

**Measuring and Facilitating Human-Computer Interaction**

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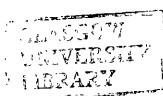
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## **DEDICATION**

To my parents, James and Margaret.

Without you it would not have been possible.

## ABSTRACT

This thesis investigates two modes of facilitating repair in human-computer interaction (HCI). These two aspects of facilitation are mode of instruction, namely minimal manuals, and the use of emotional experience.

In the first experiment, an additional 'from-scratch' design guideline was added to Carroll's (1990) guidelines for minimalist documentation in an attempt to formalise the source and type of content included in such manuals. A minimal manual was designed for e-mail using both his and the new guideline. The manual had approximately 13% of the pages of the commercial manual; it resulted in 30% faster learning and more effective use of the e-mail system overall, and significantly better performance on individual subtasks, including the recovery from errors. Significantly more users were satisfied with it than with the conventional manual. Carroll's general principles of manual design for minimal manuals were found to be a good basis for design, and it is suggested that his guidelines be combined with the proposed 'from scratch' method.

Having formalised the last remaining guideline for design, it was then possible for the second experiment to consider the issue of the level of explanation of information required within the minimal manual. A second minimal manual was designed, which had a recipe-type format. This manual, once developed, was tested against the original manual designed in study one. No significant user performance differences were observed in a comparison test, however users reported overall that they subjectively preferred to use the original manual which promoted exploration and learning, rather than the recipe-style manual. Thus it would appear that making explicit instructional steps does not serve to further facilitate interaction.

The latter part of the thesis attempted to further the understanding of human emotion within the HCI context. It was necessary to develop two new HCI measurement instruments to this end. The third experiment developed the first instrument. A

checklist of cognitions and emotions, which when administered would give an indication of those cognitions and emotions. When administered, it would give an indication of those cognitions and emotions that are experienced when interacting with an interface. By a factor analytic procedure a set of 53 cognition and emotion statements was reduced to the manageable form of 10. This measurement instrument was subsequently employed in the fourth experiment.

The aim of the fourth experiment was to measure human emotion during difficulties in interaction, and to discover whether the documented relation between emotion and facial expression holds true in the HCI context. If so, then recommendations could be made for the use of facial expression as a form of emotion feedback into computer systems, in the form of interface agents. 30 naive computer users completed a computer graphics task. During the task, their facial expressions were recorded by video, and their cognitions and state of progress were recorded, to see if there existed any relation between different types of episodes (getting stuck, making progress, and neutral episodes where nothing good and nothing bad is happening) and facial expression and emotion. The analysis of the users' facial expressions was conducted using an abridged version of Ekman and Friesen's (1978) Facial Action Coding System (the second instrument that had to be introduced by this thesis to the field). The occurrence and extremity of cognition and emotion experienced when users were stuck was measured by the checklist of cognitions previously designed and developed for this purpose. The facial expressions which were evident during episodes of progress, episodes of getting stuck, and neutral episodes were not significantly different from one another, despite there being a lot of emotional activity occurring. This was evidence against Ekman's (1972) and Oatley et al.'s (1987) hypothesis that facial expression is a correlate of emotion, in an HCI context at least. This is attributable not only to the micromomentariness of facial expressions, but also to the rapidly changing tasks that are characteristic of HCI. It does, however, provide support for a social theory of the emotions (Kraut and Johnson, 1979; Mandler, 1980), whereby emotion and facial expression act as communicative signals, and support for Frese's (1991) recommendation that HCI needs to pay more attention to socio-ergonomic factors.

The main result from this study, then, was that there is a lot of emotional activity occurring in HCI, which still needs to be addressed. The final experiment of the thesis addressed the issue of emotional discomfort during difficulties through the design and development of a cognitive programme for the management of computer anxiety. The programme was based on a type of therapy used by clinical psychologists in the national health service today, called cognitive therapy. Individuals using this programme were compared with a control group who received problem-solving assistance which took the form of information gathering from manuals, on-line help, and asking help from the course instructors or demonstrators.

It was found that although individuals in both groups, experimental and control, were just as anxious after having used their respective types of anxiety management methods, users involved in the cognitive anxiety programme were awarded as many passes for their particular course, and used their computer package just as successfully for the purpose for which they had learnt it. They felt that they had benefited as much from their form of assistance as had those who were receiving the more standard form of help. This would suggest that the cognitive programme was as effective as, and certainly no less effective than standard methods of resolving difficult, anxiety inducing situations when learning how to use a computer.

The thesis makes the following recommendations:

- (a) Firstly, that the design of user documentation should involve a synthesis of minimalist guidelines and a 'from-scratch' methodology.
- (b) Secondly, that cognitive coping techniques be developed alongside other methods of user assistance.
- (c) That it is necessary to not only develop new measurement instruments for HCI, but also to develop a framework to guide the optimal choice and combination of instruments employed.

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## FOREWORD

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**CHAPTER 1**

**A GENERAL INTRODUCTION TO THE THESIS**

"People communicate via not with computers"

Chapanis (1971)

## CHAPTER 1: INTRODUCTION TO THE THESIS

### 1.1 THE AIMS OF THIS CHAPTER

This chapter introduces the reader to the research carried out within this thesis, and explains some of the important concepts contained within it. This thesis is an attempt to investigate and thus further develop what are essentially two promising methods of repairing breakdowns within human-computer interaction (HCI). These two directions are mode of instruction, namely minimal manuals, and human emotion in interaction. To this end the thesis is split into two sections. This chapter deals first with an introduction to the goals of the thesis, and to field of human-computer interaction.

### 1.2 The goals of this thesis

This thesis investigates what would at first glance appear to be two apparently unrelated topