition involves checking whether the word can refer to an entity that already exists in the discourse model. If the check yields a positive response (semantics of lexical item allow it to be assigned to an entity in the model) then the likelihood that the correct word has been identified is heightened. Consequently, the naming information becomes more readily available.

Such an explanation does not require the target word to have occurred previously in the discourse. For instance, when the listener hears that "a project is due in the computer science course", a discourse entity representing "the project" is thought to be introduced into the discourse. When the word "program" occurs, Hess et al. assume that an early process checks whether it can be identified with an entity in the discourse model, in this case "the project". The crucial point is that facilitation is not due to activation of a word before it is encountered but to the possibility of referring to an entity already in the discourse model. In this explanation, the locus of the facilitation effect is not in the lexicon. Instead facilitation is due to the ease of determining discourse entities or the ease of integrating new information into the developing discourse representation.

The proposal of Hess et al. is similar to the Discourse Role account outlined here, in that both assume that probable items are included in the discourse representation as the text is being read and that facilitation is due to the possibility of referring to an entity already present in the discourse representation. The difference is that Hess et al. assume the construction of the discourse representation is guided by global contextual factors rather than verb-based information. Secondly, Hess et al. assume that when a word is encountered the discourse representation is checked to see if it supports integration. It is important to note that a definite description (e.g., "the poem") was used as the target for Naming (see Table 8. 1). The use of a definite description requires antecedent identification, therefore it is not surprising that a discourse level representation is accessed. This early check (during the process of identification) is similar to the notion of bonding which is an early

process that locates possible antecedents. As with bonding, the identification of the antecedent assists integration. In addition, both processes do not require the word to have been previously mentioned or even the presence of an explicit antecedent as it can be derived from the discourse model. However, the two accounts differ with respect to the assumed source of the discourse entity: context or lexical information. The results of Experiment Five demonstrate that, at least for implicit instruments, verb-based rather than contextual factors initially assist integration.

8.5.6 Lexically-based Instrument Discourse Roles

The main objective of this Chapter was to determine the relative contribution of Lexical and Contextual information to the establishment of Instrument Discourse Roles. The experimental results indicate that lexical information makes the earliest and strongest contribution not only to the establishment of Instrument Discourse Roles, but also sets the constraints that define their possible fillers. The results also indicate that verb-based information, particularly default information about instruments, contributes to the integration process. The results demonstrate that a verb's preference for its default instrument will assist integration of a reference to that instrument and that this facilitation will initially be exercised regardless of contextual factors.

The process of reference resolution, particularly the lack of difficulty that subjects experience integrating a reference to a Dominant Instrument in an inappropriate context is explained within Sanford & Garrod's two stage model of reference resolution. The results extend their original proposals by demonstrating how the phenomena of Bonding applies to Discourse Roles. It is proposed that Dominant instruments always bond with Discourse Roles because the Dominant Instrument fulfils the constraints associated with the Discourse Role. Bonding can occur regardless of contextual factors because bonding is an early low level process and is therefore unaffected by contextual information.

Contextual factors contribute to the integration process when the bond between the instrument and the Discourse Role is evaluated with respect to context. The contribution of context is manifested in the Total Reading Time data, where contextual appropriateness rather than the nature of the target

instrument determines the ease of integration of a reference. The Total Reading Time data is consistent with the results of Experiment Four, with an appropriate context assisting the integration of a reference to an instrument with an implicitly introduced antecedent. This facilitation may be attributable to contextual information modifying the constraints on the Instrument Discourse Role.

In general, the results of Experiment Five indicate that lexical information makes the primary contribution to the establishment of Instrument Discourse Roles. The First Pass reading time data indicates that Verbs exhibit a preference for their Dominant Instrument, in that Dominant Target Instruments were integrated more easily and more quickly than Non-Dominant Target Instruments. The influence of Context on the integration of instruments and Instrument Discourse Roles is shown in the Total Time data. It is interesting to note that, even though there is no effect of Target Type on the Total Time Reading data, Dominant Target Instruments consistently (though not statistically) receive faster reading times, suggesting they are easier to integrate.

Chapter Nine

Discourse Roles:
A Mechanism to Establish Coherence

9.1 Boundary Conditions on the Establishment of Discourse Roles

The main objective of this Thesis was to determine the origin of Instrument Discourse Roles and the factors responsible for constraining their content. A secondary objective was to evaluate whether implicitly introduced information is best conceptualised in the form of Roles. By exploring the factors that determine the encoding of implicit instruments the conflicting data regarding the time course of instrument inferencing is explained.

The contribution of verb-based information to discourse integration was assessed in Experiments One and Two which explored the availability of information about instruments and its contribution to the establishment of discourse coherence. Specifically, does a verb introduce a referent into the discourse model that can function as an antecedent for subsequent reference? The results of Experiment One replicate those of Garrod & Sanford (1982) and suggest that verb-based information about instruments is available during comprehension and assists the establishment of discourse coherence. The results of Experiment Two replicate those of Singer (1979) and indicate that the availability of verb-based information during discourse processing is limited. The limited availability of verb-based information is consistent with the proposals of Cotter (1984) and indicates that there may be differences between the two sets of verbs in the availability of information about their instruments and therefore differences in their ability to support discourse integration.

Experiments Three and Four explored the contribution of context to the establishment of Instrument Discourse roles. The work of Garrod & Sanford (1983) demonstrated how context can either facilitate or hinder the process of discourse integration: a supportive context assists the process of reference resolution; whereas an inappropriate context fails to support referential processing and assist discourse integration. The experimental results substantiate their proposals and indicate that a supportive context can assist the process of reference resolution via a Discourse Role. These experiments address many of the methodological problems associated with previous studies investigating instrument inferencing (Keenan et al., 1990). In particular, the results suggest that an implicit instrument, or at least an Instrument Role will be encoded, without the instrument being previously mentioned in the text.

Although the results of Experiments Three and Four highlight the use of contextual information in the encoding of implicit instruments; the evidence for the contextual establishment of Instrument Roles is not unequivocal, since the effect of context is not consistent across both contexts. The question is whether these "context differences" occur because that particular context is insufficient to support the creation of an Instrument Role or because the establishment of Instrument Discourse Roles is determined by lexical factors, such as the relationship between the Verb and the to-be-inferred Instrument, rather than context. These proposals were evaluated in the Dictionary Exercise and Questionnaire Tasks reported in Chapter Seven.

The results of both the Dictionary Exercise and the Questionnaire Tasks suggest that the relationship (forward association) between a Verb and its Instrument is the best predictor of a verb's ability to support the encoding of implicit instruments and establish Instrument Discourse Roles. The low degree of association between Singer Verbs and Instruments may explain their failure to support instrument inferencing and establish Instrument Discourse Roles that support subsequent reference. The results of the Questionnaire task also indicate the existence of a preferred (dominant) Instrument that is implied by the verb regardless of context and highlights the possible contribution of lexically-based default information to discourse comprehension. The availability of such default information is consistent with priming data which indicates that information about functional properties and relations becomes available when a word is accessed (Moss et al., 1995). Given this, information about Instruments, most probably the default instrument, should become available when the Verb is read. If such information is available, it is plausible to assume that it will assist comprehension. The contribution of Verb-based default information to comprehension and the establishment of Instrument Discourse Roles was assessed in Experiment Five.

The results of Experiment Five suggest that lexical information makes the earliest contribution to the establishment and content of an Instrument Discourse Role. Lexical default information about instruments initially assists the integration of a reference with an implicitly introduced antecedent. However, this lexical influence is short-lived and contextual appropriateness rather than lexical default information finally determines the ease of integration of a reference to an implicit instrument.

In summary, the experimental data suggests that Verb-based default information about Instruments is the determining factor in the establishment of Instrument Discourse Roles. This finding clarifies the conditions determining the encoding of Instrument Inferences. The results suggest that a high degree of Verb-Instrument association is an important factor. Such a proposal is consistent with that of McKoon and Ratcliff (1981) but extends it by demonstrating that although a high degree of association is a necessary, it is not a sufficient condition for their encoding. All the Verb-Instrument pairs used in Experiment Five were highly associated, yet only integration of the Default Instrument was facilitated. If only a Verb's Default Instrument is encoded then, unless the experiments probed for the encoding of the Default Instrument, they would fail to find evidence for the encoding of implicit instruments. Given the nature of the selection procedures used, it is highly unlikely that these studies assessed the encoding of Default Instruments. Tests that simply assess association of a Verb-Instrument pair are not sufficient to identify a default instrument. In fact, instrument generation tasks may overestimate the degree of association between Verbs and Instruments, since explicitly asking for an instrument to be provided may increase the chances that the Instrument is produced. In addition, instrument generation tasks normally use a verb phrase, "cut hair". Data derived from verb phrases only provides information about the degree to which the instrument is implied in a particular context, it does not provide an independent measure of whether the verb would imply the instrument regardless of context.

The rapid availability of default information may explain why a high probability instrument can function as an effective retrieval cue not only for sentences that explicitly mention the high probability instrument, but also for sentences that explicitly mentioned a low probability instrument (Corbett & Doshier, 1978). Since there is a strong relationship between the Default Instrument and the verb, the Default Instrument may function to retrieve a sentence containing the verb, regardless of whether the instrument was mentioned.

In conclusion, the empirical data reported in this thesis indicates that lexical semantic information can influence the integration of references to implicitly introduced instruments. Since these references have no explicit antecedent they must be resolved at the discourse level. It is proposed that Verbs establish Discourse Roles for highly semantically related items which then facilitate the resolution of references to these items. Consequently, lexical information, in

the form of verb-based Discourse Roles assists the establishment of discourse coherence by facilitating the process of reference resolution. The evidence suggests that lexical information has a rapid impact on discourse level processes. However, it must be noted that the ability of lexical items to rapidly establish Discourse Roles is limited. A major, perhaps the major constraint, explored in detail in this Thesis, is that of semantic relatedness.

The advantage that the establishment of an Instrument Discourse Role brings, emphasises the need to establish the boundary conditions on the encoding of other types of Discourse Roles. Like Instruments, Benefactives are problematic for Carlson and Tanenhaus' thematic role account. A beneficiary role is not assigned because it is not subcategorised for by the Verb. The assignment of a Beneficiary Role is even more complex than that of an Instrumental as they seem "more optional". Consider, "John bought a book" and "John bought a book for Sally". It is possible to buy a book and later decide what to do with it. Also, you can make something without making it for someone: "Jane made a cake" and "Jane made a cake for her mother". Despite these problems it is worth exploring the conditions under which a Beneficiary Discourse Role may be established because it is possible to refer to an implicitly introduced Beneficiary Role: "Jane spent all afternoon making dinner. The guests were very grateful". Despite the fact that reference is possible, it is less clear whether resolution is achieved by role-based or inferential processing. Unlike Instrumentals, the majority of Benefactives do not seem to play a major part in the event described by the verb, hence they are unlikely to be verb-based. The issue then, is to determine whether a restrictive context would assist their integration. To complicate matters further, there are some verbs, "give" and "sell" in which a recipient is necessary and is generally not unexpressed. Such examples do not easily support reference: "John gave the book. Jane was grateful", and "John sold the book. The collector was very pleased". These examples are odd, to say the least, and can only be understood by inferential processing: Jane was grateful because John gave her the book.

The experimental data also demonstrated the important contribution of context. The results of Experiment Five indicate that contextual factors do not immediately influence the content of a Discourse Role. Previous evidence, particularly that of Garrod & Sanford (1983), has shown that Script-based Roles: i.e. "lawyers in court" and "waiters in restaurants", can function as antecedents for reference and thereby contribute to the establishment of discourse coherence. It is therefore important to determine the factors that establish

Script-based Roles and explore the time course of their resolution during discourse processing.

Within the two stage model of reference resolution, it is predicted that script-based roles, which are assumed to be derived from context, will only influence the second stage of the resolution process. Information about script-based roles is not expected to be available, unlike lexically based default information, to support the process of antecedent bonding. It is possible to empirically evaluate this proposal within the reading time paradigm using eye movement methodology. Consider a text used by Garrod and Sanford (1983) in which the context either supports (1) or does not support a reference to a script-based role.

(1) In Court

Fred was being questioned (by a lawyer).

He had been accused of murder.

The lawyer was trying to prove his innocence.

(2) Telling a Lie

Fred was being questioned (by a lawyer).

He couldn't tell the truth.

The lawyer was trying to prove his innocence.

It is predicted that readers will initially (first pass reading time) encounter difficulty resolving the reference to "the lawyer" (spend longer fixating the reference) when its antecedent is implicitly introduced in both the supportive and non-supportive context conditions. However, since a supportive context is assumed to assist the integration of the reference during the second stage of the resolution process, subjects should experience less difficulty (spend less time fixating) resolving the reference to "the lawyer" when the context supports the establishment of a script-based role. In short, the facilitative effects of a script-based role will be manifested in a shorter Total Reading Time for a reference to the role, when the context supports the role. A non-supportive context will not establish a script-based role, therefore the reference to "the lawyer" can only be resolved by a time consuming bridging inference rather than role-based reference; hence, the longer reading time.

9.2 Discourse Roles: A Mechanism to Establish Coherence

The second objective was to determine how implicitness is represented in discourse. Specifically, how is implicitly introduced information represented so that it can support reference? The evidence supports the proposal that implicit information is best represented in the form of variables, termed Discourse Roles, which contribute to the establishment of discourse coherence by functioning as antecedent sites for reference.

The use of Roles to represent implicit information is consistent with contemporary accounts of discourse comprehension (Sanford & Garrod; 1981, 1989). One of the most influential proposals that uses Roles to explain the ability to refer to implicitly introduced information is that of Carlson & Tanenhaus (1988). However, their proposals do not offer an adequate explanation of the ability to refer to implicitly introduced instruments. The empirical data (particularly that of Experiment 5) suggests that information outwith that captured by their narrow syntax-based roles, assists in the creation of discourse coherence. Although they acknowledge that implicit roles are not the only means to assist discourse integration, and recognise the role of "core meaning"; this account too, is insufficient as it allows no scope for the influence of context. However, it is interesting to note that both accounts allow verb-based roles to assist the creation of discourse coherence by facilitating the process of reference resolution.

Discourse Roles facilitate the process of reference resolution by supporting the process of anaphor bonding and anaphor resolution. The results support the proposal that reference resolution is best conceptualised as a two-stage process (Sanford & Garrod, 1989) and extend their proposals by demonstrating that anaphor bonding also applies to the resolution of definite noun phrases. In addition, the antecedent that supports bonding need not be explicitly introduced: Discourse Roles can support bonding.

In conclusion, implicitly introduced information represented in the form of Discourse Roles can contribute to the establishment of discourse coherence through a process of role-based reference. In short, Discourse Roles can function as antecedent sites for reference; hence, Discourse Roles are a mechanism to establish coherence.

Appendix One

Materials used in Experiment One

<u>Verb</u>	<u>Instrument</u>
Drive	Car
Ride	Horse
Sell	Money
Bake Bread	Oven
Dress Baby	Clothes
Surf	Board
Unlock Door	Key
Freeze	Ice
Sail	Boat
Buy	Money
Photograph (Beach)	Camera
Post Letter	Post-box
Fly	Aeroplane
Smoke	Cigarettes
Cut Hair	Scissors

Experimental Materials

(1) Drive

Explicit Anaphoric

David had to attend an important meeting in town. He hated taking his car to London as the roads were so busy. He wished he had taken a friend's advice and left the car at home. If he didn't find a parking space soon he would be late for his appointment. Did David travel to London by train?

Explicit Non-anaphoric

David had to attend an important meeting in town. He hated taking his car to London as the roads were so busy. He wished he had taken a friend's advice and left a car at home. If he didn't find a parking space soon he would be late for his appointment. Did David travel to London by train?

Implicit Anaphoric

David had to attend an important meeting in town. He hated driving in London as the roads were so busy. He wished he had taken a friend's advice and left the car at home. If he didn't find a parking space soon he would be late for his appointment. Did David travel to London by train?

Implicit Non-anaphoric

David had to attend an important meeting in town. He hated driving in London as the roads were so busy. He wished he had taken a friend's advice and left a car at home. If he didn't find a parking space soon he would be late for his appointment. Did David travel to London by train?

(2) Ride

Explicit Anaphoric

The jockey's lifetime ambition was to win the Grand National. Although there was a large field, the bookmakers were offering him favourable odds. So he was quite nervous as he guided the horse up to the final fence. There was a loud gasp from the crowd when the horse refused to jump. The jockey watched in despair as the favourite went on to win.

Explicit Non-anaphoric

The jockey's lifetime ambition was to win the Grand National. Although there was a large field, the bookmakers were offering him favourable odds. So he was quite nervous as he guided the horse up to the final fence. There was a loud gasp from the crowd when a horse refused to jump. The jockey watched in despair as the favourite went on to win.

Implicit Anaphoric

The jockey's lifetime ambition was to win the Grand National. Although there was a large field, the bookmakers were offering him favourable odds. He was quite nervous as he rode up to the final fence. There was a loud gasp from the crowd when the horse refused to jump. The jockey watched in despair as the favourite went on to win.

Implicit Non-anaphoric

The jockey's lifetime ambition was to win the Grand National. Although there was a large field, the bookmakers were offering him favourable odds. He was quite nervous as he rode up to the final fence. There was a loud gasp from the crowd when a horse refused to jump. He watched in despair as the favourite went on to win.

(3) Sell

Explicit Anaphoric

The stallholder shouted loudly to advertise his goods. He attracted the attention of a passing woman. He took the money for 2lbs of apples and oranges and waved her off with a cheery grin. Then he put the money into a bag that he kept beneath the stall. He thought he would pack up soon as it was getting dark. Did the woman buy some apples?

Explicit Non-anaphoric

The stallholder shouted loudly to advertise his goods. He attracted the attention of a passing woman. He took the money for 2lbs of apples and oranges and waved her off with a cheery grin. Then he put some money into a bag that he kept beneath the stall. He thought he would pack up soon as it was getting dark. Did the woman buy some apples?

Implicit Anaphoric

The stallholder shouted loudly to advertise his goods. He attracted the attention of a passing woman. He sold her 2lbs of apples and oranges and waved her off with a cheery grin. Then he put the money into a bag that he kept beneath the stall. He thought he would pack up soon as it was getting dark. Did the woman buy some apples?

Implicit Non-anaphoric

The stallholder shouted loudly to advertise his goods. He attracted the attention of a passing woman. He sold her 2lbs of apples and oranges and waved her off with a cheery grin. Then he put some money into a bag that he kept beneath the stall. He thought he would pack up soon as it was getting dark. Did the woman buy some apples?

(4) Bake

Explicit Anaphoric

Mrs Clark had been working in the kitchen all morning. She put the bread into the oven and began to clean the kitchen. After completing the chores she checked the oven. As she expected the bread was ready. She placed it on a wire rack to cool. Did Mrs Clark bake the bread in the afternoon?

Explicit Non-anaphoric

Mrs Clark had been working in the kitchen all morning. She put the bread into the oven and began to clean the kitchen. After completing the chores she checked an oven. As she expected the bread was ready. She placed it on a wire rack to cool.

Did Mrs Clark bake the bread in the afternoon?

Implicit Anaphoric

Mrs Clark had been working in the kitchen all morning. She put the bread in to bake and began to clean the kitchen. After completing the chores she checked the oven. As she expected the bread was ready. She placed it on a wire rack to cool.

Did Mrs Clark bake the bread in the afternoon?

Implicit Non-anaphoric

Mrs Clark had been working in the kitchen all morning. She put the bread in to bake and began to clean the kitchen. After completing the chores she checked an oven. As she expected the bread was ready. She placed it on a wire rack to cool.

Did Mrs Clark bake the bread in the afternoon?

(5) Dress

Explicit Anaphoric

If the nanny didn't hurry the baby would be late for his routine clinic appointment. She was behind schedule because she was having difficulty putting the clothes on the baby, and he seemed particularly irritable. Finally, she discovered that the clothes were irritating the baby's skin. She decided to ask the doctor at the clinic for some advice.

Explicit Non-anaphoric

If the nanny didn't hurry the baby would be late for his routine clinic appointment. She was behind schedule because she was having difficulty putting the clothes on the baby, and he seemed particularly irritable. Finally, she discovered that clothes were irritating the baby's skin. She decided to ask the doctor at the clinic for some advice.

Implicit Anaphoric

If the nanny didn't hurry the baby would be late for his routine clinic appointment. She was behind schedule because she was having difficulty dressing the baby, and he seemed particularly irritable. Finally, she discovered that the clothes were irritating the baby's skin. She decided to ask the doctor at the clinic for some advice.

Implicit Non-anaphoric

If the nanny didn't hurry the baby would be late for his routine clinic appointment. She was behind schedule because she was having difficulty dressing the baby, and he seemed particularly irritable. Finally, she discovered that clothes were irritating the baby's skin. She decided to ask the doctor at the clinic for some advice.

(6) Surf

Explicit Anaphoric

The lifeguard closely monitored his allocated stretch of beach. He was rather anxious because despite the deteriorating weather conditions people continued to stand on surfboards to ride the ever increasing waves, and, one boy had disappeared beneath them. Only the board could be seen floating in the water. Was the sea rough?

Explicit Non-anaphoric

The lifeguard closely monitored his allocated stretch of beach. He was rather anxious because despite the deteriorating weather conditions people continued to stand on surfboards to ride the ever increasing waves, and, one boy had disappeared beneath them. Only a board could be seen floating in the water. He raised the alarm and dived into the water. Was the sea rough?

Implicit Anaphoric

The lifeguard closely monitored his allocated stretch of beach. He was rather anxious because despite the deteriorating weather conditions people continued to stand to surf the ever increasing waves, and one boy had disappeared beneath a huge wave. Only the board could be seen floating in the water. He raised the alarm and dived into the water. Was the sea rough?

Implicit Non-anaphoric

The lifeguard closely monitored his allocated stretch of beach. He was rather anxious because despite the deteriorating weather conditions people continued to stand to surf the ever increasing waves, and one boy had disappeared beneath a huge wave. Only a board could be seen floating in the water. He raised the alarm and dived into the water. Was the sea rough?

(7) Unlock

Explicit Anaphoric

Jane returned from her shopping trip laden with parcels. Since her hands were full it was difficult to open the door with the key. She cursed under her breath when she dropped the key into one of the bags. She fumbled about for a while reluctant to put her shopping down.

Explicit Non-anaphoric

Jane returned from her shopping trip laden with parcels. Since her hands were full it was difficult to open the door with the key. She cursed under her breath when she dropped some keys into one of the bags. She fumbled about for a while reluctant to put her shopping down.

Implicit Anaphoric

Jane returned from her shopping trip laden with parcels. Since her hands were full it was difficult to unlock the door. She cursed under her breath when she dropped the key into one of the bags. She fumbled about for a while reluctant to put her shopping down.

Implicit Non-anaphoric

Jane returned from her shopping trip laden with parcels. Since her hands were full it was difficult to unlock the door. She cursed quietly under her breath when she dropped some keys into one of the bags. She fumbled about for a while reluctant to put her shopping down.

(8) Freeze

Explicit Anaphoric

The winter of 1973 was the coldest anyone could remember. Once the snow was so heavy that it blocked the only road into town. The temperature remained so low that the lake was covered with ice for the entire season. The children had a wonderful time playing on the ice and building snowmen. They were very disappointed when the thaw came.

Explicit Non-anaphoric

The winter of 1973 was the coldest anyone could remember. Once the snow was so heavy that it blocked the only road into town. The temperature remained so low that the lake was covered with ice for the entire season. The children had a wonderful time playing on some ice and building snowmen. They were very disappointed when the thaw came.

Implicit Anaphoric

The winter of 1973 was the coldest anyone could remember. Once the snow was so heavy that it blocked the only road into town. The temperature remained so low that the lake was frozen for the entire season. The children had a wonderful time playing on the ice and building snowmen. They were very disappointed when the thaw came.

Implicit Non-anaphoric

The winter of 1973 was the coldest anyone could remember. Once the snow was so heavy that it blocked the only road into town. The temperature remained so low that the lake was frozen for the entire season. The children had a wonderful time playing on some ice and building snowmen. They were very disappointed when the thaw came.

(9) Sail

Explicit Anaphoric

Richard phoned his wife and told her the good news. He planned to catch the 6 o'clock boat from Calais. As the sea was quite rough she wondered if the boat would be delayed. She decided to check the estimated arrival times before setting off to meet him.

Did Richard sail from Dover?

Explicit Non-anaphoric

Richard phoned his wife and told her the good news. He planned to catch the 6 o'clock boat from Calais. As the sea was quite rough she wondered if a boat would be delayed. She decided to check the estimated arrival times before setting off to meet him.

Did Richard sail from Dover?

Implicit Anaphoric

Richard phoned his wife and told her the good news. He planned to sail at 6 o'clock from Calais. As the sea was quite rough she wondered if the boat would be delayed. She decided to check the estimated arrival times before setting off to meet him.

Did Richard sail from Dover?

Implicit Non-anaphoric

Richard phoned his wife and told her the good news. He planned to sail at 6 o'clock from Calais. As the sea was quite rough she wondered if a boat would be delayed. She decided to check the estimated arrival times before setting off to meet him.

Did Richard sail from Dover?

(10) Buy

Explicit Anaphoric

Jamie checked his watch. The bus was late again. When it arrived he climbed aboard, and gave the conductor money for a ticket. The conductor dropped the money when the bus stopped unexpectedly. A child had ran into the road.

Explicit Non-anaphoric

Jamie checked his watch. The bus was late again. When it arrived he climbed aboard, and gave the conductor money for a ticket. The conductor dropped some money when the bus stopped unexpectedly. A child had ran into the road.

Implicit Anaphoric

Jamie checked his watch. The bus was late again. When it arrived he climbed aboard and bought a ticket from the conductor. The conductor dropped the money when the bus stopped unexpectedly. A child had ran into the road.

Implicit Non-anaphoric

Jamie checked his watch. The bus was late again. When it arrived he climbed aboard and bought a ticket from the conductor. The conductor dropped some money when the bus stopped unexpectedly. A child had ran into the road.

(11) Photograph

Explicit Anaphoric

It was only a few hours since the oil tanker ran aground yet the small fishing village was already teeming with reporters. They jostled to be the first to capture on camera the important events as they happened. One man held the camera high above his head in an attempt to capture both the stranded ship and the slick of oil that was moving slowly but surely towards the shore.

Explicit Non-anaphoric

It was only a few hours since the oil tanker ran aground yet the small fishing village was already teeming with reporters. They jostled to capture on camera the important events as they happened. One man held a camera high above his head in an attempt to capture both the stranded ship and the slick of oil that was moving slowly but surely towards the shore.

Implicit Anaphoric

It was only a few hours since the oil tanker ran aground yet the small fishing village was already teeming with reporters. They jostled to photograph the important events as they happened. One man held the camera high above his head in an attempt to capture both the stranded ship and the slick of oil that was moving slowly but surely towards the shore.

Implicit Non-anaphoric

It was only a few hours since the oil tanker ran aground yet the small fishing village was already teeming with reporters. They jostled to be the first to photograph the important events as they happened. One man held a camera high above his head in an attempt to capture both the stranded ship and the slick of oil that was moving slowly but surely towards the shore.

(12) Post letter

Explicit Anaphoric

Gillian bought a birthday card for her mother. She planned to drop it in the post-box on the way home. She would have to take a longer route home to pass the post-box. If the card was collected to day it would arrive just in time.

Did Gillian go to visit her mother?

Explicit Non-anaphoric

Gillian bought a birthday card for her mother. She planned to drop it in the post-box on the way home. She would have to take a longer route home to pass a post-box. If the card was collected to day it would arrive just in time.

Did Gillian go to visit her mother?

Implicit Anaphoric

Gillian bought a birthday card for her mother. She planned to post it on the way home from the shops. She would have to take a longer route home to pass the post-box. If the card was collected to day it would arrive just in time.

Did Gillian go to visit her mother?

Implicit Non-anaphoric

Gillian bought a birthday card for her mother. She planned to post it on the way home from the shops. She would have to take a longer route home to pass a post-box. If the card was collected to day it would arrive just in time.

Did Gillian go to visit her mother?

(13) Fly

Explicit Anaphoric

Peter was becoming rather agitated and began to pace the floor in the departure lounge. He hated to travel by aeroplane and he was worried because no explanation had been given for the delay. He wondered if the aeroplane had been delayed due to technical difficulties.

Explicit Non-anaphoric

Peter was becoming rather agitated and began to pace the floor in the departure lounge. He hated to travel by aeroplane and he was worried because no explanation had been given for the delay. He wondered if an aeroplane had been delayed due to technical difficulties.

Implicit Anaphoric

Peter was becoming rather agitated and began to pace the floor in the departure lounge. He hated to fly in the evening and he was worried because no explanation had been given for the delay. He wondered if the aeroplane had been delayed due to technical difficulties.

Implicit Non-anaphoric

Peter was becoming rather agitated and began to pace the floor in the departure lounge. He hated to fly in the evening and he was worried because no explanation had been given for the delay. He wondered if an aeroplane had been delayed due to technical difficulties.

(14) Smoke

Explicit Anaphoric

John hated his new job as the corporation operated a clean air policy. If the employees wanted to have a cigarette they had to leave the building. This was very inconvenient and meant they could only have their cigarettes during the lunch break. Due to numerous complaints the management considered setting aside a room solely for this purpose.
Did John smoke?

Explicit Non-anaphoric

John hated his new job as the corporation operated a clean air policy. If the employees wanted to have a cigarette they had to leave the building. This was very inconvenient and meant they could only have cigarettes during the lunch break. Due to numerous complaints the management considered setting aside a room solely for this purpose.
Did John smoke?

Implicit Anaphoric

John hated his new job as the corporation operated a clean air policy. If the employees wanted to smoke they had to leave the building. This was very inconvenient and meant they could only have their cigarettes during the lunch break. Due to numerous complaints the management considered setting aside a room solely for this purpose.

Did John smoke?

Implicit Non-anaphoric

John hated his new job as the corporation operated a clean air policy. If the employees wanted to smoke they had to leave the building. This was very inconvenient and meant they could only have their cigarettes during the lunch break. Due to numerous complaints the management considered setting aside a room solely for this purpose.

Did John smoke?

15) Cut Hair

Explicit Anaphoric

The hairdresser used scissors on the customer's hair. The customer was not pleased with the final result. The hairdresser apologised and said that the scissors were blunt. The customer was not satisfied with this explanation and refused to pay.

Explicit Non-anaphoric

The hairdresser used scissors on the customer's hair. The customer was not pleased with the final result. The hairdresser apologised and said that scissors were blunt. The customer was not satisfied with this explanation and refused to pay.

Implicit Anaphoric

The hairdresser cut the customer's hair very short. The customer was not pleased with the final result. The hairdresser apologised and said that the scissors were blunt. The customer was not satisfied with this explanation and refused to pay.

Implicit Non-anaphoric

The hairdresser cut the customer's hair very short. The customer was not pleased with the final result. The hairdresser apologised and said that scissors were blunt. The customer was not satisfied with this explanation and refused to pay.

Appendix Two

Materials used in Experiment Two

VERB

INSTRUMENT

Clear Snow	Shovel
Change Tyre	Jack
Stir Soup	Spoon
Douse Fire	Water
Draw Lines	Pencil
Drive Nail	Hammer
Knit Scarf	Needles
Light Candle	Match
Open Can	Can -opener
Sweep Floor	Broom
Shoot Deer	Gun
Strike Golf-Ball	Club

Experimental Materials

(1) Clear snow

Explicit Anaphoric

The heavy snow fall during the night had blocked the drive. John helped his father clear the snow with a shovel. It was hard work so rested against the shovel and surveyed his morning's work. His dad promised to help him build a large snowman when they had finished.

Explicit Non-anaphoric

The heavy snow fall during the night had blocked the drive. John helped his father clear the snow with a shovel. It was hard work so rested against a shovel and surveyed his morning's work. His dad promised to help him build a large snowman when they had finished.

Implicit Anaphoric

The heavy snow fall during the night had blocked the drive. John helped his father clear the snow from the drive. It was hard work so rested against the shovel and surveyed his morning's work. His dad promised to help him build a large snowman when they had finished.

Implicit Non-anaphoric

The heavy snow fall during the night had blocked the drive. John helped his father clear the snow from the drive. It was hard work so rested against a shovel and surveyed his morning's work. His dad promised to help him build a large snowman when they had finished.

(2) Change tyre

Explicit Anaphoric

Allan cursed his luck as he pulled into the lay-by. He got out and began to change a tyre using a jack. He quickly replaced the tyre but unfortunately, the jack seized up as he began to lower the car. The car was left suspended 2 feet above the ground.

Explicit Non-anaphoric

Allan cursed his luck as he pulled into the lay-by. He got out and began to change a tyre using a jack. He quickly replaced the tyre but unfortunately, a jack seized up as he began to lower the car. The car was left suspended 2 feet above the ground.

Implicit Anaphoric

Allan cursed his luck as he pulled into the lay-by. He got out and began to change a tyre on his car. He quickly replaced the tyre but unfortunately, the jack seized up as he began to lower the car. The car was left suspended 2 feet above the ground.

Implicit Non-anaphoric

Allan cursed his luck as he pulled into the lay-by. He got out and began to change a tyre on his car. He quickly replaced the tyre but unfortunately, a jack seized up as he began to lower the car. The car was left suspended 2 feet above the ground.

(3) Stir soup

Explicit Anaphoric

It was almost 12 o'clock and the children would soon be home for lunch. Sue stirred the soup with a spoon. The doorbell rang, so she put down the spoon and went to open the door. Much to her surprise, her husband had come home for lunch.
Did Sue go out to lunch?

Explicit Non-anaphoric

It was almost 12 o'clock and the children would soon be home for lunch. Sue stirred the soup with a spoon. The doorbell rang, so she put down a spoon and went to open the door. Much to her surprise, her husband had come home for lunch.
Did Sue go out to lunch?

Implicit Anaphoric

It was almost 12 o'clock and the children would soon be home for lunch. Sue stirred the soup on the stove. The doorbell rang, so she put down the spoon and went to open the door. Much to her surprise, her husband had come home for lunch.

Did Sue go out to lunch?

Implicit Non-anaphoric

It was almost 12 o'clock and the children would soon be home for lunch. Sue stirred the soup on the stove. The doorbell rang, so she put down a spoon and went to open the door. Much to her surprise, her husband had come home for lunch.

Did Sue go out to lunch?

(4) Douse fire

Explicit Anaphoric

The gypsies decided to move closer to the village. They packed up camp and doused the fire with water. The children collected the water in buckets from the river. Luckily, they didn't have to walk far as the camp was situated near the river.

Were the gypsies moving camp?

Explicit Non-anaphoric

The gypsies decided to move closer to the village. They packed up camp and doused the fire with water. The children collected water in buckets from the river. Luckily, they didn't have to walk far as the camp was situated near the river.

Were the gypsies moving camp?

Implicit Anaphoric

The gypsies decided to move closer to the village. They packed up camp and doused the fire near the trees. The children collected the water in buckets from the river. Luckily, they didn't have to walk far as the camp was situated near the river.

Were the gypsies moving camp?

Implicit Non-anaphoric

The gypsies decided to move closer to the village. They packed up camp and doused the fire near the trees. The children collected water in buckets from the river. Luckily, they didn't have to walk far as the camp was situated near the river.

(5) Draw lines

Explicit Anaphoric

The architect was behind schedule on his design for the new shopping centre. He carefully drew the lines with a pencil. He chewed on the pencil as he considered possible sites for the car park. Once that was settled the project would be complete. Was the architect running to schedule?

Explicit Non-anaphoric

The architect was behind schedule on his design for the new shopping centre. He carefully drew the lines with a pencil. He chewed on a pencil as he considered possible sites for the car park. Once that was settled the project would be complete. Was the architect running to schedule?

Implicit Anaphoric

The architect was behind schedule on his design for the new shopping centre. He carefully drew the lines on the plan. He chewed on the pencil as he considered possible sites for the car park. Once that was settled the project would be complete. Was the architect running to schedule?

Implicit Non-anaphoric

The architect was behind schedule on his design for the new shopping centre. He carefully drew the lines on the plan. He chewed on a pencil as he considered possible sites for the car park. Once that was settled the project would be complete. Was the architect running to schedule?

(6) Drive nail

Explicit Anaphoric

The joiner was working in the basement of the old house. He drove the nails carefully with a hammer. It was getting late so he put the hammer in his toolbox and set off for home. He hoped to finish the job the following day.

Explicit Non-anaphoric

The joiner was working in the basement of the old house. He drove the nails carefully with a hammer. It was getting late so he put a hammer in his toolbox and set off for home. He hoped to finish the job the following day.

Implicit Anaphoric

The joiner was working in the basement of the old house. He drove the nails carefully into the wood. It was getting late so he put the hammer in his toolbox and set off for home. He hoped to finish the job the following day.

Implicit Non-anaphoric

The joiner was working in the basement of the old house. He drove the nails carefully into the wood. It was getting late so he put a hammer in his toolbox and set off for home. He hoped to finish the job the following day.

(7) Knit scarf

Explicit Anaphoric

Jean was preparing for winter. She was knitting a scarf with her needles. She wanted to watch her favourite soap opera so she pushed the needles through the ball of wool. She would finish the scarf later that evening.

Does Jean dislike soap operas?

Explicit Non-anaphoric

Jean was preparing for winter. She was knitting a scarf with her needles. She wanted to watch her favourite soap opera so she pushed needles through the ball of wool. She would finish the scarf later that evening.

Does Jean dislike soap operas?

Implicit Anaphoric

Jean was preparing for winter. She was knitting a scarf with green wool. She wanted to watch her favourite soap opera so she pushed the needles through the ball of wool. She would finish the scarf later that evening.

Does Jean dislike soap operas?

Implicit Non-anaphoric

Jean was preparing for winter. She was knitting a scarf with green wool. She wanted to watch her favourite soap opera so she pushed needles through the ball of wool. She would finish the scarf later that evening.

Does Jean dislike soap operas?

(8) Light candle

Explicit Anaphoric

There was an unexpected power cut due to the storm. Paul lit a candle with a match. He threw the match onto the floor. Then checked to see if the telephone was still working.

Was there a power cut?

Explicit Non-anaphoric

There was an unexpected power cut due to the storm. Paul lit a candle with a match. He threw a match onto the floor. Then checked to see if the telephone was still working.

Was there a power cut?

Implicit Anaphoric

There was an unexpected power cut due to the storm. Paul lit a candle in the kitchen. He threw the match onto the floor. Then checked to see if the telephone was still working.

Was there a power cut?

Implicit Non-anaphoric

There was an unexpected power cut due to the storm. Paul lit a candle in the kitchen. He threw a match onto the floor. Then checked to see if the telephone was still working.

Was there a power cut?

(9) Open can

Explicit Anaphoric

It was 7 o'clock when David arrived home. He was hungry so he opened a can of soup with a can-opener. He poured the soup into a saucepan and put the can-opener into the sink. The telephone rang just as he started to eat his soup.

Explicit Non-anaphoric

It was 7 o'clock when David arrived home. He was hungry so he opened a can of soup with a can-opener. He poured the soup into a saucepan and put a can-opener into the sink. The telephone rang just as he started to eat his soup.

Implicit Anaphoric

It was 7 o'clock when David arrived home. He was hungry so he opened a can of soup for his dinner. He poured the soup into a saucepan and put the can-opener into the sink. The telephone rang just as he started to eat his soup.

Implicit Non-anaphoric

It was 7 o'clock when David arrived home. He was hungry so he opened a can of soup for his dinner. He poured the soup into a saucepan and put a can-opener into the sink. The telephone rang just as he started to eat his soup.

(10) Sweep floor

Explicit Anaphoric

Although it was only six thirty the sailor had already started his duties. He had hoisted the main-sail and now he was sweeping the floor with a broom. When the Captain arrived he put down the broom and saluted him. Once he was out of sight he resumed his task.

Did the Captain sweep the floor?

Explicit Non-anaphoric

Although it was only six thirty the sailor had already started his duties. He had hoisted the main-sail and now he was sweeping the floor with a broom. When the Captain arrived he put down a broom and saluted him. Once he was out of sight he resumed his task.

Did the Captain sweep the floor?

Implicit Anaphoric

Although it was only six thirty the sailor had already started his duties. He had hoisted the main sail and now he was sweeping the floor of the cabin. When the Captain arrived he put down the broom and saluted him. Once he was out of sight he resumed his task.

Did the Captain sweep the floor?

Implicit Non-anaphoric

Although it was only six thirty the sailor had already started his duties. He had hoisted the main sail and now he was sweeping the floor of the cabin. When the Captain arrived he put down a broom and saluted him. Once he was out of sight he resumed his task.

Did the Captain sweep the floor?

(11) Shoot deer

Explicit Anaphoric

The hunter set off on his trip expedition early in the morning. He stalked, then shot, a deer with his gun. Then he rested in the shade of a tree and kept the gun close-by in case he spotted another deer. He didn't see another deer but he did see a rabbit.

Explicit Non-anaphoric

The hunter set off on his trip expedition early in the morning. He stalked, then shot, a deer with his gun. Then he rested in the shade of a tree and kept a gun close-by in case he spotted another deer. He didn't see another deer but he did see a rabbit.

Implicit Anaphoric

The hunter set off on his trip expedition early in the morning. He stalked, then shot, a deer in the forest. Then he rested in the shade of a tree and kept the gun close-by in case he spotted another deer. He didn't see another deer but he did see a rabbit.

Implicit Non-anaphoric

The hunter set off on his trip expedition early in the morning. He stalked, then shot, a deer in the forest. Then he rested in the shade of a tree and kept a gun close-by in case he spotted another deer. He didn't see another deer but he did see a rabbit.

(12) Strike golf-ball

Explicit Anaphoric

Jason liked to play golf on Sunday afternoon. He struck the ball with the club. It began to rain, so he put the club in the bag and set off for a drink in the clubhouse.

Explicit Non-anaphoric

Jason liked to play golf on Sunday afternoon. He struck the ball with the club. It began to rain, so he put a club in the bag and set off for a drink in the clubhouse.

Implicit Anaphoric

Jason liked to play golf on Sunday afternoon. He struck the ball with skill. It began to rain, so he put the club in the bag and set off for a drink in the clubhouse.

Implicit Non-anaphoric

Jason liked to play golf on Sunday afternoon. He struck the ball with skill. It began to rain, so he put a club in the bag and set off for a drink in the clubhouse.

Appendix Three

Pre-test Questionnaire used in Experiment Three

Instructions

Please specify the Instrument or Instruments which are likely to be used when performing the actions listed on the following page.

An Instrument is the tool, object, or thing which should be used to carry out a given task.

E.g., To mix ingredients you would use a spoon.

To open a can you would use a can-opener.

To dry your hair you would use a towel, a hairdryer.

Hint - Think about what you would use to

e.g., What would you use to lift cargo?

Answer: crane (Instrument)

- 1) To dry yourself.....
- 2) To fill Christmas stockings.....
- 3) To cover eyes.....
- 4) To carry groceries.....
- 5) To wash clothes.....
- 6) To take photographs.....
- 7) To write letter.....
- 8) To catch a mouse.....
- 9) To steer boat.....
- 10) Animals drink from.....
- 11) To view at slides.....
- 12) To chop wood.....
- 13) To listen to heartbeat.....
- 14) To carve meat.....
- 15) To cut grass.....
- 16) To decorate cake.....
- 17) To ride a bike.....
- 18) To spread butter.....
- 19) To light candle.....
- 21) To shoot arrows.....
- 22) To clean your teeth.....
- 23) To play drums.....
- 24) To boil an egg.....
- 25) To hang a man.....
- 26) To open a bottle of wine.....
- 27) To hit a ball.....
- 28) To measure length of line.....

- 1) To dry clothes.....
- 2) To fill car tank.....
- 3) To cover person.....
- 4) To carry groceries.....
- 5) To wash hair.....
- 6) To take temperature.....
- 7) To write on blackboard.....
- 8) To catch fish.....
- 9) To steer car.....
- 10) To drink tea.....
- 11) To view at stars.....
- 12) To chop vegetables.....
- 13) To listen to personal hi-fi.....
- 14) To carve stone.....
- 15) To cut hair.....
- 16) To decorate Christmas Tree.....
- 17) To ride a horse.....
- 18) To spread cement.....
- 19) To light cigarette.....
- 21) To shoot bullets.....
- 22) To clean window.....
- 23) To play rugby.....
- 24) To boil water.....
- 25) To hang coat.....
- 26) To open can.....
- 27) To hit nail.....
- 28) To measure air pressure.....

Appendix Four

Verbs & Instruments used in Experiment 3

<u>Verb In Context</u>	<u>Instrument</u>
View Bacteria	Microscope
View Stars	Telescope
Carry Bricks	Hod
Carry Groceries	Bag
Shoot Bullets	Gun
Shoot Arrows	Bow
Play Ruby	Ball
Play Drums	Sticks
Hit Nail	Hammer
Hit Ball	Bat
Decorate Christmas Tree	Tinsel
Decorate Cake	Icing
Fill Car Tank	Petrol
Fill Christmas Stocking	Presents
Drink Wine	Glass
Animals Drink	Trough
Chop Vegetables	Knife
Chop Wood	Axe
Steer Boat	Rudder
Steer Car	Wheel
Catch Fish	Rod
Catch Mouse	Trap
Cut Hair	Scissors
Cut Grass	Lawnmower
Spread Butter	Knife
Spread Cement	Trowel
Carve Meat	Knife
Carve Stone	Chisel
Cover Eyes	Blindfold
Cover Person	Blanket
Write Letter	Pen
Write Board	Chalk
Take Photograph	Camera
Take Temperature	Thermometer
Clean Window	Cloth
Clean Teeth	Toothbrush
Listen Heartbeat	Stethoscope
Listen Personal Hi-Fi	Headphones
Wash Clothes	Powder
Wash Hair	Shampoo

Experimental Materials

1) View

(a) View Stars

Explicit Anaphoric

The new observatory was built at the top of a hill. The astronomer viewed the stars with a telescope. To obtain the best view the telescope was situated on the roof of the building. The new lab contained some of the most sophisticated equipment and employed some of the best research staff.

Explicit Non-Anaphoric

The new observatory was built at the top of a hill. The astronomer viewed the stars with a telescope. To obtain the best view a telescope was situated on the roof of the building. The new lab contained some of the most sophisticated equipment and employed some of the best research staff.

Implicit Anaphoric

The new observatory was built at the top of a hill. The astronomer viewed the stars in a distant galaxy. To obtain the best view the telescope was situated on the roof of the building. The new lab contained some of the most sophisticated equipment and employed some of the best research staff.

Implicit Non-Anaphoric

The new observatory was built at the top of a hill. The astronomer viewed the stars in a distant galaxy. To obtain the best view a telescope was situated on the roof of the building. The new lab contained some of the most sophisticated equipment and employed some of the best research staff.

(b) View Bacteria

Explicit Anaphoric

A large team of scientists were investigating the epidemic. Samples of bacteria were viewed through a microscope. As expected the microscope revealed that the infection was being carried in the water supply. All that remained to be found was an antidote.

Explicit Non-Anaphoric

A large team of scientists were investigating the epidemic. Samples of bacteria were viewed through a microscope. As expected a microscope revealed that the infection was being carried in the water supply. All that remained to be found was an antidote.

Implicit Anaphoric

A large team of scientists were investigating the epidemic. Samples of bacteria were viewed and extensively analysed. As expected the microscope revealed that the infection was being carried in the water supply. All that remained to be found was an antidote.

Implicit Non-Anaphoric

A large team of scientists were investigating the epidemic. Samples of bacteria were viewed and extensively analysed. As expected a microscope revealed that the infection was being carried in the water supply. All that remained to be found was an antidote.

2) Carry

(a) Carry Groceries

Explicit Anaphoric

Graham hated shopping on Saturday afternoon because the shops were so busy. He carried his groceries home in a bag. Much to his annoyance, the bag burst and his groceries fell to the ground. He angrily picked them up and hurried home. Did Graham carry the groceries home in a bag?

Explicit Non-Anaphoric

Graham hated shopping on Saturday afternoon because the shops were so busy. He carried his groceries home in a bag. Much to his annoyance, a bag burst and his groceries fell to the ground. He angrily picked them up and hurried home. Did Graham carry the groceries home in a bag?

Implicit Anaphoric

Graham hated shopping on Saturday afternoon because the shops were so busy. He carried his groceries home from the shops. Much to his annoyance, the bag burst and his groceries fell to the ground. He angrily picked them up and hurried home. Did Graham carry the groceries home in a bag?

Implicit Non-Anaphoric

Graham hated shopping on Saturday afternoon because the shops were so busy. He carried his groceries home from the shops. Much to his annoyance, a bag burst and his groceries fell to the ground. He angrily picked them up and hurried home.
Did Graham carry the groceries home in a bag?

(b) Carry Bricks

Explicit Anaphoric

The builder was working hard as the job was 3 weeks behind schedule. He carried the bricks in a hod. He was tiring quickly because the hod was heavy. He decided to stop for a rest.
Did the builder stop for a rest?

Explicit Non-Anaphoric

The builder was working hard as the job was 3 weeks behind schedule. He carried the bricks in a hod. He was tiring quickly because a hod was heavy. He decided to stop for a rest.
Did the builder stop for a rest?

Implicit Anaphoric

The builder was working hard as the job was 3 weeks behind schedule. He carried the bricks up the ladder. He was tiring quickly because the hod was heavy. He decided to stop for a rest.
Did the builder stop for a rest?

Implicit Non-Anaphoric

The builder was working hard as the job was 3 weeks behind schedule. He carried the bricks up the ladder. He was tiring quickly because a hod was heavy. He decided to stop for a rest.
Did the builder stop for a rest?

3) Shoot

(a) Shoot Arrows

Explicit Anaphoric

The archer was nervous as the final contestants were called to take their positions. He shot the arrow from his bow. He missed the bull's-eye because the string on the bow was loose. This bad shot would cost him the contest.
Did the archer hit the bull's-eye?

Explicit Non-Anaphoric

The archer was nervous as the final contestants were called to take their positions. He shot the arrow from his bow. He missed the bull's-eye because the string on a bow was loose. This bad shot would cost him the contest.

Did the archer hit the bull's-eye?

Implicit Anaphoric

The archer was nervous as the final contestants were called to take their positions. He shot the arrow with caution. He missed the bull's-eye because the string on the bow was loose. This bad shot would cost him the contest.

Did the archer hit the bull's-eye?

Implicit Non-Anaphoric

The archer was nervous as the final contestants were called to take their positions. He shot the arrow with caution. He missed the bull's-eye because the string on a bow was loose. This bad shot would cost him the contest.

Did the archer hit the bull's-eye?

(b) Shoot Bullets

Explicit Anaphoric

Graham won numerous prizes at the rifle range. He shot the bullets from the gun with great skill. He missed the target once, when the gun jammed and failed to fire. The stallholder was sad to see him leave as his skill had attracted lots of spectators.

Did Graham win prizes at the rifle range?

Explicit Non-Anaphoric

Graham won numerous prizes at the rifle range. He shot the bullets from the gun with great skill. He missed the target once, when a gun jammed and failed to fire. The stallholder was sad to see him leave as his skill had attracted lots of spectators.

Did Graham win prizes at the rifle range?

Implicit Anaphoric

Graham won numerous prizes at the rifle range. He shot the bullets from 5 meters with great skill. He missed the target once, when the gun jammed and failed to fire. The stallholder was sad to see him leave as his skill had attracted lots of spectators.

Did Graham win prizes at the rifle range?

Implicit Non-Anaphoric

Graham won numerous prizes at the rifle range. He shot the bullets from 5 meters with great skill. He missed the target once, when a gun jammed and failed to fire. The stallholder was sad to see him leave as his skill had attracted lots of spectators.

Did Graham win prizes at the rifle range?

4) Play

(a) Play Rugby

Explicit Anaphoric

It was a sunny day and the twins decided to go to the park. They wanted to play rugby, so they took a ball. They were most disappointed when the ball was accidentally kicked into the lake. They decided to buy some ice-cream as consolation.

Explicit Non-Anaphoric

It was a sunny day and the twins decided to go to the park. They wanted to play rugby, so they took a ball. They were most disappointed when a ball was accidentally kicked into the lake. They decided to buy some ice-cream as consolation.

Implicit Anaphoric

It was a sunny day and the twins decided to go to the park. They wanted to play rugby, so they took some friends. They were most disappointed when the ball was accidentally kicked into the lake. They decided to buy some ice-cream as consolation.

Implicit Non-Anaphoric

It was a sunny day and the twins decided to go to the park. They wanted to play rugby, so they took some friends. They were most disappointed when a ball was accidentally kicked into the lake. They decided to buy some ice-cream as consolation.

(b) Play Drums

Explicit Anaphoric

Mark was excited by the prospect of rehearsing with his new band. He played his drums with sticks. The rehearsal was going well till he hit a drum so hard that the stick broke in two. He laughed and decided to stop for a break.

Explicit Non-Anaphoric

Mark was excited by the prospect of rehearsing with his new band. He played his drums with sticks. The rehearsal was going well till he hit a drum so hard that a stick broke in two. He laughed and decided to stop for a break.

Implicit Anaphoric

Mark was excited by the prospect of rehearsing with his new band. He played his drums very loudly. The rehearsal was going well till he hit a drum so hard that the stick broke in two. He laughed and decided to stop for a break.

Implicit Non-Anaphoric

Mark was excited by the prospect of rehearsing with his new band. He played his drums very loudly. The rehearsal was going well till he hit a drum so hard that a stick broke in two. He laughed and decided to stop for a break.

5) Hit

(a) Hit Nail

Explicit Anaphoric

Ian was making a kennel for his new puppy. He hit the nails with a hammer. He cried loudly when the hammer slipped and he hit his thumb. He cried so loudly that his mother came to see what was wrong.

Did Ian hit his thumb with the hammer?

Explicit Non-Anaphoric

Ian was making a kennel for his new puppy. He hit the nails with a hammer. He cried loudly when a hammer slipped and he hit his thumb. He cried so loudly that his mother came to see what was wrong.

Did Ian hit his thumb with the hammer?

Implicit Anaphoric

Ian was making a kennel for his new puppy. He hit the nails into the wood. He cried loudly when the hammer slipped and he hit his thumb. He cried so loudly that his mother came to see what was wrong.

Did Ian hit his thumb with the hammer?

Implicit Non-Anaphoric

Ian was making a kennel for his new puppy. He hit the nails into the wood. He cried loudly when a hammer slipped and he hit his thumb. He cried so loudly that his mother came to see what was wrong.

(b) Hit Ball

Explicit Anaphoric

Tom's dad was teaching him to play cricket. He showed him how to hit the ball with the bat. He told him to stand in front of the wicket and swing the bat smoothly as he prepared to take his shot. Within a few days, Tom could hit the ball far enough to score a good few runs.

Was Tom learning to play cricket?

Explicit Anaphoric

Tom's dad was teaching him to play cricket. He showed him how to hit the ball with the bat. He told him to stand in front of the wicket and swing a bat smoothly as he prepared to take his shot. Within a few days, Tom could hit the ball far enough to score a good few runs.

Was Tom learning to play cricket?

Implicit Anaphoric

Tom's dad was teaching him to play cricket. He showed him how to hit the ball with spin. He told him to stand in front of the wicket and swing the bat smoothly as he prepared to take his shot. Within a few days, Tom could hit the ball far enough to score a good few runs.

Was Tom learning to play cricket?

Implicit Non-Anaphoric

Tom's dad was teaching him to play cricket. He showed him how to hit the ball with spin. He told him to stand in front of the wicket and swing a bat smoothly as he prepared to take his shot. Within a few days, Tom could hit the ball far enough to score a good few runs.

Was Tom learning to play cricket?

6) Decorate

(a) Decorate Cake

Explicit Anaphoric

It was the night before Jane's birthday and her mother was busy preparing for the party. She decorated the birthday cake with green and white icing. When she finished, she washed the dishes and licked the icing from the bowl. She hoped Jane would enjoy her surprise party.

Did Jane know about the party?

Explicit Non-Anaphoric

It was the night before Jane's birthday and her mother was busy preparing for the party. She decorated the birthday cake with green and white icing. When she finished, she washed the dishes and licked icing from the bowl. She hoped Jane would enjoy her surprise party.

Did Jane know about the party?

Implicit Anaphoric

It was the night before Jane's birthday and her mother was busy preparing for the party. She decorated the birthday cake with various designs. When she finished, she washed the dishes and licked the icing from the bowl. She hoped Jane would enjoy her surprise party.

Did Jane know about the party?

Implicit Non-Anaphoric

It was the night before Jane's birthday and her mother was busy preparing for the party. She decorated the birthday cake with various designs. When she finished, she washed the dishes and licked icing from the bowl. She hoped Jane would enjoy her surprise party.

Did Jane know about the party?

(b) Decorate Christmas Tree

Explicit Anaphoric

It was Christmas Eve and the Smith children were excited. Their mother helped them decorate the Christmas Tree with tinsel. When they switched on the lights the tinsel glittered brightly on the tree. They asked their mother if she would take a photograph of them beside the Tree.

Did the children decorate the Tree a week before Christmas?

Explicit Non-Anaphoric

It was Christmas Eve and the Smith children were excited. Their mother helped them decorate the Christmas Tree with tinsel. When they switched on the light tinsel glittered brightly on the tree. They asked their mother if she would take a photograph of them beside the Tree.

Did the children decorate the Tree a week before Christmas?

Implicit Anaphoric

It was Christmas Eve and the Smith children were excited. Their mother helped them decorate the Christmas Tree in the hall. When they switched on the lights the tinsel glittered brightly on the tree. They asked their mother if she would take a photograph of them beside the Tree.

Implicit Non-Anaphoric

It was Christmas Eve and the Smith children were excited. Their mother helped them decorate the Christmas Tree in the hall. When they switched on the lights tinsel glittered brightly on the tree. They asked their mother if she would take a photograph of them beside the Tree.

Did the children decorate the Tree a week before Christmas?

7) Fill

(a) Fill Christmas Stockings

Explicit Anaphoric

It was Christmas Eve and the Clark children were finally asleep. Their father quietly filled the stockings with presents. The children opened the presents early the next morning. They were very pleased with the toys Santa had left for them.

Explicit Non-Anaphoric

It was Christmas Eve and the Clark children were finally asleep. Their father quietly filled the stockings with presents. The children opened presents early the next morning. They were very pleased with the toys Santa had left for them.

Implicit Anaphoric

It was Christmas Eve and the Clark children were finally asleep. Their father quietly filled the stockings hung by the fire. The children opened the presents early the next morning. They were very pleased with the toys Santa had left for them.

Implicit Non-Anaphoric

It was Christmas Eve and the Clark children were finally asleep. Their father quietly filled the stockings hung by the fire. The children opened presents early the next morning. They were very pleased with the toys Santa had left for them.

(b) Fill Car Tank

Explicit Anaphoric

Alison's brakes screeched loudly as she pulled into the Esso station. She filled the car tank with petrol. In her hurry, she accidentally spilt the petrol over both herself and the garage forecourt. She would definitely be late for work as she would need to go home and change.

Explicit Non-Anaphoric

Alison's brakes screeched loudly as she pulled into the Esso station. She filled the car tank with petrol. In her hurry, she accidentally spilt petrol over both herself and the garage forecourt. She would definitely be late for work as she would need to go home and change.

Implicit Anaphoric

Alison's brakes screeched loudly as she pulled into the Esso station. She filled the car tank with haste. In her hurry, she accidentally spilt the petrol over both herself and the garage forecourt. She would definitely be late for work as she would need to go home and change.

Implicit Non-Anaphoric

Alison's brakes screeched loudly as she pulled into the Esso station. She filled the car tank with haste. In her hurry, she accidentally spilt petrol over both herself and the garage forecourt. She would definitely be late for work as she would need to go home and change.

8) Drink

(a) Drink Tea

Explicit Anaphoric

Anne settled down to watch television. She was drinking her tea from a china cup when the doorbell rang. As she rose to open the door, she knocked the cup to the floor. She hoped the tea wouldn't leave a nasty stain.

Explicit Non-Anaphoric

Anne settled down to watch television. She was drinking her tea from a china cup when the doorbell rang. As she rose to open the door, she knocked a cup to the floor. She hoped the tea wouldn't leave a nasty stain.

Implicit Anaphoric

Anne settled down to watch television. She was drinking her afternoon tea when the doorbell rang. As she rose to open the door, she knocked the cup to the floor. She hoped the tea wouldn't leave a nasty stain.

Implicit Non-Anaphoric

Anne settled down to watch television. She was drinking her afternoon tea when the doorbell rang. As she rose to open the door, she knocked a cup to the floor. She hoped the tea wouldn't leave a nasty stain.

(b) Animals Drink

Explicit Anaphoric

Mrs Brown took her children to the Show Farm on Sunday. They stopped to watch the cattle drinking from a trough. The cattle were very thirsty and the trough had been filled at least twice that day. Next, they went to see the goats being milked.

Explicit Non-Anaphoric

Mrs Brown took her children to the Show Farm on Sunday. They stopped to watch the cattle drinking from a trough. The cattle were very thirsty and a trough had been filled at least twice that day. Next, they went to see the goats being milked.

Implicit Anaphoric

Mrs Brown took her children to the Show Farm on Sunday. They stopped to watch the cattle drinking their water. The cattle were very thirsty and the trough had been filled at least twice that day. Next, they went to see the goats being milked.

Implicit Non-Anaphoric

Mrs Brown took her children to the Show Farm on Sunday. They stopped to watch the cattle drinking their water. The cattle were very thirsty and a trough had been filled at least twice that day. Next, they went to see the goats being milked.

9) Chop

(a) Chop Vegetables

Explicit Anaphoric

It was the lunch time rush and the restaurant kitchen was warm and steamy. The chef was busy chopping vegetables with a knife. He accidentally dropped the knife on the floor. He called to his assistant for some help.
Did the chef drop the knife?

Explicit Non-Anaphoric

It was the lunch time rush and the restaurant kitchen was warm and steamy. The chef was busy chopping vegetables with a knife. He accidentally dropped a knife on the floor. He called to his assistant for some help.
Did the chef drop the knife?

Implicit Anaphoric

It was the lunch time rush and the restaurant kitchen was warm and steamy. The chef was busy chopping vegetables for the soup. He accidentally dropped the knife on the floor. He called to his assistant for some help.

Did the chef drop the knife?

Implicit Non-Anaphoric

It was the lunch time rush and the restaurant kitchen was warm and steamy. The chef was busy chopping vegetables for the soup. He accidentally dropped a knife on the floor. He called to his assistant for some help.

Did the chef drop the knife?

(b) Chop Wood

Explicit Anaphoric

Jack was busy preparing for winter. He was chopping wood with an axe. He worked so hard that the axe was now quite blunt. He would be glad when this chore was finished.

Did Jack enjoy chopping wood?

Explicit Non-Anaphoric

Jack was busy preparing for winter. He was chopping wood with an axe. He worked so hard that an axe was now quite blunt. He would be glad when this chore was finished.

Did Jack enjoy chopping wood?

Implicit

Jack was busy preparing for winter. He was chopping wood for the fire. He worked so hard that the axe was now quite blunt. He would be glad when this chore was finished.

Did Jack enjoy chopping wood?

Implicit Non-Anaphoric

Jack was busy preparing for winter. He was chopping wood for the fire. He worked so hard that an axe was now quite blunt. He would be glad when this chore was finished.

Did Jack enjoy chopping wood?

10) Steer

(a) Steer Boat

Explicit Anaphoric

Due to the high winds and rough sea the small fishing boat was far from its charted course. The stormy weather had made it difficult to steer the boat with the rudder. When the storm subsided the Captain discovered that the rudder was damaged. He decided to radio for assistance.
Was the weather stormy?

Explicit Non-Anaphoric

Due to the high winds and rough sea the small fishing boat was far from its charted course. The stormy weather had made it difficult to steer the boat with the rudder. When the storm subsided the Captain discovered that a rudder was damaged. He decided to radio for assistance.
Was the weather stormy?

Implicit Anaphoric

Due to the high winds and rough sea the small fishing boat was far from its charted course. The stormy weather had made it difficult to steer the boat towards the shore. When the storm subsided the Captain discovered that the rudder was damaged. He decided to radio for assistance.
Was the weather stormy?

Implicit Non-Anaphoric

Due to the high winds and rough sea the small fishing boat was far from its charted course. The stormy weather had made it difficult to steer the boat towards the shore. When the storm subsided the Captain discovered that a rudder was damaged. He decided to radio for assistance.
Was the weather stormy?

(b) Steer Car

Explicit Anaphoric

James reduced his speed as the road contained many sharp bends. He steered the car around the bends with the wheel. Sometimes, he had to turn the wheel quickly to keep the car on course. Once he almost ran off the road and into a ditch.
Did the road contain many sharp bends?

Explicit Non-Anaphoric

James reduced his speed as the road contained many sharp bends. He steered the car around the bends with the wheel. Sometimes, he had to turn a wheel quickly to keep a car on course. Once he almost ran off the road and into a ditch.

Did the road contain many sharp bends?

Implicit Anaphoric

James reduced his speed as the road contained many sharp bends. He steered the car around the bends with great care. Sometimes, he had to turn the wheel quickly to keep the car on course. Once he almost ran off the road and into a ditch.

Did the road contain many sharp bends?

Implicit Non-Anaphoric

James reduced his speed as the road contained many sharp bends. He steered the car around the bends with great care. Sometimes, he had to turn a wheel quickly to keep a car on course. Once he almost ran off the road and into a ditch.

Did the road contain many sharp bends?

11) Catch

(a) Catch Mouse

Explicit Anaphoric

Several mice lived under the floorboards of the empty house. On numerous occasions the caretaker tried to catch them in a trap. To lure them out he baited the trap with cheese. The problem had to be dealt with quickly as the mice were discouraging potential buyers.

Explicit Non-Anaphoric

Several mice lived under the floorboards of the empty house. On numerous occasions the caretaker tried to catch them in a trap. To lure them out he baited a trap with cheese. The problem had to be dealt with quickly as the mice were discouraging potential buyers.

Implicit Anaphoric

Several mice lived under the floorboards of the empty house. On numerous occasions the caretaker tried to catch them in the cellar. To lure them out he baited the trap with cheese. The problem had to be dealt with quickly as the mice were discouraging potential buyers.

Implicit Non-Anaphoric

Several mice lived under the floorboards of the empty house. On numerous occasions the caretaker tried to catch them in the cellar. To lure them out he baited a trap with cheese. The problem had to be dealt with quickly as the mice were discouraging potential buyers.

(b) Catch Fish

Explicit Anaphoric

Richard walked along the bank looking for a shady spot. He hoped he would catch many fish this time with his new rod. He sat under a tree and baited the rod with a worm. He enjoyed his fishing trips as he found them very relaxing.

Explicit Non-Anaphoric

Richard walked along the bank looking for a shady spot. He hoped he would catch many fish this time with his new rod. He sat under a tree and baited a rod with a worm. He enjoyed his fishing trips as he found them very relaxing.

Implicit Anaphoric

Richard walked along the bank looking for a shady spot. He hoped he would catch many fish from the fresh water stream. He sat under a tree and baited the rod with a worm. He enjoyed his fishing trips as he found them very relaxing.

Implicit Non-Anaphoric

Richard walked along the bank looking for a shady spot. He hoped he would catch many fish from the fresh water stream. He sat under a tree and baited a rod with a worm. He enjoyed his fishing trips as he found them very relaxing.

12) Cut

(a) Cut Hair

Explicit Anaphoric

It was Saturday afternoon and the salon was very busy. The hairdresser cut the customer's hair with scissors. The hairdresser complained that the scissors were blunt. She had been very busy all day and was looking forward to closing time. Was it Monday morning?

Explicit Non-Anaphoric

It was Saturday afternoon and the salon was very busy. The hairdresser cut the customer's hair with scissors. The hairdresser complained that scissors were blunt. She had been very busy all day and was looking forward to closing time. Was it Monday morning?

Implicit Anaphoric

It was Saturday afternoon and the salon was very busy. The hairdresser cut the customer's hair with caution. The hairdresser complained that the scissors were blunt. She had been very busy all day and was looking forward to closing time. Was it Monday morning?

Implicit Non-Anaphoric

It was Saturday afternoon and the salon was very busy. The hairdresser cut the customer's hair with caution. The hairdresser complained that scissors were blunt. She had been very busy all day and was looking forward to closing time. Was it Monday morning?

(b) Cut Grass

Explicit Anaphoric

It was early summer and there was lots of work to be done in the garden. The gardener cut the grass with a lawn-mower. He had to wear earmuffs as the lawn-mower was noisy. When he finished he ate his sandwiches in the shade of a large tree. Did the gardener eat his lunch on the river bank?

Explicit Non-Anaphoric

It was early summer and there was lots of work to be done in the garden. The gardener cut the grass with a lawn-mower. He had to wear earmuffs as a lawn-mower was noisy. When he finished he ate his sandwiches in the shade of a large tree. Did the gardener eat his lunch on the river bank?

Implicit Anaphoric

It was early summer and there was lots of work to be done in the garden. The gardener cut the grass surrounding the pond. He had to wear earmuffs as the lawn-mower was noisy. When he finished he ate his sandwiches in the shade of a large tree. Did the gardener eat his lunch on the river bank?

Implicit Non-Anaphoric

It was early summer and there was lots of work to be done in the garden. The gardener cut the grass surrounding the pond. He had to wear earmuffs as a lawn-mower was noisy. When he finished he ate his sandwiches in the shade of a large tree. Did the gardener eat his lunch on the river bank?

13) Spread

(a) Spread Butter

Explicit Anaphoric

Susan was making a sandwich for her lunch. She spread the butter thickly with a knife. Then she washed up, and put the dishes in the cupboard and the knife in the cutlery drawer. She liked to leave the kitchen tidy.

Explicit Non-Anaphoric

Susan was making a sandwich for her lunch. She spread the butter thickly with a knife. Then she washed up, and put the dishes in the cupboard and a knife in the cutlery drawer. She liked to leave the kitchen tidy.

Implicit Anaphoric

Susan was making a sandwich for her lunch. She spread the butter thickly on the bread. Then she washed up, and put the dishes in the cupboard and the knife in the cutlery drawer. She liked to leave the kitchen tidy.

Implicit Anaphoric

Susan was making a sandwich for her lunch. She spread the butter thickly on the bread. Then she washed up, and put the dishes in the cupboard and a knife in the cutlery drawer. She liked to leave the kitchen tidy.

(b) Spread Cement

Explicit Anaphoric

Andrew stopped to watch the men working on the building site. He watched the builder spreading cement with a trowel. He pushed a brick firmly into place and used the trowel to remove any excess cement. The foundations had to be secure as the building had to meet strict safety regulations.

Explicit Non-Anaphoric

Andrew stopped to watch the men working on the building site. He watched the builder spreading cement with a trowel. He pushed a brick firmly into place and used a trowel to remove any excess cement. The foundations had to be secure as the building had to meet strict safety regulations.

Implicit Anaphoric

Andrew stopped to watch the men working on the building site. He watched the builder spreading cement on the bricks. He pushed a brick firmly into place and used the trowel to remove any excess cement. The foundations had to be secure as the building had to meet strict safety regulations.

Implicit Non-Anaphoric

Andrew stopped to watch the men working on the building site. He watched the builder spreading cement on the bricks. He pushed a brick firmly into place and used a trowel to remove any excess cement. The foundations had to be secure as the building had to meet strict safety regulations.

14) Carve

(a) Carve Meat

Explicit Anaphoric

The chef was preparing for the buffet. He carved the meat with a knife. He let out a loud cry when the knife slipped and he cut his hand. The cut was rather deep and would probably need stitches.

Explicit Non-Anaphoric

The chef was preparing for the buffet. He carved the meat with a knife. He let out a loud cry when a knife slipped and he cut his hand. The cut was rather deep and would probably need stitches.

Implicit Anaphoric

The chef was preparing for the buffet. He carved the meat in thin slices. He let out a loud cry when the knife slipped and he cut his hand. The cut was rather deep and would probably need stitches.

Implicit Non-Anaphoric

The chef was preparing for the buffet. He carved the meat in thin slices. He let out a loud cry when a knife slipped and he cut his hand. The cut was rather deep and would probably need stitches.

(b) Carve Wood

Explicit Anaphoric

The wooden figure was almost complete. The carpenter was carving the intricate facial details with a chisel. He needed to be very precise so he kept the chisel very sharp. When he finished, he stood back to admire his work.

Explicit Non-Anaphoric

The wooden figure was almost complete. The carpenter was carving the intricate facial details with a chisel. He needed to be very precise so he kept a chisel very sharp. When he finished, he stood back to admire his work.

Implicit Anaphoric

The wooden figure was almost complete. The carpenter was carving the intricate facial details with great care. He needed to be very precise so he kept the chisel very sharp. When he finished, he stood back to admire his work.

Implicit Non-Anaphoric

The wooden figure was almost complete. The carpenter was carving the intricate facial details with great care. He needed to be very precise so he kept a chisel very sharp. When he finished, he stood back to admire his work.

15) Cover

(a) Cover Eyes

Explicit Anaphoric

The kidnapper abducted the hostage as she was leaving her home. He covered her eyes with a blindfold and took her to a remote farm. He removed the blindfold when they reached the farmhouse. She was afraid and hoped the ransom would soon be paid.

Did the Kidnapper hide in a remote farmhouse?

Explicit Non-Anaphoric

The kidnapper abducted the hostage as she was leaving her home. He covered her eyes with a blindfold and took her to a remote farm. He removed a blindfold when they reached the farmhouse. She was afraid and hoped the ransom would soon be paid.

Did the Kidnapper hide in a remote farmhouse?

Implicit Anaphoric

The kidnapper abducted the hostage as she was leaving her home. He covered her eyes, tied her hands and took her to a remote farm. He removed the blindfold when they reached the farmhouse. She was afraid and hoped the ransom would soon be paid.

Did the Kidnapper hide in a remote farmhouse?

Implicit Anaphoric

The kidnapper abducted the hostage as she was leaving her home. He covered her eyes, tied her hands and took her to a remote farm. He removed a blindfold when they reached the farmhouse. She was afraid and hoped the ransom would soon be paid.

Did the Kidnapper hide in a remote farmhouse?

(b) Cover Person

Explicit Anaphoric

The child was so tired after the birthday party that he fell asleep on the sofa. His mother covered him with a blanket. She didn't want to wake him so the blanket would keep him warm. He slept soundly for a few hours and awoke just in time for tea. Did the child sleep in his bed?

Explicit Non-Anaphoric

The child was so tired after the birthday party that he fell asleep on the sofa. His mother covered him with a blanket. She didn't want to wake him so a blanket would keep him warm. He slept soundly for a few hours and awoke just in time for tea. Did the child sleep in his bed?

Implicit Anaphoric

The child was so tired after the birthday party that he fell asleep on the sofa. His mother covered him with great care. She didn't want to wake him so the blanket would keep him warm. He slept soundly for a few hours and awoke just in time for tea. Did the child sleep in his bed?

Implicit Non-Anaphoric

The child was so tired after the birthday party that he fell asleep on the sofa. His mother covered him with great care. She didn't want to wake him so a blanket would keep him warm. He slept soundly for a few hours and awoke just in time for tea. Did the child sleep in his bed?

15) Write

(a) Write Letter

Explicit Anaphoric

Jim was so irritated by the bias of the newspaper article that he decided to complain. He wrote a letter with a pen. Just as he was finishing, the pen ran out of ink. He found another, and addressed the envelope.

Explicit Non-Anaphoric

Jim was so irritated by the bias of the newspaper article that he decided to complain. He wrote a letter with a pen. Just as he was finishing, a pen ran out of ink. He found another, and addressed the envelope.

Implicit Anaphoric

Jim was so irritated by the bias of the newspaper article that he decided to complain. He wrote a letter to the editor. Just as he was finishing, the pen ran out of ink. He found another, and addressed the envelope.

Implicit Non-Anaphoric

Jim was so irritated by the bias of the newspaper article that he decided to complain. He wrote a letter to the editor. Just as he was finishing, a pen ran out of ink. He found another, and addressed the envelope.

(b) Write Board

Explicit Anaphoric

The pupils complained about the homework exercise. They chatted as the teacher wrote the exercise on the board with chalk. They laughed loudly when the piece of chalk squeaked on the board. The teacher was angry, so she increased the number of questions.

Explicit Non-Anaphoric

The pupils complained about the homework exercise. They chatted as the teacher wrote the exercise on the board with chalk. They laughed loudly when a piece of chalk squeaked on the board. The teacher was angry, so she increased the number of questions.

Implicit Anaphoric

The pupils complained about the homework exercise. They chatted as the teacher wrote the exercise on the board by the door. They laughed loudly when the piece of chalk squeaked on the board. The teacher was angry, so she increased the number of questions.

Implicit Non-Anaphoric

The pupils complained about the homework exercise. They chatted as the teacher wrote the exercise on the board by the door. They laughed loudly when a piece of chalk squeaked on the board. The teacher was angry, so she increased the number of questions.

16) Take

(a) Take Photographs

Explicit Anaphoric

During his summer vacation Andrew visited many interesting places. He took lots of photographs with his new camera. He was most upset when he lost the camera during a visit to a museum. He wondered if he could afford to buy another one. Did Andrew lose his camera in the museum?

Explicit Non-Anaphoric

During his summer vacation Andrew visited many interesting places. He took lots of photographs with his new camera. He was most upset when he lost a camera during a visit to a museum. He wondered if he could afford to buy another one. Did Andrew lose his camera in the museum?

Implicit Anaphoric

During his summer vacation Andrew visited many interesting places. He took lots of photographs and bought souvenirs. He was most upset when he lost the camera during a visit to a museum. He wondered if he could afford to buy another one. Did Andrew lose his camera in the museum?

Implicit Non-Anaphoric

During his summer vacation Andrew visited many interesting places. He took lots of photographs and bought souvenirs. He was most upset when he lost a camera during a visit to a museum. He wondered if he could afford to buy another one. Did Andrew lose his camera in the museum?

(b) Take Temperature

Explicit Anaphoric

The nurse was rather worried about one of her patients. She took his temperature with a thermometer and noted the reading on his chart. She put the thermometer back under his arm to recheck the reading. His temperature was still rising.

Did the nurse note the reading on a chart?

Explicit Non-Anaphoric

The nurse was rather worried about one of her patients. She took his temperature with a thermometer and noted the reading on his chart. She put a thermometer back under his arm to recheck the reading. His temperature was still rising.

Did the nurse note the reading on a chart?

Implicit Anaphoric

The nurse was rather worried about one of her patients. She took his temperature every ten minutes and noted the reading on his chart. She put the thermometer back under his arm to recheck the reading. His temperature was still rising.

Did the nurse note the reading on a chart?

Implicit Non-Anaphoric

The nurse was rather worried about one of her patients. She took his temperature every ten minutes and noted the reading on his chart. She put a thermometer back under his arm to recheck the reading. His temperature was still rising.

Did the nurse note the reading on a chart?

17) Clean

(a) Clean Teeth

Explicit Anaphoric

Richard's mother told him that it was well past his bedtime. She told him to clean his teeth with his toothbrush. He complained loudly as he took the toothbrush from the bathroom cabinet. He was tired and wished he hadn't stayed up so late.

Did Richard clean his teeth?

Explicit Non-Anaphoric

Richard's mother told him that it was well past his bedtime. She told him to clean his teeth with his toothbrush. He complained loudly as he took a toothbrush from the bathroom cabinet. He was tired and wished he hadn't stayed up so late.

Did Richard clean his teeth?

Implicit Anaphoric

Richard's mother told him that it was well past his bedtime. She told him to clean his teeth before going to bed. He complained loudly as he took the toothbrush from the bathroom cabinet. He was tired and wished he hadn't stayed up so late.

Did Richard clean his teeth?

Implicit Non-Anaphoric

Richard's mother told him that it was well past his bedtime. She told him to clean his teeth before going to bed. He complained loudly as he took a toothbrush from the bathroom cabinet. He was tired and wished he hadn't stayed up so late.

Did Richard clean his teeth?

(b) Clean Windows

Explicit Anaphoric

Greg hated tidying his room. He cleaned the window with a cloth. He accidentally dropped the cloth as he stretched to reach the uppermost corner of the window. He cursed under his breath and decided to stop for a break.

Did Greg like tidying his room?

Explicit Non-Anaphoric

Greg hated tidying his room. He cleaned the window with a cloth. He accidentally dropped a cloth as he stretched to reach the uppermost corner of the window. He cursed under his breath and decided to stop for a break.

Did Greg like tidying his room?

Implicit Anaphoric

Greg hated tidying his room. He cleaned the window reluctantly. He accidentally dropped the cloth as he stretched to reach the uppermost corner of the window. He cursed under his breath and decided to stop for a break.

Did Greg like tidying his room?

Implicit Non-Anaphoric

Greg hated tidying his room. He cleaned the window reluctantly. He accidentally dropped a cloth as he stretched to reach the uppermost corner of the window. He cursed under his breath and decided to stop for a break.

Did Greg like tidying his room?

19) Listen

(a) Listen Personal Hi-Fi

Explicit Anaphoric

Caroline had been travelling for almost an hour and was becoming rather bored. She was unable to listen to her personal stereo as the headphones were broken. She wished she had checked that the headphones were working before leaving home. At least, it was still light enough to admire the scenery.

Explicit Non-Anaphoric

Caroline had been travelling for almost an hour and was becoming rather bored. She was unable to listen to her personal stereo as the headphones were broken. She wished she had checked that headphones were working before leaving home. At least, it was still light enough to admire the scenery.

Implicit Anaphoric

Karen had been travelling for almost an hour and was becoming rather bored. She was unable to listen to her personal stereo during the long train journey. She wished she had checked that the headphones were working before leaving home. At least, it was still light enough to admire the scenery.

Implicit Non-Anaphoric

Karen had been travelling for almost an hour and was becoming rather bored. She was unable to listen to her personal stereo during the long train journey. She wished she had checked that headphones were working before leaving home. At least, it was still light enough to admire the scenery.

(b) Listen Heartbeat

Explicit Anaphoric

Robert was rather nervous as he waited in the clinic. The doctor listened to his heartbeat with a stethoscope. The rhythm was slightly irregular so he checked the stethoscope was properly situated. He decided to phone a colleague for a second opinion.

Explicit Anaphoric

Robert was rather nervous as he waited in the clinic. The doctor listened to his heartbeat with a stethoscope. The rhythm was slightly irregular so he checked a stethoscope was properly situated. He decided to phone a colleague for a second opinion.

Implicit Anaphoric

Robert was rather nervous as he waited in the clinic. The doctor listened to his heartbeat and checked his pulse. The rhythm was slightly irregular so he checked the stethoscope was properly situated. He decided to phone a colleague for a second opinion. (207

Implicit Non-Anaphoric

Robert was rather nervous as he waited in the clinic. The doctor listened to his heartbeat and checked his pulse. The rhythm was slightly irregular so he checked a stethoscope was properly situated. He decided to phone a colleague for a second opinion.

20) Wash

(a) Wash Hair

Explicit Anaphoric

It was bath time for the baby. He began to cry loudly while having his hair washed with shampoo. His mother later discovered that the shampoo was nipping his eyes. He stopped crying when he was taken out of the bath

Explicit Anaphoric

It was bath time for the baby. He began to cry loudly while having his hair washed with shampoo. His mother later discovered that shampoo was nipping his eyes. He stopped crying when he was taken out of the bath.

Implicit Anaphoric

It was bath time for the baby. He began to cry loudly while having his hair washed in the bath. His mother later discovered that the shampoo was nipping his eyes. He stopped crying when he was taken out of the bath.

Implicit Non-Anaphoric

It was bath time for the baby. He began to cry loudly while having his hair washed in the bath. His mother later discovered that shampoo was nipping his eyes. He stopped crying when he was taken out of the bath.

(b) Wash Clothes

Explicit Anaphoric

Jane cleared the table then began the rest of her household chores. She liked to wash the children's clothes with powder. Unfortunately, she dropped the powder as she took it from the cupboard. She decided to go to the shops and buy some more.

Explicit Non-Anaphoric

Jane cleared the table then began the rest of her household chores. She liked to wash the children's clothes with powder. Unfortunately, she dropped powder as she took it from the cupboard. She decided to go to the shops and buy some more.

Implicit Anaphoric

Jane cleared the table then began the rest of her household chores. She liked to wash the children's clothes on Thursdays. Unfortunately, she dropped the powder as she took it from the cupboard. She decided to go to the shops and buy some more.

Implicit Non-Anaphoric

Jane cleared the table then began the rest of her household chores. She liked to wash the children's clothes on Thursdays. Unfortunately, she dropped powder as she took it from the cupboard. She decided to go to the shops and buy some more.

Appendix Five

Materials used in Experiment Four

1) Cut

(a) Cut hair

Inappropriate Explicit Anaphoric

The hairdresser cut the customer's hair unevenly. She was distracted by the noise of a lawnmower outside the shop. The customer complained as she did not receive the style she wanted. The lawnmower was making a terrible noise. Was the customer happy?

Inappropriate Explicit Non-Anaphoric

The hairdresser cut the customer's hair unevenly. She was distracted by the noise of a lawnmower outside the shop. The customer complained as she did not receive the style she wanted. A lawnmower was making a terrible noise. Was the customer happy?

Inappropriate Implicit Anaphoric

The hairdresser cut the customer's hair unevenly. She was distracted by the noise from the garden outside the shop. The customer complained as she did not receive the style she wanted. The lawnmower was making a terrible noise. Was the customer happy?

Inappropriate Implicit Non-Anaphoric

The hairdresser cut the customer's hair unevenly. She was distracted by the noise from the garden outside the shop. The customer complained as she did not receive the style she wanted. A lawnmower was making a terrible noise. Was the customer happy?

(b) Cut grass

Inappropriate Explicit Anaphoric

The gardener cut the grass and weeded the flower beds. It was approaching midday and he thought he would stop for lunch. He tidied up his scissors before heading off to eat lunch in the shade of a large tree. He always put the scissors away as they were very sharp.

Inappropriate Explicit Non-Anaphoric

The gardener cut the grass and weeded the flower beds. It was approaching midday and he thought he would stop for lunch. He tidied up his scissors before heading off to eat lunch in the shade of a large tree. He always put scissors away as they were very sharp.

Inappropriate Implicit Anaphoric

The gardener cut the grass and weeded the flower beds. It was approaching midday and he thought he would stop for lunch. He tidied up his equipment before heading off to eat lunch in the shade of a large tree. He always put the scissors away as they were very sharp

Inappropriate Implicit Non-Anaphoric

The gardener cut the grass and weeded the flower beds. It was approaching midday and he thought he would stop for lunch. He tidied up his equipment before heading off to eat lunch in the shade of a large tree. He always put scissors away as they were very sharp.

2) Spread

(a) Spread butter

Inappropriate Explicit Anaphoric

Mary spread the butter thickly on the bread. She stood at the window and admired the garden as she ate the sandwich. She noticed a trowel in the flower bed. She thought her father must have left the trowel after weeding the garden. He was becoming quite forgetful in his old age.
Did Mary's father leave a trowel in the garden?

Inappropriate Explicit Non-Anaphoric

Mary spread the butter thickly on the bread. She stood at the window and admired the garden as she ate the sandwich. She noticed a trowel in the flower bed. She thought her father must have left a trowel after weeding the garden. He was becoming quite forgetful in his old age.
Did Mary's father leave a trowel in the garden?

Inappropriate Implicit Anaphoric

Mary spread the butter thickly on the bread. She stood at the window and admired the garden as she ate the sandwich. She noticed an implement in the flower bed. She thought her father must have left the trowel after weeding the garden. He was becoming quite forgetful in his old age.
Did Mary's father leave a trowel in the garden?

Inappropriate Implicit Non-Anaphoric

Mary spread the butter thickly on the bread. She stood at the window and admired the garden as she ate the sandwich. She noticed an implement in the flower bed. She thought her father must have left a trowel after weeding the garden. He was becoming quite forgetful in his old age.

Did Mary's father leave a trowel in the garden?

(b) Spread cement

Inappropriate Explicit Anaphoric

The builder spread the cement smoothly over the bricks. It was important that the building had secure foundations so it would meet safety requirements. He took a knife from his pocket and opened a bag of sand. He cursed when the knife slipped and he cut his hand.

Inappropriate Explicit Non-Anaphoric

The builder spread the cement smoothly over the bricks. It was important that the building had secure foundations so it would meet safety requirements. He took a knife from his pocket and opened a bag of sand. He cursed when a knife slipped and he cut his hand.

Inappropriate Implicit Anaphoric

The builder spread the cement smoothly over the bricks. It was important that the building had secure foundations so it would meet safety requirements. He took something from his pocket and opened a bag of sand. He cursed when the knife slipped and he cut his hand.

Inappropriate Implicit Non-Anaphoric

The builder spread the cement smoothly over the bricks. It was important that the building had secure foundations so it would meet safety requirements. He took something from his pocket and opened a bag of sand. He cursed when a knife slipped and he cut his hand.

3) Carve

(a) Carve wood

Inappropriate Explicit Anaphoric

The carpenter carved the intricate detail on the face of the wooden statue. He sat at the window as he preferred to work in natural light. He kept his knives arranged on the window ledge. It was getting rather dull so he moved closer to the window. As he did so he accidentally dropped the knife on the floor.

Inappropriate Explicit Non-Anaphoric

The carpenter carved the intricate detail on the face of the wooden statue. He sat at the window as he preferred to work in natural light. He kept his knives arranged on the window ledge. It was getting rather dull so he moved closer to the window. As he did so he accidentally dropped a knife on the floor.

Inappropriate Implicit Anaphoric

The carpenter carved the intricate detail on the face of the wooden statue. He sat at the window as he preferred to work in natural light. He kept his tools arranged on the window ledge. It was getting rather dull so he moved closer to the window. In so doing he accidentally dropped the knife on the floor.

Inappropriate Implicit Non-Anaphoric

The carpenter carved the intricate detail on the face of the wooden statue. He sat at the window as he preferred to work in natural light. He kept his tools arranged on the window ledge. It was getting rather dull so he moved closer to the window. In so doing he accidentally dropped a knife on the floor.

(b) Carve meat

Inappropriate Explicit Anaphoric

The chef carved the meat into thin slices. He was not pleased with his new job as the hotel was being refurbished and there were workmen everywhere. Only the other day he found a chisel under the sink. He decided to complain as the chisel was sharp and someone could have been injured.
Was the chef pleased with his new job?

Inappropriate Explicit Non-Anaphoric

The chef carved the meat into thin slices. He was not pleased with his new job as the hotel was being refurbished and there were workmen everywhere. Only the other day he found a chisel under the sink. He decided to complain as a chisel was sharp and someone could have been injured.
Was the chef pleased with his new job?

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The chef carved the meat into thin slices. He was not pleased with his new job as the hotel was being refurbished and there were workmen everywhere. Only the other day he found tools under the sink. He decided to complain as the chisel was sharp and someone could have been injured.
Was the chef pleased with his new job?

Inappropriate Implicit Non-Anaphoric

The chef carved the meat into thin slices. He was not pleased with his new job as the hotel was being refurbished and there were workmen everywhere. Only the other day he found tools under the sink. He decided to complain as a chisel was sharp and someone could have been injured.

Was the chef pleased with his new job?

4) Cover

(a) Cover eyes

Inappropriate Explicit Anaphoric

The kidnapper covered the hostage's eyes and tied her hands. The woman was then pushed into a van, wrapped in a blanket and taken to their hideout. The old house was cold and damp so she was glad of the blanket to keep her warm. She hoped the ransom would soon be paid.

Was the hostage male?

Inappropriate Explicit Non-Anaphoric

The kidnapper covered the hostage's eyes and tied her hands. The woman was then pushed into a van, wrapped in a blanket and taken to their hideout. The old house was cold and damp so she was glad of a blanket to keep her warm. She hoped the ransom would soon be paid.

Was the hostage male?

Inappropriate Implicit Anaphoric

The kidnapper covered the hostage's eyes and tied her hands. The woman was then pushed into a van, gagged, threatened and taken to their hideout. The old house was cold and damp so she was glad of the blanket to keep her warm. She hoped the ransom would soon be paid.

Was the hostage male?

Inappropriate Implicit Non-Anaphoric

The kidnapper covered the hostage's eyes and tied her hands. The woman was then pushed into a van, gagged, threatened and taken to their hideout. The old house was cold and damp so she was glad of a blanket to keep her warm. She hoped the ransom would soon be paid.

Was the hostage male?

(b) Cover patient

Inappropriate Explicit Anaphoric

The nurse covered the sleeping patient. He was having a lot of trouble getting to sleep so she had given him a blindfold to keep out the light. The blindfold seemed to be the perfect solution. She was glad as he needed a lot of rest. {205

Inappropriate Explicit Non-Anaphoric

The nurse covered the sleeping patient. He was having a lot of trouble getting to sleep so she had given him a blindfold to keep out the light. A blindfold seemed to be the perfect solution. She was glad as he needed a lot of rest.

Inappropriate Implicit Anaphoric

The nurse covered the sleeping patient. He was having a lot of trouble getting to sleep so she had given him something to help. The blindfold seemed to be the perfect solution. She was glad as he needed a lot of rest.

Inappropriate Implicit Non-Anaphoric

The nurse covered the sleeping patient. He was having a lot of trouble getting to sleep so she had given him something to help. A blindfold seemed to be the perfect solution. She was glad as he needed a lot of rest.

5) Chop

(a) Chop wood

Inappropriate Explicit Anaphoric

Jack chopped the wood for the fire. It was one of his least favourite chores but he wanted to stockpile enough logs to last throughout the winter. He also checked his knife was sharp. He liked to have the knife in case of emergencies.
Was Jack prepared for the winter?

Inappropriate Explicit Non-Anaphoric

Jack chopped the wood for the fire. It was one of his least favourite chores but he wanted to stockpile enough logs to last throughout the winter. He also checked his knife was sharp. He liked to have a knife in case of emergencies.
Was Jack prepared for the winter?

Inappropriate Implicit Anaphoric

Jack chopped the wood for the fire. It was one of his least favourite chores but he wanted to stockpile enough logs to last throughout the winter. He also checked his tools were in order. He liked to have the knife in case of emergencies.
Was Jack prepared for the winter?

Inappropriate Implicit Non-Anaphoric

Jack chopped the wood for the fire. It was one of his least favourite chores but he wanted to stockpile enough logs to last throughout the winter. He also checked his tools were in order. He liked to have a knife in case of emergencies.
Was Jack prepared for the winter?

(b) Chop vegetables

Inappropriate Explicit Anaphoric

Jane chopped the vegetables and prepared the food for the barbecue. As she worked at one of the tables that had been set up in the garden she admired the brightly coloured flowers. She spotted an axe propped up against the garden shed. She decided to move the axe as it was very sharp and someone may be injured.

Inappropriate Explicit Non-Anaphoric

Jane chopped the vegetables and prepared the food for the barbecue. As she worked at one of the tables that had been set up in the garden she admired the brightly coloured flowers. She spotted an axe propped up against the garden shed. She decided to move an axe as it was very sharp and someone may be injured.

Inappropriate Implicit Anaphoric

Jane chopped the vegetables and prepared the food for the barbecue. As she worked at one of the tables that had been set up in the garden she admired the brightly coloured flowers. She spotted something propped up against the garden shed. She decided to move the axe as it was very sharp and someone may be injured.

Inappropriate Implicit Non-Anaphoric

Jane chopped the vegetables and prepared the food for the barbecue. As she worked at one of the tables that had been set up in the garden she admired the brightly coloured flowers. She spotted something propped up against the garden shed. She decided to move an axe as it was very sharp and someone may be injured.

6) write

(a) Write letter

Inappropriate Explicit Anaphoric

The teacher wrote a letter to the pupil's parents. He was informing them of their son's disruptive behaviour. Only the other day he had taken chalk from the teacher's desk. He denied it, but he was the obvious suspect as the chalk was found in his bag. He incurred a greater punishment for lying.

Did the teacher write to the boy's parents?

Inappropriate Explicit Non-Anaphoric

The teacher wrote a letter to the pupil's parents. He was informing them of their son's disruptive behaviour. Only the other day he had taken chalk from the teacher's desk. He denied it, but he was the obvious suspect as chalk was found in his bag. He incurred a greater punishment for lying.

Did the teacher write to the boy's parents?

Inappropriate Implicit Anaphoric

The teacher wrote a letter to the pupil's parents. He was informing them of their son's disruptive behaviour. Only the other day he had taken something from the teacher's desk. He denied it, but he was the obvious suspect as the chalk was found in his bag. He incurred a greater punishment for lying.

Did the teacher write to the boy's parents?

Inappropriate Implicit Non-Anaphoric

The teacher wrote a letter to the pupil's parents. He was informing them of their son's disruptive behaviour. Only the other day he had taken something from the teacher's desk. He denied it, but he was the obvious suspect as the chalk was found in his bag. He incurred a greater punishment for lying.

Did the teacher write to the boy's parents?

(b) Write board

Inappropriate Explicit Anaphoric

The teacher wrote a math exercise on the blackboard. The pupils complained as it was a homework assignment. When the teacher turned round to answer a question she knocked a pen from her desk. The pupils laughed when the pen burst and ink leaked all over the floor.

Inappropriate Explicit Non-Anaphoric

The teacher wrote a math exercise on the blackboard. The pupils complained as it was a homework assignment. When the teacher turned round to answer a question she knocked a pen from her desk. The pupils laughed when a pen burst and ink leaked all over the floor.

Inappropriate Implicit Anaphoric

The teacher wrote a math exercise on the blackboard. The pupils complained as it was a homework assignment. When the teacher turned round to answer a question she knocked something from her desk. The pupils laughed when the pen burst and ink leaked all over the floor.

Inappropriate Implicit Non-Anaphoric

The teacher wrote a math exercise on the blackboard. The pupils complained as it was a homework assignment. When the teacher turned round to answer a question she knocked something from her desk. The pupils laughed when a pen burst and ink leaked all over the floor.

7) Catch

(a) Catch mouse

Inappropriate Explicit Anaphoric

Mark had developed numerous plans to catch the mice that lived under the floorboards of the old house. When he spotted a fishing rod in the shed he formed a new plan. He attached some cheese and passed it through a crack in the floorboards. Unfortunately, the fishing rod snapped just as the mouse was about to take the bait.
Did Mark catch the mouse?

Inappropriate Explicit Non-Anaphoric

Mark had developed numerous plans to catch the mice that lived under the floorboards of the old house. When he spotted a fishing rod in the shed he formed a new plan. He attached some cheese and passed it through a crack in the floorboards. Unfortunately, a fishing rod snapped just as the mouse was about to take the bait.
Did Mark catch the mouse?

Inappropriate Implicit Anaphoric

Mark had developed numerous plans to catch the mice that lived under the floorboards of the old house. When he spotted some cheese and passed it through a crack in the floorboards. Unfortunately, the fishing rod snapped just as the mouse was about to take the bait.

Inappropriate Implicit Non-Anaphoric

Mark had developed numerous plans to catch the mice that lived under the floorboards of the old house. When he spotted some tackle in the shed he formed a new plan. He attached some cheese and passed it through a crack in the floorboards. Unfortunately, the fishing rod snapped just as the mouse was about to take the bait.

Did Mark catch the mouse?

(b) Catch fish

Inappropriate Explicit Anaphoric

Richard hoped he would catch many fish on this trip. As he walked along the bank looking for a suitable spot he caught his foot in an old rabbit trap. He cursed the carelessness of someone to leave the trap in such a dangerous place. He sat down on the bank to rest his injured foot.

Inappropriate Explicit Non-Anaphoric

Richard hoped he would catch many fish on this trip. As he walked along the bank looking for a suitable spot he caught his foot in an old rabbit trap. He cursed the carelessness of someone to leave a trap in such a dangerous place. He sat down on the bank to rest his injured foot.

Inappropriate Implicit Anaphoric

Richard hoped he would catch many fish on this trip. As he walked along the bank looking for a suitable spot he caught his foot on a piece of wire. He cursed the carelessness of someone to leave the trap in such a dangerous place. He sat down on the bank to rest his injured foot.

Inappropriate Implicit Non-Anaphoric

Richard hoped he would catch many fish on this trip. As he walked along the bank looking for a suitable spot he caught his foot on a piece of wire. He cursed the carelessness of someone to leave a trap in such a dangerous place. He sat down on the bank to rest his injured foot.

8) Take

(a) Take Photographs

Inappropriate Explicit Anaphoric

During her summer vacation Angela took many photographs and purchased numerous souvenirs. She was enjoying her trip but she was finding the weather rather warm. The thermometer outside read 30 degrees. The actual temperature may have been higher as the thermometer was in the shade.

Inappropriate Explicit Non-Anaphoric

During her summer vacation Angela took many photographs and purchased numerous souvenirs. She was enjoying her trip but she was finding the weather rather warm. The thermometer outside read 30 degrees. The actual temperature may have been higher as a thermometer was in the shade.

Inappropriate Implicit Anaphoric

During her summer vacation Angela took many photographs and purchased numerous souvenirs. She was enjoying her trip but she was finding the weather rather warm. The temperature outside was 30 degrees. The actual temperature may have been higher as the thermometer was in the shade.

Inappropriate Implicit Non-Anaphoric

During her summer vacation Angela took many photographs and purchased numerous souvenirs. She was enjoying her trip but she was finding the weather rather warm. The temperature outside was 30 degrees. The actual temperature may have been higher as a thermometer was in the shade.

(b) Take Temperature

Inappropriate Explicit Anaphoric

The nurse took the child's temperature and noted the reading on his chart. He was disappointed to be in hospital on his Birthday but he was looking forward to visiting time as his parents would bring his presents and cards. He hoped he would get the camera he asked for. He unwrapped his gifts and was happy to see the camera he had wanted.
Did the nurse take the child's pulse?

Inappropriate Explicit Non-Anaphoric

The nurse took the child's temperature and noted the reading on his chart. He was disappointed to be in hospital on his Birthday but he was looking forward to visiting time as his parents would bring his presents and cards. He hoped he would get the camera he asked for. He unwrapped his gifts and was happy to see a camera he had wanted.

Did the nurse take the child's pulse?

Inappropriate Implicit Anaphoric

The nurse took the child's temperature and noted the reading on his chart. He was disappointed to be in hospital on his Birthday but he was looking forward to visiting time as his parents would bring his presents and cards. He hoped he would get the present he asked for. He unwrapped his gifts and was happy to see the camera he had wanted.

Did the nurse take the child's pulse?

Inappropriate Implicit Non-Anaphoric

The nurse took the child's temperature and noted the reading on his chart. He was disappointed to be in hospital on his Birthday but he was looking forward to visiting time as his parents would bring his presents and cards. He hoped he would get the present he asked for. He unwrapped his gifts and was happy to see a camera he had wanted.

Did the nurse take the child's pulse?

9) Clean

(a) Clean windows

Inappropriate Explicit Anaphoric

Jane reluctantly began to clean the windows. This was the household chore she hated the most. She accidentally knocked a toothbrush to the floor when she stretched to reach the uppermost corner of the bathroom window. She stopped to pick up the toothbrush and continued with her chore.

Inappropriate Explicit Non-Anaphoric

Jane reluctantly began to clean the windows. This was the household chore she hated the most. She accidentally knocked a toothbrush to the floor as she stretched to reach the uppermost corner of the bathroom window. She stopped to pick up a toothbrush and continued with her chore.

Inappropriate Implicit Anaphoric

Jane reluctantly began to clean the windows. This was the household chore she hated the most. She accidentally knocked something to the floor as she stretched to reach the uppermost corner of the bathroom window. She stopped and picked up the toothbrush and continued with her chore

Inappropriate Implicit Non-Anaphoric

Jane reluctantly began to clean the windows. This was the household chore she hated the most. She accidentally knocked something to the floor as she stretched to reach the uppermost corner of the bathroom window. She stopped and picked up a toothbrush and continued with her chore.

(b) Clean teeth

Inappropriate Explicit Anaphoric

John's mother told him to clean his teeth before going to bed. He reluctantly went to the bathroom where he accidentally knocked over a bottle of shampoo. He asked his mother for a cloth. She told him to go to bed before he had any more accidents, then picked up the cloth and mopped up the shampoo. Did John knock over a bottle of shampoo?

Inappropriate Explicit Non-Anaphoric

John's mother told him to clean his teeth before going to bed. He reluctantly went to the bathroom where he accidentally knocked over a bottle of shampoo. He asked his mother for a cloth. She told him to go to bed before he had any more accidents, then picked up a cloth and mopped up the shampoo. Did John knock over a bottle of shampoo?

Inappropriate Implicit Anaphoric

John's mother told him to clean his teeth before going to bed. He reluctantly went to the bathroom where he accidentally knocked over a bottle of shampoo. He went and told his mother. She told him to go to bed before he had any more accidents, then picked up the cloth and mopped up the shampoo. Did John knock over a bottle of shampoo?

Inappropriate Implicit Non-Anaphoric

John's mother told him to clean his teeth before going to bed. He reluctantly went to the bathroom where he accidentally knocked over a bottle of shampoo. He went and told his mother. She told him to go to bed before he had any more accidents, then picked up a cloth and mopped up the shampoo. Did John knock over a bottle of shampoo?

10) Listen

(a) Listen Personal Hi-Fi

Inappropriate Explicit Anaphoric

James was unable to listen to his personal hi-fi during the long train journey. He was bored so he looked around the carriage. He spotted what looked like a stethoscope on the luggage rack. He thought the man sitting opposite looked like a doctor, perhaps the stethoscope belonged to him.

Did James listen to his personal hi-fi?

Inappropriate Explicit Non-Anaphoric

James was unable to listen to his personal hi-fi during the long train journey. He was bored so he looked around the carriage. He spotted what looked like a stethoscope on the luggage rack. He thought the man sitting opposite looked like a doctor, perhaps a stethoscope belonged to him.

Did James listen to his personal hi-fi?

Inappropriate Implicit Anaphoric

James was unable to listen to his personal hi-fi during the long train journey. He was bored so he looked around the carriage. He spotted a rather strange-looking object on the luggage rack. He thought the man sitting opposite looked like a doctor, perhaps the stethoscope belonged to him.

Did James listen to his personal hi-fi?

Inappropriate Implicit Non-Anaphoric

James was unable to listen to his personal hi-fi during the long train journey. He was bored so he looked around the carriage. He spotted a rather strange-looking object on the luggage rack. He thought the man sitting opposite looked like a doctor, perhaps a stethoscope belonged to him.

Did James listen to his personal hi-fi?

(b) Listen heartbeat

Inappropriate Explicit Anaphoric

The doctor listened to the patient's heartbeat and checked his pulse. The rhythm was slightly irregular. He asked the patient to remove his stereo headphones then rechecked his heartbeat. He thought the noise from the headphones may have interfered with his reading.

Inappropriate Explicit Non-Anaphoric

The doctor listened to the patient's heartbeat and checked his pulse. The rhythm was slightly irregular. He asked the patient to remove his stereo headphones then rechecked his heartbeat. He thought the noise from headphones may have interfered with his reading.

Inappropriate Implicit Anaphoric

The doctor listened to the patient's heartbeat and checked his pulse. The rhythm was slightly irregular. He asked the patient to remove his personal hi-fi then rechecked his heartbeat. He thought the noise from the headphones may have interfered with his reading.

Inappropriate Implicit Non-Anaphoric

The doctor listened to the patient's heartbeat and checked his pulse. The rhythm was slightly irregular. He asked the patient to remove his personal hi-fi then rechecked his heartbeat. He thought the noise from headphones may have interfered with his reading.

11) Wash

(a) Wash Clothes

Inappropriate Explicit Anaphoric

Mary wanted to wash the children's dirty clothes. As she was running late for work she hurriedly took the clothes from the laundry basket and in so doing accidentally knocked a bottle of shampoo to the floor. As she cleaned up the shampoo she cursed herself for being so clumsy.

Inappropriate Explicit Non-Anaphoric

Mary washed the children's dirty clothes. As she was running late for work she hurriedly took the clothes from the laundry basket and in so doing accidentally knocked a bottle of shampoo to the floor. As she cleaned up some shampoo she cursed herself for being so clumsy.

Inappropriate Implicit Anaphoric

Mary washed the children's dirty clothes. As she was running late for work she hurriedly took the clothes from the laundry basket and in so doing accidentally knocked a large bottle to the floor. As she cleaned up the shampoo she cursed herself for being so clumsy.

Inappropriate Implicit Non-Anaphoric

Mary washed the children's dirty clothes. As she was running late for work she hurriedly took the clothes from the laundry basket and in so doing accidentally knocked a large bottle to the floor. As she cleaned up some shampoo she cursed herself for being so clumsy.

(b) Wash hair

Inappropriate Explicit Anaphoric

The baby began to cry while having his hair washed. His mother became rather distressed, so she quickly removed him from the bath. In her hurry she accidentally knocked a box of soap powder from a nearby shelf. As she comforted the baby she noticed that the soap powder had spilt on the floor.
Did the baby cry when he was having his hair washed?

Inappropriate Explicit Non-Anaphoric

The baby began to cry while having his hair washed. His mother became rather distressed, so she quickly removed him from the bath. In her hurry she accidentally knocked a box of soap powder from a nearby shelf. As she comforted the baby she noticed that soap powder had spilt on the floor.
Did the baby cry when he was having his hair washed?

Inappropriate Implicit Anaphoric

The baby began to cry while having his hair washed. His mother became rather distressed, so, she quickly removed him from the bath. In her hurry she accidentally knocked some cleaning items from a nearby shelf. As she comforted the baby she noticed that the soap powder had spilt on the floor.
Did the baby cry when he was having his hair washed?

Inappropriate Implicit Non-Anaphoric

The baby began to cry while having his hair washed. His mother became rather distressed, so, she quickly removed him from the bath. In her hurry she accidentally knocked some cleaning items from a nearby shelf. As she comforted the baby she noticed that soap powder had spilt on the floor.
Did the baby cry when he was having his hair washed?

12) Steer

(a) Steer car

Inappropriate Explicit Anaphoric

Allan carefully steered the car through the narrow entrance of the yard. He looked around for the owner as he needed some advice. He was having some problems with his boat and thought he might need a new rudder. On hearing the problem the owner suggested that the rudder should be replaced.

Did Allan need a new rudder?

Inappropriate Explicit Non-Anaphoric

Allan carefully steered the car through the narrow entrance of the yard. He looked around for the owner as he needed some advice. He was having some problems with his boat and thought he might need a new rudder. On hearing the problem the owner suggested that a rudder should be replaced.

Did Allan need a new rudder?

Inappropriate Implicit Anaphoric

Allan carefully steered the car through the narrow entrance of the yard. He looked around for the owner as he needed some advice. He was having some problems with his boat and thought he might need a new part. On hearing the problem the owner suggested that the rudder should be replaced.

Did Allan need a new rudder?

Inappropriate Implicit Non-Anaphoric

Allan carefully steered the car through the narrow entrance of the yard. He looked around for the owner as he needed some advice. He was having some problems with his boat and thought he might need a new part. On hearing the problem the owner suggested that a rudder should be replaced.

Did Allan need a new rudder?

(b) Steer boat

Inappropriate Explicit Anaphoric

Peter was having difficulty steering the rowing boat towards the bank. The oars were catching in all the junk that had been thrown into the canal. Earlier he had spotted an old bicycle wheel in the water. Now the boat was completely stuck. The boat had hit the wheel of the abandoned bicycle. He called to a passer-by for help.

Inappropriate Explicit Non-Anaphoric

Peter was having difficulty steering the rowing boat towards the bank. The oars were catching in all the junk that had been thrown into the canal. Earlier he had spotted an old bicycle wheel in the water. Now the boat was completely stuck. The boat had hit a wheel of the abandoned bicycle. He called to a passer-by for help.

Inappropriate Implicit Anaphoric

Peter was having difficulty steering the rowing boat towards the bank. The oars were catching in all the junk that had been thrown into the canal. Earlier he had spotted an old bicycle floating in the water. Now the boat was completely stuck. The boat had hit the wheel of the abandoned bicycle. He called to a passer-by for help.

Inappropriate Implicit Non-Anaphoric

Peter was having difficulty steering the rowing boat towards the bank. The oars were catching in all the junk that had been thrown into the canal. Earlier he had spotted an old bicycle floating in the water. Now the boat was completely stuck. The boat had hit a wheel of the abandoned bicycle. He called to a passer-by for help.

13) Look

(a) Look At Fibres

Inappropriate Explicit Anaphoric

The forensic scientist looked at the fibres taken from the crime scene. His careful analysis considerably reduced the number of possible suspects. He kept his telescope by the window. The telescope was a recent addition to the lab and he hoped it would be useful in his investigations.

Inappropriate Explicit Non-Anaphoric

The forensic scientist looked at the fibres taken from the crime scene. His careful analysis considerably reduced the number of possible suspects. He kept his telescope by the window. A telescope was a recent addition to the lab and he hoped it would be useful in his investigations.

Inappropriate Implicit Anaphoric

The forensic scientist looked at the fibres taken from the crime scene. His careful analysis considerably reduced the number of possible suspects. He kept his equipment by the window. The telescope was a recent addition to the lab and he hoped it would be useful in his investigations.

Inappropriate Implicit Non-Anaphoric

The forensic scientist looked at the fibres taken from the crime scene. His careful analysis considerably reduced the number of possible suspects. He kept his equipment by the window. A telescope was a recent addition to the lab and he hoped it would be useful in his investigations.

(b) Look At Stars

Inappropriate Explicit Anaphoric

The astronomer looked at the stars and charted their movements. He was charting the path of comet through a distant solar system. His lab contained one of the most sophisticated microscopes and employed some of the best research staff. The microscope was very powerful and quite difficult to operate.

Did the astronomer have sophisticated equipment?

Inappropriate Explicit Non-Anaphoric

The astronomer looked at the stars and charted their movements. He was charting the path of comet through a distant solar system. His lab contained one of the most sophisticated microscopes and employed some of the best research staff. A microscope was very powerful and quite difficult to operate.

Did the astronomer have sophisticated equipment?

Inappropriate Implicit Anaphoric

The astronomer looked at the stars and charted their movements. He was charting the path of comet through a distant solar system. His lab contained some of the most sophisticated equipment and employed some of the best research staff. The microscope was very powerful and quite difficult to operate.

Did the astronomer have sophisticated equipment?

Inappropriate Implicit Non-Anaphoric

The astronomer looked at the stars and charted their movements. He was charting the path of comet through a distant solar system. His lab contained some of the most sophisticated equipment and employed some of the best research staff. A microscope was very powerful and quite difficult to operate.

Did the astronomer have sophisticated equipment?

14) Carry

(a) Carry Groceries

Inappropriate Explicit Anaphoric

Caroline carried the groceries home from the supermarket. It was raining, so she took a short cut past the building site. She looked to see how work was progressing. She noticed a man climbing a ladder with a hod. It seemed like a extremely dangerous task as the hod looked heavy. She shivered as she had a fear of heights.

Did Caroline take the longest route home?

Inappropriate Explicit Non-Anaphoric

Caroline carried the groceries home from the supermarket. It was raining, so she took a short cut past the building site. She looked to see how work was progressing. She noticed a man climbing a ladder with a hod. It seemed like an extremely dangerous task as a hod looked heavy. She shivered as she had a fear of heights.

Did Caroline take the longest route home?

Inappropriate Implicit Anaphoric

Caroline carried the groceries home from the supermarket. It was raining, so she took a short cut past the building site. She looked to see how work was progressing. She noticed a man carefully climbing a ladder. It seemed like an extremely dangerous task as the hod looked heavy. She shivered as she had a fear of heights.

Did Caroline take the longest route home?

Inappropriate Implicit Non-Anaphoric

Caroline carried the groceries home from the supermarket. It was raining, so she took a short cut past the building site. She looked to see how work was progressing. She noticed a man carefully climbing a ladder. It seemed like an extremely dangerous task as a hod looked heavy. She shivered as she had a fear of heights.

Did Caroline take the longest route home?

(b) Carry Bricks

Inappropriate Explicit Anaphoric

The builder carried the bricks up the ladder. It was a risky climb as there was a strong wind. Just as he began to climb a strong gust of wind blew a bag into his face. He stopped and removed the bag from his face. He paused for a few minutes to recover and then continued his climb.

Inappropriate Explicit Non-Anaphoric

The builder carried the bricks up the ladder. It was a risky climb as there was a strong wind. Just as he began to climb a strong gust of wind blew a bag into his face. He stopped and removed a bag from his face. He paused for a few minutes to recover and then continued his climb.

Inappropriate Implicit Anaphoric

The builder carried the bricks up the ladder. It was a risky climb as there was a strong wind. Just as he began to climb a strong gust of wind blew something into his face. He stopped and removed the bag from his face. He paused for a few minutes to recover and then continued his climb.

Inappropriate Implicit Non-Anaphoric

The builder carried the bricks up the ladder. It was a risky climb as there was a strong wind. Just as he began to climb a strong gust of wind blew something into his face. He stopped and removed a bag from his face. He paused for a few minutes to recover and then continued his climb.

15) Shoot

(a) Shoot bullets

Inappropriate Explicit Anaphoric

John won a prize at the rifle range. He always shot the bullet slightly left of, the centre of, the target. His friend was less fortunate. He was distracted by a stallholder holding up a bow. The prospect of using the bow intrigued him. He thought it would be exciting.
Did John win a prize?

Inappropriate Explicit Non-Anaphoric

John won a prize at the rifle range. He always shot the bullet slightly left of, the centre of, the target. His friend was less fortunate. He was distracted by a stallholder holding up a bow. The prospect of using a bow intrigued him. He thought it would be exciting.
Did John win a prize?

Inappropriate Implicit Anaphoric

John won a prize at the rifle range. He always shot the bullet slightly left of, the centre of, the target. His friend was less fortunate. He was distracted by a stallholder dressed as Robin Hood. The prospect of using the bow intrigued him. He thought it would be exciting.
Did John win a prize?

Inappropriate Implicit Non-Anaphoric

John won a prize at the rifle range. He always shot the bullet slightly left of, the centre of, the target. His friend was less fortunate. He was distracted by a stallholder dressed as Robin Hood. The prospect of using a bow intrigued him. He thought it would be exciting.

Did John win a prize?

(b) Shoot Arrows

Inappropriate Explicit Anaphoric

The archer shot the arrow wide of the target. It should have been easy for him to hit the bull's-eye as he was standing close to the target. He was distracted by the sound of a gun from the nearby woods. The gun was probably fired by the gamekeeper to frighten foxes away from the newly hatched pheasants.

Inappropriate Explicit Non-Anaphoric

The archer shot the arrow wide of the target. It should have been easy for him to hit the bull's-eye as he was standing close to the target. He was distracted by the sound of a gun from the nearby woods. A gun was probably fired by the gamekeeper to frighten foxes away from the newly hatched pheasants.

Inappropriate Implicit Anaphoric

The archer shot the arrow wide of the target. It should have been easy for him to hit the bull's-eye as he was standing close to the target. He was distracted by the sound of a gamekeeper in the woods. The gun was probably fired by the gamekeeper to frighten foxes away from the newly hatched pheasants.

Inappropriate Implicit Non-Anaphoric

The archer shot the arrow wide of the target. It should have been easy for him to hit the bull's-eye as he was standing close to the target. He was distracted by the sound of a gamekeeper in the woods. A gun was probably fired by the gamekeeper to frighten foxes away from the newly hatched pheasants.

16) Play

(a) Play Ruby

Inappropriate Explicit Anaphoric

The boys were unable to play rugby because of the stormy weather. Even if the rain subsided, the high wind had blown lots of sticks onto the pitch. Once the weather cleared, the groundsman would remove the sticks and cut the grass. They hoped the weather would clear soon, so they could practice for the semi-final.

Was the weather fine?

Inappropriate Explicit Non-Anaphoric

The boys were unable to play rugby because of the stormy weather. Even if the rain subsided, the high wind had blown lots of sticks onto the pitch. Once the weather cleared, the groundsman would remove sticks and cut the grass. They hoped the weather would clear soon, so they could practice for the semi-final.

Was the weather fine?

Inappropriate Implicit Anaphoric

The boys were unable to play rugby because of the stormy weather. Even if the rain subsided, the high wind had blown lots of debris onto the pitch. Once the weather cleared, the groundsman would remove the sticks and cut the grass. They hoped the weather would clear soon, so they could practice for the semi-final.

Was the weather fine?

Inappropriate Implicit Non-Anaphoric

The boys were unable to play rugby because of the stormy weather. Even if the rain subsided, the high wind had blown lots of debris onto the pitch. Once the weather cleared, the groundsman would remove sticks and cut the grass. They hoped the weather would clear soon, so they could practice for the semi-final.

Was the weather fine?

(b) Play Drums

Inappropriate Explicit Anaphoric

Gregory enjoyed playing the drums and was looking forward to rehearsing with his new band. Since they had arranged to practice in his garden shed he decided to tidy up. He found lots of junk and an old ball that had belonged to him as a child. All the ball needed was some air and it would be as good as new.

Inappropriate Explicit Non-Anaphoric

Gregory enjoyed playing the drums and was looking forward to rehearsing with his new band. Since they had arranged to practice in his garden shed he decided to tidy up. He found lots of junk and an old ball that had belonged to him as a child. All a ball needed was some air and it would be as good as new.

Inappropriate Implicit Anaphoric

Gregory enjoyed playing the drums and was looking forward to rehearsing with his new band. Since they had arranged to practice in his garden shed he decided to tidy up. He found lots of junk and some sports equipment that had belonged to him as a child. All the ball needed was some air and it would be as good as new.

Inappropriate Implicit Non-Anaphoric

Gregory enjoyed playing the drums and was looking forward to rehearsing with his new band. Since they had arranged to practice in his garden shed he decided to tidy up. He found lots of junk and some sports equipment that had belonged to him as a child. All a ball needed was some air and it would be as good as new.

17) Hit

(b) Hit Nail

Inappropriate Explicit Anaphoric

John hit the nail into the wood. He was making a bird-table for his daughter. He was working slowly as his arm was very painful. Earlier that day he had tripped over a cricket bat. His son must have left the bat outside the garden shed. He never tidied his stuff away.

Inappropriate Explicit Non-Anaphoric

John hit the nail into the wood. He was making a bird-table for his daughter. He was working slowly as his arm was very painful. Earlier that day he had tripped over a cricket bat. His son must have left a bat outside the garden shed. He never tidied his stuff away.

Inappropriate Implicit Anaphoric

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Inappropriate Implicit Non-Anaphoric

John hit the nail into the wood. He was making a bird-table for his daughter. He was working slowly as his arm was very painful. Earlier that day he had tripped over some cricket equipment. His son must have left a bat outside the garden shed. He never tidied his stuff away.

(b) Hit ball

Inappropriate Explicit Anaphoric

Andrew enjoyed playing cricket, even though he could not hit the ball any distance. He was disappointed when he was not picked for the team. As he stood dejected in the corner he noticed a hammer lying under the bench. He could not bear to watch the members practice so he took the hammer to the janitor's office and then went home.

Was Andrew happy that he was not picked for the team?

Inappropriate Explicit Non-Anaphoric

Andrew enjoyed playing cricket, even though he could not hit the ball any distance. He was disappointed when he was not picked for the team. As he stood dejected in the corner he noticed a hammer lying under the bench. He could not bear to watch the members practice so he took a hammer to the janitor's office and then went home.

Was Andrew happy that he was not picked for the team?

Inappropriate Implicit Anaphoric

Andrew enjoyed playing cricket, even though he could not hit the ball any distance. He was disappointed when he was not picked for the team. As he stood dejected in the corner he noticed a tool lying under the bench. He could not bear to watch the members practice so he took the hammer to the janitor's office and then went home.

Was Andrew happy that he was not picked for the team?

Inappropriate Implicit Non-Anaphoric

Andrew enjoyed playing cricket, even though he could not hit the ball any distance. He was disappointed when he was not picked for the team. As he stood dejected in the corner he noticed a tool lying under the bench. He could not bear to watch the members practice so he took a hammer to the janitor's office and then went home.

Was Andrew happy that he was not picked for the team?

18) Decorate

(a) Decorate Cake

Inappropriate Explicit Anaphoric

Jane decorated her daughter's birthday cake the night before the party. She planned to prepare the rest of the party food the following day. She hoped she had chosen the appropriate colour of tinsel. Her daughter laughed as the tinsel sparkled in the light of the candles.

Did Jane organise a birthday party for her daughter?

Inappropriate Explicit Non-Anaphoric

Jane decorated her daughter's birthday cake the night before the party. She planned to prepare the rest of the party food the following day. She hoped she had chosen the appropriate colour of tinsel. Her daughter laughed as tinsel sparkled in the light of the candles.

Did Jane organise a birthday party for her daughter?

Inappropriate Implicit Anaphoric

Jane decorated her daughter's birthday cake the night before the party. She planned to prepare the rest of the party food the following day. She hoped she had chosen the appropriate colour of decorations. Her daughter laughed as the tinsel sparkled in the light of the candles.

Did Jane organise a birthday party for her daughter?

Inappropriate Implicit Non-Anaphoric

Jane decorated her daughter's birthday cake the night before the party. She planned to prepare the rest of the party food the following day. She hoped she had chosen the appropriate colour of decorations. Her daughter laughed as tinsel sparkled in the light of the candles.

Did Jane organise a birthday party for her daughter?

(b) Decorate Christmas Tree

Inappropriate Explicit Anaphoric

The Smith children decorated the tree on Christmas Eve. They called to their mother for help. She was in the kitchen mixing icing. She said she would come and help when she had finished putting the icing on the cake. The children waited impatiently for her to arrive. They wanted her to put the lights on the tree.

Inappropriate Explicit Non-Anaphoric

The Smith children decorated the tree on Christmas Eve. They called to their mother for help. She was in the kitchen mixing icing. She said she would come and help when she had finished putting icing on the cake. The children waited impatiently for her to arrive. They wanted her to put the lights on the tree.

Inappropriate Implicit Anaphoric

The Smith children decorated the tree on Christmas Eve. They called to their mother for help. She was in the kitchen making a cake. She said she would come and help when she had finished putting the icing on the cake. The children waited impatiently for her to arrive. They wanted her to put the lights on the tree.

Inappropriate Implicit Non-Anaphoric

The Smith children decorated the tree on Christmas Eve. They called to their mother for help. She was in the kitchen making a cake. She said she would come and help when she had finished putting icing on the cake. The children waited impatiently for her to arrive. They wanted her to put the lights on the tree.

19) Fill

(a) Fill Car

Inappropriate Explicit Anaphoric

Tom filled the car at the Esso station. He worked quickly as he was late. He promised his wife he would be home early as it was her Birthday. He spent longer than he thought in the jewellers choosing a present for her. He hoped that when she saw the present she would forgive him. He decided to take her some flowers as well.
Did Tom arrive home on time?

Inappropriate Explicit Non-Anaphoric

Tom filled the car at the Esso station. He worked quickly as he was late. He promised his wife he would be home early as it was her Birthday. He spent longer than he thought in the jewellers choosing a present for her. He hoped that when she saw a present she would forgive him. He decided to take her some flowers as well.
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Inappropriate Implicit Anaphoric

Tom filled the car at the Esso station. He worked quickly as he was late. He promised his wife he would be home early as it was her Birthday. He spent longer than he thought in the jewellers choosing something for her. He hoped that when she saw the present she would forgive him. He decided to take her some flowers as well.

Did Tom arrive home on time?

Inappropriate Implicit Non-Anaphoric

Tom filled the car at the Esso station. He worked quickly as he was late. He promised his wife he would be home early as it was her Birthday. He spent longer than he thought in the jewellers choosing something for her. He hoped that when she saw a present she would forgive him. He decided to take her some flowers as well.

Did Tom arrive home on time?

(b) Fill Christmas Stocking

Inappropriate Explicit Anaphoric

It was ten o'clock Christmas Eve and Richard hurried home to fill the children's Christmas stockings. He was almost home when he ran out of petrol. He remembered passing a garage about a mile back, perhaps he could get the petrol there. He reached the garage just as it was about to close.

Inappropriate Explicit Non-Anaphoric

It was ten o'clock Christmas Eve and Richard hurried home to fill the children's Christmas stockings. He was almost home when he ran out of petrol. He remembered passing a garage about a mile back, perhaps he could get petrol there. He reached the garage just as it was about to close.

Inappropriate Implicit Anaphoric

It was ten o'clock Christmas Eve and Richard hurried home to fill the children's Christmas stockings. He was almost home when the car broke down. He remembered passing a garage about a mile back, perhaps he could get the petrol there. He reached the garage just as it was about to close.

Inappropriate Implicit Non-Anaphoric

It was ten o'clock Christmas Eve and Richard hurried home to fill the children's Christmas stockings. He was almost home when the car broke down. He remembered passing a garage about a mile back, perhaps he could get petrol there. He reached the garage just as it was about to close.

20) Drink

(a) Animals Drink

Inappropriate Explicit Anaphoric

Mrs Brown took the children to the Show Farm on Sunday afternoon. The children were fascinated and stopped to watch the cattle drinking their water. She left the children with their father while she went to have a cup of coffee. She accidentally knocked the cup from the table as she got up to leave. She decided to take the children to see the chickens before they left.

Inappropriate Explicit Non-Anaphoric

Mrs Brown took the children to the Show Farm on Sunday afternoon. The children were fascinated and stopped to watch the cattle drinking their water. She left the children with their father while she went to have a cup of coffee. She accidentally knocked a cup from the table as she got up to leave. She decided to take the children to see the chickens before they left.

Inappropriate Implicit Anaphoric

Mrs Brown took the children to the Show Farm on Sunday afternoon. The children were fascinated and stopped to watch the cattle drinking their water. She left the children with their father while she went to have coffee. She accidentally knocked the cup from the table as she got up to leave. She decided to take the children to see the chickens before they left.

Inappropriate Implicit Non-Anaphoric

Mrs Brown took the children to the Show Farm on Sunday afternoon. The children were fascinated and stopped to watch the cattle drinking their water. She left the children with their father while she went to have coffee. She accidentally knocked a cup from the table as she got up to leave. She decided to take the children to see the chickens before they left.

(b) Humans Drink

Inappropriate Explicit Anaphoric

Annemarie sat in the shade of a large tree and drank her tea. It was a nice day for a picnic. She watched as the animals in a nearby field gathered round a trough. The hot weather had made the animals very thirsty and the farmer had refilled the trough at least three times that day. Did the animals drink a lot of water?

Inappropriate Explicit Non-Anaphoric

Annemarie sat in the shade of a large tree and drank her tea. It was a nice day for a picnic. She watched as the animals in a nearby field gathered round a trough. The hot weather had made the animals very thirsty and the farmer had refilled a trough at least three times that day. Did the animals drink a lot of water?

Inappropriate Implicit Anaphoric

Annemarie sat in the shade of a large tree and drank her tea. It was a nice day for a picnic. She watched as the animals in a nearby field gathered round a farmer. The hot weather had made the animals very thirsty and the farmer had refilled the trough at least three times that day. Did the animals drink a lot of water?

Inappropriate Implicit Non-Anaphoric

Annemarie sat in the shade of a large tree and drank her tea. It was a nice day for a picnic. She watched as the animals in a nearby field gathered round a farmer. The hot weather had made the animals very thirsty and the farmer had refilled a trough at least three times that day. Did the animals drink a lot of water?

Appendix Six

Verb -> Instrument Questionnaire

Please specify what you would need to carry out the following actions.

- 1) To listen heartbeat.....
- 2) To chop wood.....
- 3) To cover something.....
- 4) To clean window.....
- 5) To wash hair.....
- 6) To steer something.....
- 7) To take photograph.....
- 8) To catch mouse.....
- 9) To write something.....
- 10) To view something.....
- 11) To drink wine.....
- 12) To carry something.....
- 13) To shoot arrows.....
- 14) To play rugby.....
- 15) To cut hair.....
- 16) To carve something.....
- 17) To spread cement.....
- 18) To hit ball.....
- 19) To fill something.....
- 20) To decorate Christmas Tree.....
- 21) To smoke.....
- 22) To post something.....
- 23) To photograph beach.....
- 24) To ride something.....
- 25) To sail.....
- 26) To buy something.....
- 27) To unlock door.....
- 28) To drive.....
- 29) To stir something.....
- 30) To open can.....
- 31) To light something.....
- 32) To fly something.....
- 33) To look at something.....
- 34) To strike something.....
- 35) To change tyre.....
- 36) To knit something.....

Please specify what you would need to carry out the following actions.

- 1) To listen personal hi-fi.....
- 2) To chop something.....
- 3) To cover eyes.....
- 4) To clean teeth.....
- 5) To wash something.....
- 6) To steer boat.....
- 7) To take temperature.....
- 8) To catch something.....
- 9) To write letter.....
- 10) To view bacteria.....
- 11) To drink something.....
- 12) To carry groceries.....
- 13) To shoot bullets.....
- 14) To play something.....
- 15) To cut something.....
- 16) To carve stone.....
- 17) To spread butter.....
- 18) To hit something.....
- 19) To fill Christmas stocking.....
- 20) To decorate cake.....
- 21) To smoke something.....
- 22) To post letter.....
- 23) To photograph something.....
- 24) To ride.....
- 25) To bake something.....
- 26) To surf something.....
- 27) To stir soup.....
- 28) To clear something.....
- 29) To dress something.....
- 30) To draw something.....
- 31) To light candle.....
- 32) To sweep something.....
- 33) To look stars.....
- 34) To strike golf-ball.....
- 35) To change something.....
- 36) To knit scarf.....

Please specify what you would need to carry out the following actions.

- 1) To listen to something.....
- 2) To chop vegetables.....
- 3) To cover person.....
- 4) To clean something.....
- 5) To wash clothes.....
- 6) To steer car.....
- 7) To take something.....
- 8) To catch fish.....
- 9) To write on blackboard.....
- 10) To view stars.....
- 11) To drink tea.....
- 12) To carry bricks.....
- 13) To shoot something.....
- 14) To play drums.....
- 15) To cut grass.....
- 16) To carve meat.....
- 17) To spread something.....
- 18) To hit nail.....
- 19) To fill car tank.....
- 20) To decorate something.....
- 21) To bake bread.....
- 22) To sail something.....
- 23) To dress baby.....
- 24) To unlock something.....
- 25) To clear snow.....
- 26) To drive something.....
- 27) To sweep floor.....
- 28) To surf wave.....
- 29) To buy tickets.....
- 30) To drive nail.....
- 31) To hit baseball.....
- 32) To draw lines.....
- 33) To open something.....
- 34) To fly.....
- 35) To sell something.....
- 36) To shoot deer.....

Appendix Seven

. Instrument -> Verb Questionnaire

Please list the possible uses for the following items.

- 1) shovel.....
- 2) jack.....
- 3) spoon.....
- 4) water.....
- 5) pencil.....
- 6) hammer.....
- 7) needles.....
- 8) match.....
- 9) can opener.....
- 10) broom.....
- 11) gun.....
- 12) club.....
- 13) scissors.....
- 14) cigarette.....
- 15) post-box.....
- 16) camera.....
- 17) oven.....
- 18) boat.....
- 19) money.....
- 20) key.....
- 21) clothes.....
- 22) car.....
- 23) aeroplane.....
- 24) surfboard.....
- 25) stethoscope.....
- 26) knife.....
- 27) blindfold.....
- 28) shampoo.....
- 29) rudder.....
- 30) thermometer.....
- 31) trap.....
- 32) horse.....
- 33) chalk.....
- 34) telescope.....
- 35) trough.....
- 36) bag.....
- 37) tooth brush.....
- 38) sticks.....
- 39) lawn-mower.....
- 40) chisel.....
- 41) trowel.....
- 42) bat.....
- 43) petrol.....
- 44) tinsel.....
- 45) headphones.....
- 46) axe.....
- 47) blanket.....

- 48) cloth.....
- 49) powder.....
- 50) wheel.....
- 51) camera.....
- 52) fishing rod.....
- 53) pen.....
- 54) microscope.....
- 55) glass.....
- 56) hod.....
- 57) bow.....
- 58) ball.....
- 59) scissors.....
- 60) knife.....
- 61) hammer.....
- 62) presents.....
- 63) icing.....

Appendix Eight

Materials used in Experiment Five

Dominant Target Instruments

1) Chop Vegetables

(A)

Explicit Appropriate Context

The cook was busy preparing food before the lunch time rush. She chopped the vegetables with a knife. It took rather a long time because the knife was blunt. She stopped half way through for a break.

Did she stop for a break?

Explicit Inappropriate Context

The lumberjack was busy stockpiling wood before winter. He chopped the wood with a knife. It took rather a long time because the knife was blunt. He stopped half way through for a break.

Did he stop for a break?

Implicit Appropriate Context

The cook was busy preparing food before the lunch time rush. She chopped the vegetables for the stew. It took rather a long time because the knife was blunt. She stopped half way through for a break.

Did she stop for a break?

Implicit Inappropriate Context

The lumberjack was busy stockpiling wood before winter. He chopped the wood by the river. It took rather a long time because the knife was blunt. He stopped half way through for a break.

Did he stop for a break?

(B)

Explicit Appropriate Context

The chef was very busy preparing the dinner in the restaurant. He was chopping vegetables with a knife. The task was easy because the knife was very sharp. It was seven o'clock when the task was completed.

Was the task completed by seven o'clock?

Explicit Inappropriate Context

Nicholas was very busy preparing for winter in the mountains. He was chopping wood for the fire with a knife. The task was easy because the knife was very sharp. It was seven o'clock when the task was completed.

Was the task completed by seven o'clock?

Implicit Appropriate Context

The chef was very busy preparing the dinner in the restaurant. He was chopping vegetables for the soup. The task was easy because the knife was very sharp. It was seven o'clock when the task was completed.

Was the task completed by seven o'clock?

Implicit Inappropriate Context

Nicholas was very busy preparing for winter in the mountains. He was chopping wood for the fire with care. The task was easy because the knife was very sharp. It was seven o'clock when the task was completed.

Was the task completed by seven o'clock?

2) Wash Hair: Shampoo

(A)

Explicit Appropriate Context

It was almost eight thirty on Monday morning and Sue was going to be late for work. She washed her hair with shampoo. Unfortunately, the shampoo spilt on the floor. She cursed under her breath as she cleaned up the mess.

Would Sue be early for work?

Explicit Inappropriate Context

It was almost eight thirty on Monday morning and Sue was going to be late for work. She washed her clothes with shampoo. Unfortunately, the shampoo spilt on the floor. She cursed under her breath as she cleaned up the mess.

Would Sue be early for work?

Implicit Appropriate Context

It was almost eight thirty on Monday morning and Sue was going to be late for work. She washed her hair with haste. Unfortunately, the shampoo spilt on the floor. She cursed under her breath as she cleaned up the mess.

Would Sue be early for work?

Implicit Inappropriate Context

It was almost eight thirty on Monday morning and Sue was going to be late for work. She washed her clothes with haste. Unfortunately, the shampoo spilt on the floor. She cursed under her breath as she cleaned up the mess.
Would Sue be early for work?

(B)

Explicit Appropriate Context

Margaret was busy taking care of her baby daughter. She washed the baby's hair with shampoo. She was distracted when the baby began to cry and the shampoo dropped on the floor. She checked the baby was well before cleaning up the mess.
Was Margaret looking after her son?

Explicit Inappropriate Context

Margaret was busy taking care of her baby daughter. She washed the baby's clothes with shampoo. She was distracted when the baby began to cry and the shampoo dropped on the floor. She checked the baby was well before cleaning up the mess.
Was Margaret looking after her son?

Implicit Appropriate Context

Margaret was busy taking care of her baby daughter. She washed the baby's hair with care. She was distracted when the baby began to cry and the shampoo dropped on the floor. She checked the baby was well before cleaning up the mess.
Was Margaret looking after her son?

Implicit Inappropriate Context

Margaret was busy taking care of her baby daughter. She washed the baby's clothes with care. She was distracted when the baby began to cry and the shampoo dropped on the floor. She checked the baby was well before cleaning up the mess.
Was Margaret looking after her son?

3) Steer Car: Wheel

(A)

Explicit Appropriate Context

The driver reduced the speed of his car because of the stormy weather. It was difficult to steer the car using the wheel. He quickly turned the wheel to keep on course. He was relieved when he reached his destination unharmed.
Was the weather calm?

Explicit Inappropriate Context

The oarsman reduced the speed of his boat because of the stormy weather. It was difficult to steer the boat using the wheel.

He quickly turned the wheel to keep on course. He was relieved when he reached his destination unharmed.

Was the weather calm?

Implicit Appropriate Context

The driver reduced the speed of his car because of the stormy weather. It was difficult to steer the car due to high winds.

He quickly turned the wheel to keep on course. He was relieved when he reached his destination unharmed.

Was the weather calm?

Implicit Inappropriate Context

The oarsman reduced the speed of his boat because of the stormy weather. It was difficult to steer the boat due to high winds.

He quickly turned the wheel to keep on course. He was relieved when he reached his destination unharmed.

Was the weather calm?

(B)

Explicit Appropriate Context

The Smith family thoroughly enjoyed their sightseeing tour through the mountains. The children laughed as their father steered the car around the tight bends with the wheel.

They asked if the wheel was difficult to turn. Their mother told them it was too dangerous for them to try.

Did the children cry?

Explicit Inappropriate Context

The Smith family thoroughly enjoyed their sightseeing trip down the river. The children laughed as their father steered the boat around the tight bends with the wheel.

They asked if the wheel was difficult to turn. Their mother told them it was too dangerous for them to try.

Did the children cry?

Implicit Appropriate Context

The Smith family thoroughly enjoyed their sightseeing tour through the mountains. The children laughed as their father steered the car around the tight bends in the road.

They asked if the wheel was difficult to turn. Their mother told them it was too dangerous for them to try.

Did the children cry?

Implicit Inappropriate Context

The Smith family thoroughly enjoyed their sightseeing trip down the river. The children laughed as their father steered the boat around the tight bends in the river.

They asked if the wheel was difficult to turn. Their mother told them it was too dangerous for them to try.

Did the children cry?

4) Catch Mouse: Trap

(A)

Explicit Appropriate Context

The caretaker walked through the basement looking for mouse holes. He hoped he would catch many mice with a new trap. He checked the trap was baited correctly. He sat down and waited.

Did the caretaker sit down and wait?

Explicit Inappropriate Context

The fisherman walked along the river bank looking for a shady spot. He hoped he would catch many fish with a new trap. He checked the trap was baited correctly. He sat down and waited.

Did the fisherman sit down and wait?

Implicit Appropriate Context

The caretaker walked through the basement looking for mouse holes. He hoped he would catch many mice on this trip. He checked the trap was baited correctly. He sat down and waited.

Did the caretaker sit down and wait?

Implicit Inappropriate Context

The fisherman walked along the river bank looking for a shady spot. He hoped he would catch many fish on this trip. He checked the trap was baited correctly. He sat down and waited.

Did the fisherman sit down and wait?

(B)

Explicit Appropriate Context

Numerous mice had settled in a cool shady corner of the house. Jack walked quietly to the spot hoping he would catch the mice in a trap. To lure them out, the trap was baited with food. His plan was very successful.

Was his plan successful?

Explicit Inappropriate Context

Numerous fish had settled in a cool shady bend in the river. Jack walked quietly to the spot hoping he would catch the fish in a trap. To lure them out, the trap was baited with food. His plan was very successful.

Was his plan successful?

Implicit Appropriate Context

Numerous mice had settled in a cool shady corner of the house. Jack walked quietly to the spot hoping he would catch the mice by surprise. To lure them out, the trap was baited with food. His plan was very successful.

Was his plan successful?

Implicit Inappropriate Context

Numerous fish had settled in a cool shady bend in the river. Jack walked quietly to the spot hoping he would catch the fish by surprise. To lure them out, the trap was baited with food. His plan was very successful.

Was his plan successful?

5) Write Letter: Pen

(A)

Explicit Appropriate Context

The teacher worked quietly as the children read their books. She was busy writing a letter of complaint with a pen. However, she was disturbed by a loud scream from the back of the class and the pen dropped onto the floor. She called for quiet, and threatened the class with detention if there was any further disturbance.

Did the teacher drop something on the floor?

Explicit Inappropriate Context

The teacher worked quietly as the children read their books. She was busy writing an exercise on the blackboard with a pen. However, she was disturbed by a loud scream from the back of the class and the pen dropped onto the floor. She called for quiet, and threatened the class with detention if there was any further disturbance.

Did the teacher drop something on the floor?

Implicit Appropriate Context

The teacher worked quietly as the children read their books. She was busy writing a letter of complaint to a parent. However, she was disturbed by a loud scream from the back of the class and the pen dropped onto the floor. She called for quiet, and threatened the class with detention if there was any further disturbance.

Did the teacher drop something on the floor?

Implicit Inappropriate Context

The teacher worked quietly as the children read their books. She was busy writing an exercise on the blackboard by the door. However, she was disturbed by a loud scream from the back of the class and the pen dropped onto the floor. She called for quiet, and threatened the class with detention if there was any further disturbance.

Did the teacher drop something on the floor?

(B)

Explicit Appropriate Context

The tutor considered the problem in great detail. He wrote a possible solution in a letter with a pen. While doing so, the pen slipped from his hand and fell onto the floor. He hoped his suggestion would help solve the problem. Did the tutor think of a possible solution?

Explicit Inappropriate Context

The tutor considered the problem in great detail. He wrote a possible solution on the blackboard with a pen. While doing so, the pen slipped from his hand and fell onto the floor. He hoped his suggestion would help solve the problem. Did the tutor think of a possible solution?

Implicit Appropriate Context

The tutor considered the problem in great detail.

He wrote a possible solution in a letter to the Principal.

While doing so, the pen slipped from his hand and fell onto the floor. He hoped his suggestion would help solve the problem.

Did the tutor think of a possible solution?

Implicit Inappropriate Context

The tutor considered the problem in great detail.

He wrote a possible solution on the blackboard near the window.

While doing so, the pen slipped from his hand and fell onto the floor. He hoped his suggestion would help solve the problem.

Did the tutor think of a possible solution?

6) View Bacteria: Microscope

(A)

Explicit Appropriate Context

A large team of biologists were studying the newly discovered strain of bacteria. The bacteria was viewed with a powerful new microscope. The lab where the microscope was situated was closely monitored by security cameras. The findings were of great scientific importance.

Was the team of scientists small?

Explicit Inappropriate Context

A large team of astronomers were studying the newly discovered solar system. The solar system was viewed with a powerful new microscope. The lab where the microscope was situated was closely monitored by security cameras. The findings were of great scientific importance.

Was the team of scientists small?

Implicit Appropriate Context

A large team of biologists were studying the newly discovered strain of bacteria. The bacteria was viewed and carefully analysed. The lab where the microscope was situated was closely monitored by security cameras. The findings were of great scientific importance.

Was the team of scientists small?

Implicit Inappropriate Context

A large team of astronomers were studying the newly discovered solar system. The solar system was viewed and carefully analysed. The lab where the microscope was situated was closely monitored by security cameras. The findings were of great scientific importance.

(B)

Explicit Appropriate Context

The biologist carefully monitored the progress of the virus as it travelled through the water supply. Samples were viewed with a microscope at regular intervals. The microscope was new and very powerful. The scientist collected lots of important data.

Was the microscope old?

Explicit Inappropriate Context

The astronomer carefully monitored the progress of the comet as it travelled through the solar system. The trail was viewed with a microscope at regular intervals. The microscope was new and very powerful. The scientist collected lots of important data.

Was the telescope old?

Implicit Appropriate Context

The biologist carefully monitored the progress of the virus as it travelled through the water supply. Samples were viewed and analysed at regular intervals. The microscope was new and very powerful. The scientist collected lots of important data.

Was the microscope old?

Implicit Inappropriate Context

The astronomer carefully monitored the progress of the comet as it travelled through the solar system. The trail was viewed and analysed at regular intervals. The microscope was new and very powerful. The scientist collected lots of important data.

Was the telescope old?

7) Shoot Bullets: Gun

(A)

Explicit Appropriate Context

Graham won many prizes at the Fair, especially at the rifle range. He kept a steady hand and shot the bullets with a gun. He missed the target once when the gun jammed and failed to fire. Despite the mishap, he still managed to achieve the highest score of the day.

Did Graham achieve the lowest score of the day?

Explicit Inappropriate Context

Graham won many prizes at the Fair, especially at the archery contest. He kept a steady hand and shot the arrows with a gun. He missed the target once when the gun jammed and failed to fire. Despite the mishap, he still managed to achieve the highest score of the day.

Did Graham achieve the lowest score of the day?

Implicit Appropriate Context

Graham won many prizes at the Fair, especially at the rifle range. He kept a steady hand and shot the bullets with skill. He missed the target once when the gun jammed and failed to fire. Despite the mishap, he still managed to achieve the highest score of the day.

Did Graham achieve the lowest score of the day?

Implicit Inappropriate Context

Graham won many prizes at the Fair, especially at the archery contest. He kept a steady hand and shot the arrows with skill. He missed the target once when the gun jammed and failed to fire. Despite the mishap, he still managed to achieve the highest score of the day.

Did Graham achieve the lowest score of the day?

(B)

Explicit Appropriate Context

Richard was rather nervous as he took up position at the rifle range. He aimed and shot the bullets with a gun. He cursed when the gun failed to fire. He checked to see what was causing the problem.

Did the gun fire?

Explicit Inappropriate Context

Richard was rather nervous as he took up position at the archery contest. He aimed and shot the arrows with a gun. He cursed when the gun failed to fire. He checked to see what was causing the problem.

Did the gun fire?

Implicit Appropriate Context

Richard was rather nervous as he took up position at the rifle range. He aimed and shot the bullets towards the bull's eye. He cursed when the gun failed to fire. He checked to see what was causing the problem.

Did the gun fire?

Implicit Inappropriate Context

Richard was rather nervous as he took up position at the archery contest. He aimed and shot the arrows towards the bull's eye. He cursed when the gun failed to fire. He checked to see what was causing the problem.

Did the gun fire?

8) Carve Meat: Knife

(A)

Explicit Appropriate Context

The chef was very busy preparing the buffet for lunch at the hotel. He only had to carve the meat with a knife and it would be complete. Unfortunately, the knife slipped and he cut his hand. The cut was deep and would probably need stitches.

Was the cut deep?

Explicit Inappropriate Context

The carpenter was busy preparing the statue for display at the hotel. He only had to carve the final details with a knife and it would be complete. Unfortunately, the knife slipped and he cut his hand. The cut was deep and would probably need stitches.

Was the cut deep?

Implicit Appropriate Context

The chef was very busy preparing the buffet for lunch at the hotel. He only had to carve the meat in thin slices and it would be complete. Unfortunately, the knife slipped and he cut his hand. The cut was deep and would probably need stitches.

Was the cut deep?

Implicit Inappropriate Context

The carpenter was busy preparing the statue for display at the hotel. He only had to carve the final details with care and it would be complete. Unfortunately, the knife slipped and he cut his hand. The cut was deep and would probably need stitches.

Was the cut deep?

(B) Dominant Target - knife

Explicit Appropriate Context

The gourmet cook was completing the final dish for the celebrity dinner. She carved the last joint of meat with a knife.

She screamed when the knife slipped and she cut her hand.

Someone nearby heard the scream and came to her assistance.

Did she scream when she cut her hand?

Explicit Inappropriate Context

The talented sculptor was completing the final statue for the exhibition. She carved the facial details with a knife. She screamed when the knife slipped and she cut her hand. Someone nearby heard the scream and came to her assistance. Did she scream when she cut her hand?

Implicit Appropriate Context

The gourmet cook was completing the final dish for the celebrity dinner. She carved the last joint of meat onto a plate. She screamed when the knife slipped and she cut her hand. Someone nearby heard the scream and came to her assistance. Did she scream when she cut her hand?

Implicit Inappropriate Context

The talented sculptor was completing the final statue for the exhibition. She carved the facial details into the stone. She screamed when the knife slipped and she cut her hand. Someone nearby heard the scream and came to her assistance. Did she scream when she cut her hand?

9 Hit Ball: Bat

(A)

Explicit Appropriate Context

On Sunday morning Andrew played baseball in the park. He walked to base and prepared to hit the ball with a bat. Unfortunately, the bat slipped and he hurt his thumb. His thumb was very red and beginning to bruise. Did Andrew hurt his thumb?

Explicit Inappropriate Context

On Sunday morning Andrew did some repairs in the house. He climbed the ladder and prepared to hit the nail with a bat. Unfortunately, the bat slipped and he hurt his thumb. His thumb was very red and beginning to bruise. Did Andrew hurt his thumb?

Implicit Appropriate Context

On Sunday morning Andrew played baseball in the park. He walked to base and prepared to hit the ball for a home run. Unfortunately, the bat slipped and he hurt his thumb. His thumb was very red and beginning to bruise. Did Andrew hurt his thumb?

Implicit Inappropriate Context

On Sunday morning Andrew did some repairs in the house.
 He climbed the ladder and prepared to hit the nail into the wall.
 Unfortunately, the bat slipped and he hurt his thumb.
 His thumb was very red and beginning to bruise.
 Did Andrew hurt his thumb?

(B)

Explicit Appropriate Context

The captain of the cricket team stood by the wicket.
 He hit the ball over the boundary with a bat. It required
 a lot of strength as the bat was extremely heavy.
 He gripped the handle tightly to make the task easier.
 Did the task require a lot of strength?

Explicit Inappropriate Context

The joiner from the construction crew stood by the bench.
 He hit the nail into the wood with a bat. It required
 a lot of strength as the bat was extremely heavy.
 He gripped the handle tightly to make the task easier.
 Did the task require a lot of strength?

Implicit Appropriate Context

The captain of the cricket team stood by the wicket.
 He hit the ball over the boundary with great force. It required
 a lot of strength as the bat was extremely heavy.
 He gripped the handle tightly to make the task easier.
 Did the task require a lot of strength?

Implicit Inappropriate Context

The joiner from the construction crew stood by the bench.
 He hit the nail into the wood with great force. It required
 a lot of strength as the bat was extremely heavy.
 He gripped the handle tightly to make the task easier.
 Did the task require a lot of strength?

10) Decorate Cake: Icing

(A)

Explicit Appropriate Context

It was two days before her Birthday party and Jennifer was very
 excited. She helped her mother decorate the birthday cake
 with pink icing. She laughed as the icing was put in place.
 She was very pleased with the final result.
 Did Jennifer help her father?

Explicit Inappropriate Context

It was two days before Christmas Eve and Jennifer was very excited. She helped her mother decorate the Christmas tree with pink icing. She laughed as the icing was put in place. She was very pleased with the final result.
Did Jennifer help her father?

Implicit Appropriate Context

It was two days before her Birthday party and Jennifer was very excited. She helped her mother decorate the birthday cake with great care. She laughed as the icing was put in place. She was very pleased with the final result.
Did Jennifer help her father?

Implicit Inappropriate Context

It was two days before Christmas Eve and Jennifer was very excited. She helped her mother decorate the Christmas tree with great care. She laughed as the icing was put in place. She was very pleased with the final result.
Did Jennifer help her father?

(B)

Explicit Appropriate Context

Janet was organising a Birthday celebration for her mother. The guests were due and she was still decorating the cake with icing. Some guests arrived before the icing was in place. She apologised for not being ready on time.
Was Janet ready on time?

Explicit Inappropriate Context

Janet was organising the Christmas celebration for the family. The guests were due and she was still decorating the tree with icing. Some guests arrived before the icing was in place. She apologised for not being ready on time.
Was Janet ready on time?

Implicit Appropriate Context

Janet was organising a Birthday celebration for her mother. The guests were due and she was still decorating the birthday cake. Some guests arrived before the icing was in place. She apologised for not being ready on time.
Was Janet ready on time?

Implicit Inappropriate Context

Janet was organising the Christmas celebration for the family. The guests were due and she was still decorating the Christmas tree. Some guests arrived before the icing was in place. She apologised for not being ready on time. Was Janet ready on time?

11) Drink

(A)

Explicit Appropriate Context

Mary was glad to relax after a busy day at the office. She sat in her favourite armchair and drank tea from a china cup. She was tired and as she fell asleep the cup dropped on the floor. She was awoken half an hour later by the sound of the doorbell. Did Mary drop something on the floor when she fell asleep?

Explicit Inappropriate Context

Mary was glad to relax after a busy day at the office. She sat in her favourite armchair and drank wine from a china cup. She was tired and as she fell asleep the cup dropped on the floor. She was awoken half an hour later by the sound of the doorbell. Did Mary drop something on the floor when she fell asleep?

Implicit Appropriate Context

Mary was glad to relax after a busy day at the office. She sat in her favourite armchair and drank tea as she watched TV. She was tired and as she fell asleep the cup dropped on the floor. She was awoken half an hour later by the sound of the doorbell. Did Mary drop something on the floor when she fell asleep?

Implicit Inappropriate Context

Mary was glad to relax after a busy day at the office. She sat in her favourite armchair and drank wine as she watched TV. She was tired and as she fell asleep the cup dropped on the floor. She was awoken half an hour later by the sound of the doorbell. Did Mary drop something on the floor when she fell asleep?

(B)

Explicit Appropriate Context

It was early evening and Alison was watching her favourite soap opera. She was drinking a cup of tea when the doorbell rang. As she got up to answer the door, the cup slipped from her hand and fell onto the floor. She opened the door before tidying up the mess.

Was Alison watching TV?

Explicit Inappropriate Context

It was early evening and Alison was watching her favourite soap opera. She was drinking a cup of wine when the doorbell rang. As she got up to answer the door, the cup slipped from her hand and fell onto the floor. She opened the door before tidying up the mess.

Was Alison watching TV?

Implicit Appropriate Context

It was early evening and Alison was watching her favourite soap opera. She was drinking some tea when the doorbell rang. As she got up to answer the door, the cup slipped from her hand and fell onto the floor. She opened the door before tidying up the mess.

Was Alison watching TV?

Implicit Inappropriate Context

It was early evening and Alison was watching her favourite soap opera. She was drinking some wine when the doorbell rang. As she got up to answer the door, the cup slipped from her hand and fell onto the floor. She opened the door before tidying up the mess.

Was Alison watching TV?

12) Eat Salad - Fork

(A) Dominant Target - fork

Explicit Appropriate Context

John was hungry so he went into the Kitchen to prepare a snack. He ate some salad with a fork. He heard the doorbell and as he rose to open the door the fork fell from the table onto the floor. His friend had arrived ten minutes early.

Did John's friend arrive late?

Explicit Inappropriate Context

John was hungry so he went into the Kitchen to prepare a snack
 He ate some corn flakes with a fork. He heard the doorbell and
 as he rose to open the door the fork fell from the table onto
 the floor. His friend had arrived ten minutes early.
 Did John's friend arrive late?

Implicit Appropriate Context

John was hungry so he went into the Kitchen to prepare a snack
 He ate some salad with haste. He heard the doorbell and
 as he rose to open the door the fork fell from the table onto
 the floor. His friend had arrived ten minutes early.
 Did John's friend arrive late?

Implicit Inappropriate Context

John was hungry so he went into the Kitchen to prepare a snack
 He ate some corn flakes with haste. He heard the doorbell and
 as he rose to open the door the fork fell from the table onto
 he floor. His friend had arrived ten minutes early.
 Did John's friend arrive late?

(B)

Explicit Appropriate Context

Audrey went into the kitchen to have a snack before going out.
 She was in a rush so she ate some salad with a fork.
 In her hurry, the fork was accidentally knocked onto the floor.
 She left the house without finishing her snack.
 Did Audrey eat an apple?

Explicit Inappropriate Context

Audrey went into the kitchen to have a snack before going out.
 She was in a rush so she ate some corn flakes with a fork.
 In her hurry, the fork was accidentally knocked onto the floor.
 She left the house without finishing her snack.
 Did Audrey eat an apple?

Implicit Appropriate Context

Audrey went into the kitchen to have a snack before going out.
 She was in a rush so she ate some salad from the fridge.
 In her hurry, the fork was accidentally knocked onto the floor.
 She left the house without finishing her snack.
 Did Audrey eat an apple?

Implicit Inappropriate Context

Audrey went into the kitchen to have a snack before going out.
 She was in a rush so she ate some corn flakes and a roll.
 In her hurry, the fork was accidentally knocked onto the floor.
 She left the house without finishing her snack.
 Did Audrey eat an apple?

Non Dominant Target Instruments

1) Chop Wood - Axe

(A)

Explicit Appropriate Context

Nicholas was very busy preparing for winter in the mountains.
 He was chopping wood for the fire with an axe. The task was
 easy because the axe was very sharp. It was seven o'clock
 when the task was completed.
 Was the task completed by seven o'clock?

Explicit Inappropriate Context

The chef was very busy preparing the dinner in the restaurant.
 He was chopping vegetables with an axe. The task was
 easy because the axe was very sharp. It was seven o'clock
 when the task was completed.
 Was the task completed by seven o'clock?

Implicit Appropriate Context

Nicholas was very busy preparing for winter in the mountains.
 He was chopping wood for the fire with care. The task was
 easy because the axe was very sharp. It was seven o'clock
 when the task was completed.
 Was the task completed by seven o'clock?

Implicit Inappropriate Context

The chef was very busy preparing the dinner in the restaurant.
 He was chopping vegetables for the soup. The task was
 easy because the axe was very sharp. It was seven o'clock
 when the task was completed.
 Was the task completed by seven o'clock? [12

(B)

Explicit Appropriate Context

The lumberjack was busy stockpiling wood before winter. He chopped the wood with an axe. It took rather a long time because the axe was blunt. He stopped half way through for a break.

Did he stop for a break?

Explicit Inappropriate Context

The cook was busy preparing food before the lunch time rush. She chopped the vegetables with an axe. It took rather a long time because the axe was blunt. She stopped half way through for a break.

Did she stop for a break?

Implicit Appropriate Context

The lumberjack was busy stockpiling wood before winter. He chopped the wood by the river. It took rather a long time because the axe was blunt. He stopped half way through for a break.

Did he stop for a break?

Implicit Inappropriate Context

The cook was busy preparing food before the lunch time rush. She chopped the vegetables for the stew. It took rather a long time because the axe was blunt. She stopped half way through for a break.

Did she stop for a break?

2) Wash Clothes - Powder

(A)

Explicit Appropriate Context

It was almost eight thirty on Monday morning and Sue was going to be late for work. She washed her clothes with powder. Unfortunately, the powder spilt on the floor. She cursed under her breath as she cleaned up the mess.

Would Sue be early for work?

Explicit Inappropriate Context

It was almost eight thirty on Monday morning and Sue was going to be late for work. She washed her hair with powder. Unfortunately, the powder spilt on the floor. She cursed under her breath as she cleaned up the mess.

Would Sue be early for work?

Implicit Appropriate Context

It was almost eight thirty on Monday morning and Sue was going to be late for work. She washed her clothes with haste. Unfortunately, the powder spilt on the floor. She cursed under her breath as she cleaned up the mess.
Would Sue be early for work?

Implicit Inappropriate Context

It was almost eight thirty on Monday morning and Sue was going to be late for work. She washed her hair with haste. Unfortunately, the powder spilt on the floor. She cursed under her breath as she cleaned up the mess.
Would Sue be early for work?

(B)

Explicit Appropriate Context

Margaret was busy taking care of her baby daughter. She washed the baby's clothes with powder. She was distracted when the baby began to cry and the powder dropped on the floor. She checked the baby was well before cleaning up the mess.
Was Margaret looking after her son?

Explicit Inappropriate Context

Margaret was busy taking care of her baby daughter. She washed the baby's hair with powder. She was distracted when the baby began to cry and the powder dropped on the floor. She checked the baby was well before cleaning up the mess.
Was Margaret looking after her son?

Implicit Appropriate Context

Margaret was busy taking care of her baby daughter. She washed the baby's clothes with care. She was distracted when the baby began to cry and the powder dropped on the floor. She checked the baby was well before cleaning up the mess.
Was Margaret looking after her son?

Implicit Inappropriate Context

Margaret was busy taking care of her baby daughter. She washed the baby's hair with care. She was distracted when the baby began to cry and the powder dropped on the floor. She checked the baby was well before cleaning up the mess.
Was Margaret looking after her son?

3) Steer Boat - Rudder

(A)

Explicit Appropriate Context

The oarsman reduced the speed of his boat because of the stormy weather. It was difficult to steer the boat using the rudder. He quickly turned the rudder to keep on course. He was relieved when he reached his destination unharmed.
Was the weather calm?

Explicit Inappropriate Context

The driver reduced the speed of his car because of the stormy weather. It was difficult to steer the car using the rudder. He quickly turned the rudder to keep on course. He was relieved when he reached his destination unharmed.
Was the weather calm?

Implicit Appropriate Context

The oarsman reduced the speed of his boat because of the stormy weather. It was difficult to steer the boat due to high winds. He quickly turned the rudder to keep on course. He was relieved when he reached his destination unharmed.
Was the weather calm?

Implicit Inappropriate Context

The driver reduced the speed of his car because of the stormy weather. It was difficult to steer the car due to high winds. He quickly turned the rudder to keep on course. He was relieved when he reached his destination unharmed.
Was the weather calm?

(B)

Explicit Appropriate Context

The Smith family thoroughly enjoyed their sightseeing trip down the river. The children laughed as their father steered the boat around the tight bends with the rudder. They asked if the rudder was difficult to turn. Their mother told them it was too dangerous for them to try.
Did the children cry?

Explicit Inappropriate Context

The Smith family thoroughly enjoyed their sightseeing tour through the mountains. The children laughed as their father steered the car around the tight bends with the rudder. They asked if the rudder was difficult to turn. Their mother told them it was too dangerous for them to try.

Did the children cry?

Implicit Appropriate Context

The Smith family thoroughly enjoyed their sightseeing trip down the river. The children laughed as their father steered the boat around the tight bends in the river.

They asked if the rudder was difficult to turn. Their mother told them it was too dangerous for them to try.

Did the children cry?

Implicit Inappropriate Context

The Smith family thoroughly enjoyed their sightseeing tour through the mountains. The children laughed as their father steered the car around the tight bends in the road.

They asked if the rudder was difficult to turn. Their mother told them it was too dangerous for them to try.

Did the children cry?

4) Catch Fish - Rod

(A)

Explicit Appropriate Context

The fisherman walked along the river bank looking for a shady spot. He hoped he would catch many fish with a new rod. He checked the rod was baited correctly. He sat down and waited.

Did the fisherman sit down and wait?

Explicit Inappropriate Context

The caretaker walked through the basement looking for mouse holes. He hoped he would catch many mice with a new rod. He checked the rod was baited correctly. He sat down and waited.

Did the caretaker sit down and wait?

Implicit Appropriate Context

The fisherman walked along the river bank looking for a shady spot. He hoped he would catch many fish on this trip.

He checked the rod was baited correctly. He sat down and waited.

Did the fisherman sit down and wait?

Implicit Inappropriate Context

The caretaker walked through the basement looking for mouse holes. He hoped he would catch many mice on this trip.

He checked the rod was baited correctly. He sat down and waited.

Did the caretaker sit down and wait?

(B)

Explicit Appropriate Context

Numerous fish had settled in a cool shady bend in the river. Jack walked quietly to the spot hoping he would catch the fish with a rod. To lure them out, the rod was baited with food. His plan was very successful.
Was his plan successful?

Explicit Inappropriate Context

Numerous mice had settled in a cool shady corner of the house. Jack walked quietly to the spot hoping he would catch the mice with a rod. To lure them out, the rod was baited with food. His plan was very successful.
Was his plan successful?

Implicit Appropriate Context

Numerous fish had settled in a cool shady bend in the river. Jack walked quietly to the spot hoping he would catch the fish by surprise. To lure them out, the rod was baited with food. His plan was very successful.
Was his plan successful?

Implicit Inappropriate Context

Numerous mice had settled in a cool shady corner of the house. Jack walked quietly to the spot hoping he would catch the mice by surprise. To lure them out, the rod was baited with food. His plan was very successful.
Was his plan successful?

5) Write Board - Chalk

(A)

Explicit Appropriate Context

The teacher worked quietly as the children read their books. She was busy writing an exercise on the blackboard with chalk. However, she was disturbed by a loud scream from the back of the class and the chalk dropped onto the floor. She called for quiet, and threatened the class with detention if there was any further disturbance.
Did the teacher drop something on the floor?

Explicit Inappropriate Context

The teacher worked quietly as the children read their books. She was busy writing a letter of complaint with chalk. However, she was disturbed by a loud scream from the back of the class and the chalk dropped onto the floor. She called for quiet, and threatened the class with detention if there was any further disturbance.

Did the teacher drop something on the floor?

Implicit Appropriate Context

The teacher worked quietly as the children read their books. She was busy writing an exercise on the blackboard by the door. However, she was disturbed by a loud scream from the back of the class and the chalk dropped onto the floor. She called for quiet, and threatened the class with detention if there was any further disturbance.

Did the teacher drop something on the floor?

Implicit Inappropriate Context

The teacher worked quietly as the children read their books. She was busy writing a letter of complaint to a parent. However, she was disturbed by a loud scream from the back of the class and the chalk dropped onto the floor. She called for quiet, and threatened the class with detention if there was any further disturbance.

Did the teacher drop something on the floor?

(B)

Explicit Appropriate Context

The tutor considered the problem in great detail. He wrote a possible solution on the blackboard with chalk. While doing so, the chalk slipped from his hand and fell onto the floor. He hoped his suggestion would help solve the problem.

Did the tutor think of a possible solution?

Explicit Inappropriate Context

The tutor considered the problem in great detail. He wrote a possible solution in a letter with chalk. While doing so, the chalk slipped from his hand and fell onto the floor. He hoped his suggestion would help solve the problem.

Did the tutor think of a possible solution?

Implicit Appropriate Context

The tutor considered the problem in great detail. He wrote a possible solution on the blackboard near the window. While doing so, the chalk slipped from his hand and fell onto the floor. He hoped his suggestion would help solve the problem.

Implicit Inappropriate Context

The tutor considered the problem in great detail.

He wrote a possible solution in a letter to the Principal.

While doing so, the chalk slipped from his hand and fell onto the floor. He hoped his suggestion would help solve the problem.

Did the tutor think of a possible solution?

6) View Stars - Telescope

(A)

Explicit Appropriate Context

A large team of astronomers were studying the newly discovered solar system. The solar system was viewed with a powerful new telescope. The lab where the telescope was situated was closely monitored by security cameras. The findings were of great scientific importance.

Was the team of scientists small?

Explicit Inappropriate Context

A large team of biologists were studying the newly discovered strain of bacteria. The bacteria was viewed with a powerful new telescope. The lab where the telescope was situated was closely monitored by security cameras. The findings were of great scientific importance.

Was the team of scientists small?

Implicit Appropriate Context

A large team of astronomers were studying the newly discovered solar system. The solar system was viewed and carefully analysed. The lab where the telescope was situated was closely monitored by security cameras. The findings were of great scientific importance.

Was the team of scientists small?

Implicit Inappropriate Context

A large team of biologists were studying the newly discovered strain of bacteria. The bacteria was viewed and carefully analysed. The lab where the telescope was situated was closely monitored by security cameras. The findings were of great scientific importance.

Was the team of scientists small?

(B)

Explicit Appropriate Context

The astronomer carefully monitored the progress of the comet as it travelled through the solar system. The trail was viewed with a telescope at regular intervals. The telescope was new and very powerful. The scientist collected lots of important data.

Was the telescope old?

Explicit Inappropriate Context

The biologist carefully monitored the progress of the virus as it travelled through the water supply. Samples were viewed with a telescope at regular intervals. The telescope was new and very powerful. The scientist collected lots of important data.

Was the microscope old?

Implicit Appropriate Context

The astronomer carefully monitored the progress of the comet as it travelled through the solar system. The trail was viewed and analysed at regular intervals. The telescope was new and very powerful. The scientist collected lots of important data.

Was the telescope old?

Implicit Inappropriate Context

The biologist carefully monitored the progress of the virus as it travelled through the water supply. Samples were viewed and analysed at regular intervals. The telescope was new and very powerful. The scientist collected lots of important data.

Was the telescope old?

7) Shoot Arrows - Bow

(A)

Explicit Appropriate Context

Graham won many prizes at the Fair, especially at the archery contest. He kept a steady hand and shot the arrows with a bow. He missed the target once when the bow jammed and failed to fire. Despite the mishap, he still managed to achieve the highest score of the day.

Did Graham achieve the lowest score of the day?

Explicit Inappropriate Context

Graham won many prizes at the Fair, especially at the rifle range. He kept a steady hand and shot the bullets with a bow. He missed the target once when the bow jammed and failed to fire. Despite the mishap, he still managed to achieve the highest score of the day.

Did Graham achieve the lowest score of the day?

Implicit Appropriate Context

Graham won many prizes at the Fair, especially at the archery contest. He kept a steady hand and shot the arrows with skill. He missed the target once when the bow jammed and failed to fire. Despite the mishap, he still managed to achieve the highest score of the day.

Did Graham achieve the lowest score of the day?

Implicit Inappropriate Context

Graham won many prizes at the Fair, especially at the rifle range. He kept a steady hand and shot the bullets with skill. He missed the target once when the bow jammed and failed to fire. Despite the mishap, he still managed to achieve the highest score of the day.

Did Graham achieve the lowest score of the day?

(B)

Explicit Appropriate Context

Richard was rather nervous as he took up position at the archery contest. He aimed and shot the arrows with a bow. He cursed when the bow failed to fire. He checked to see what was causing the problem.

Did the bow fire?

Explicit Inappropriate Context

Richard was rather nervous as he took up position at the rifle range. He aimed and shot the bullets with a bow. He cursed when the bow failed to fire. He checked to see what was causing the problem.

Did the bow fire?

Implicit Appropriate Context

Richard was rather nervous as he took up position at the archery contest. He aimed and shot the arrows towards the bull's eye. He cursed when the bow failed to fire. He checked to see what was causing the problem.

Did the bow fire?

Implicit Inappropriate Context

Richard was rather nervous as he took up position at the rifle range. He aimed and shot the bullets towards the bull's eye. He cursed when the bow failed to fire. He checked to see what was causing the problem.
Did the bow fire?

8) Carve Stone- Chisel

(A)

Explicit Appropriate Context

The carpenter was busy preparing the statue for display at the hotel. He only had to carve the final details with a chisel and it would be complete. Unfortunately, the chisel slipped and he cut his hand. The cut was deep and would probably need stitches.
Was the cut deep?

Explicit Inappropriate Context

The chef was very busy preparing the buffet for lunch at the hotel. He only had to carve the meat with a chisel and it would be complete. Unfortunately, the chisel slipped and he cut his hand. The cut was deep and would probably need stitches.
Was the cut deep?

Implicit Appropriate Context

The carpenter was busy preparing the statue for display at the hotel. He only had to carve the final details with care and it would be complete. Unfortunately, the chisel slipped and he cut his hand. The cut very deep and would probably need stitches.
Was the cut deep?

Implicit Inappropriate Context

The chef was very busy preparing the buffet for lunch at the hotel. He only had to carve the meat in thin slices and it would be complete. Unfortunately, the chisel slipped and he cut his hand. The cut was deep and would probably need stitches.
Was the cut deep?

(B)

Explicit Appropriate Context

The talented sculptor was completing the final statue for the exhibition. She carved the facial details with a chisel. She screamed when the chisel slipped and she cut her hand. Someone nearby heard the scream and came to her assistance.
Did she scream when she cut her hand?

Explicit Inappropriate Context

The gourmet cook was completing the final dish for the celebrity dinner. She carved the last joint of meat with a chisel. She screamed when the chisel slipped and she cut her hand. Someone nearby heard the scream and came to her assistance. Did she scream when she cut her hand?

Implicit Appropriate Context

The gourmet cook was completing the final dish for the celebrity dinner. She carved the last joint of meat onto a plate. She screamed when the chisel slipped and she cut her hand. Someone nearby heard the scream and came to her assistance. Did she scream when she cut her hand?

Implicit Inappropriate Context

The talented sculptor was completing the final statue for the exhibition. She carved the facial details into the stone. She screamed when the chisel slipped and she cut her hand. Someone nearby heard the scream and came to her assistance. Did she scream when she cut her hand?

9) Hit Nail - Hammer

(A)

Explicit Appropriate Context

The joiner from the construction crew stood by the bench. He hit the nail into the wood with a hammer. It required a lot of strength as the hammer was extremely heavy. He gripped the handle tightly to make the task easier. Did the task require a lot of strength?

Explicit Inappropriate Context

The captain of the cricket team stood by the wicket. He hit the ball over the boundary with a hammer. It required a lot of strength as the hammer was extremely heavy. He gripped the handle tightly to make the task easier. Did the task require a lot of strength?

Implicit Appropriate Context

The joiner from the construction crew stood by the bench. He hit the nail into the wood with great force. It required a lot of strength as the hammer was extremely heavy. He gripped the handle tightly to make the task easier. Did the task require a lot of strength?

Implicit Inappropriate Context

The captain of the cricket team stood by the wicket.
 He hit the ball over the boundary with great force. It required
 a lot of strength as the hammer was extremely heavy.
 He gripped the handle tightly to make the task easier.
 Did the task require a lot of strength?

(B)

Explicit Appropriate Context

On Sunday morning Andrew did some repairs in the house.
 He climbed the ladder and prepared to hit the nail with a hammer.
 Unfortunately, the hammer slipped and he hurt his thumb.
 His thumb was very red and beginning to bruise.
 Did Andrew hurt his thumb?

Explicit Inappropriate Context

On Sunday morning Andrew played baseball in the park.
 He walked to base and prepared to hit the ball with a hammer.
 Unfortunately, the hammer slipped and he hurt his thumb.
 His thumb was very red and beginning to bruise.
 Did Andrew hurt his thumb?

Implicit Appropriate Context

On Sunday morning Andrew did some repairs in the house.
 He climbed the ladder and prepared to hit the nail into the wall.
 Unfortunately, the hammer slipped and he hurt his thumb.
 His thumb was very red and beginning to bruise.
 Did Andrew hurt his thumb?

Implicit Inappropriate Context

On Sunday morning Andrew played baseball in the park.
 He walked to base and prepared to hit the ball for a home run.
 Unfortunately, the hammer slipped and he hurt his thumb.
 His thumb was very red and beginning to bruise.
 Did Andrew hurt his thumb?

10) Decorate Tree - Tinsel

(A)

Explicit Appropriate Context

It was two days before Christmas Eve and Jennifer was very
 excited. She helped her mother decorate the Christmas tree
 with red tinsel. She laughed as the tinsel was put in place.
 She was very pleased with the final result.
 Did Jennifer help her father?

Explicit Inappropriate Context

It was two days before her Birthday party and Jennifer was very excited. She helped her mother decorate the birthday cake with red tinsel. She laughed as the tinsel was put in place. She was very pleased with the final result.
Did Jennifer help her father?

Implicit Appropriate Context

It was two days before Christmas Eve and Jennifer was very excited. She helped her mother decorate the Christmas tree with great care. She laughed as the tinsel was put in place. She was very pleased with the final result.
Did Jennifer help her father?

Implicit Inappropriate Context

It was two days before her Birthday party and Jennifer was very excited. She helped her mother decorate the birthday cake with great care. She laughed as the tinsel was put in place. She was very pleased with the final result.
Did Jennifer help her father?

(B)

Explicit Appropriate Context

Janet was organising the Christmas celebration for the family. The guest were due and she was still decorating the tree with tinsel. Some guests arrived before the tinsel was in place. She apologised for not being ready on time.
Was Janet ready on time?

Explicit Inappropriate Context

Janet was organising a Birthday celebration for her mother. The guest were due and she was still decorating the cake with tinsel. Some guests arrived before the tinsel was in place. She apologised for not being ready on time.
Was Janet ready on time?

Implicit Appropriate Context

Janet was organising the Christmas celebration for the family. The guest were due and she was still decorating the Christmas tree. Some guests arrived before the tinsel was in place. She apologised for not being ready on time.
Was Janet ready on time?

Implicit Inappropriate Context

Janet was organising a Birthday celebration for her mother. The guests were due and she was still decorating the birthday cake. Some guests arrived before the tinsel was in place. She apologised for not being ready on time. Was Janet ready on time?

11) Drink Wine - Glass

(A)

Explicit Appropriate Context

Mary was glad to relax after a busy day at the office. She sat in her favourite armchair and drank wine from a crystal glass. She was tired and as she fell asleep the glass dropped on the floor. She was awoken half an hour later by the sound of the doorbell.

Did Mary drop something on the floor when she fell asleep?

Explicit Inappropriate Context

Mary was glad to relax after a busy day at the office. She sat in her favourite armchair and drank tea from a crystal glass. She was tired and as she fell asleep the glass dropped on the floor. She was awoken half an hour later by the sound of the doorbell.

Did Mary drop something on the floor when she fell asleep?

Implicit Appropriate Context

Mary was glad to relax after a busy day at the office. She sat in her favourite armchair and drank wine as she watched TV. She was tired and as she fell asleep the glass dropped on the floor. She was awoken half an hour later by the sound of the doorbell.

Did Mary drop something on the floor when she fell asleep?

Implicit Inappropriate Context

Mary was glad to relax after a busy day at the office. She sat in her favourite armchair and drank tea as she watched TV. She was tired and as she fell asleep the glass dropped on the floor. She was awoken half an hour later by the sound of the doorbell.

Did Mary drop something on the floor when she fell asleep?

(B)

Explicit Appropriate Context

It was early evening and Alison was watching her favourite soap opera. She was drinking a glass of wine when the doorbell rang. As she got up to answer the door, the glass slipped from her hand and fell onto the floor. She opened the door before tidying up the mess.

Was Alison watching TV?

Explicit Inappropriate Context

It was early evening and Alison was watching her favourite soap opera. She was drinking a glass of tea when the doorbell rang. As she got up to answer the door, the glass slipped from her hand and fell onto the floor. She opened the door before tidying up the mess.

Was Alison watching TV?

Implicit Appropriate Context

It was early evening and Alison was watching her favourite soap opera. She was drinking some wine when the doorbell rang. As she got up to answer the door, the glass slipped from her hand and fell onto the floor. She opened the door before tidying up the mess.

Was Alison watching TV?

Implicit Inappropriate Context

It was early evening and Alison was watching her favourite soap opera. She was drinking some tea when the doorbell rang. As she got up to answer the door, the glass slipped from her hand and fell onto the floor. She opened the door before tidying up the mess.

Was Alison watching TV?

12) Eat Corn Flakes - Spoon

(A)

Explicit Appropriate Context

John was hungry so he went into the Kitchen to prepare a snack. He ate some corn flakes with a spoon. He heard the doorbell and as he rose to open the door the spoon fell from the table onto the floor. His friend had arrived ten minutes early.

Did John's friend arrive late?

Explicit Inappropriate Context

John was hungry so he went into the Kitchen to prepare a snack. He ate some salad with a spoon. He heard the doorbell and as he rose to open the door the spoon fell from the table onto the floor. His friend had arrived ten minutes early.

Did John's friend arrive late?

Implicit Appropriate Context

John was hungry so he went into the Kitchen to prepare a snack. He ate some corn flakes with haste. He heard the doorbell and as he rose to open the door the spoon fell from the table onto the floor. His friend had arrived ten minutes early.

Did John's friend arrive late?

Implicit Inappropriate Context

John was hungry so he went into the Kitchen to prepare a snack. He ate some salad with haste. He heard the doorbell and as he rose to open the door the spoon fell from the table onto the floor. His friend had arrived ten minutes early.

Did John's friend arrive late?

(B)

Explicit Appropriate Context

Audrey went into the kitchen to have a snack before going out. She was in a rush so she ate some corn flakes with a spoon. In her hurry, the spoon was accidentally knocked onto the floor. She left the house without finishing her snack.

Did Audrey eat an apple?

Explicit Inappropriate Context

Audrey went into the kitchen to have a snack before going out. She was in a rush so she ate some salad with a spoon. In her hurry, the spoon was accidentally knocked onto the floor. She left the house without finishing her snack.

Did Audrey eat an apple?

Implicit Appropriate Context

Audrey went into the kitchen to have a snack before going out. She was in a rush so she ate some corn flakes and a roll. In her hurry, the spoon was accidentally knocked onto the floor. She left the house without finishing her snack.

Did Audrey eat an apple?

Implicit Inappropriate Context

Audrey went into the kitchen to have a snack before going out.

She was in a rush so she ate some salad from the fridge.

In her hurry, the spoon was accidentally knocked onto the floor.

She left the house without finishing her snack.

Did Audrey eat an apple?

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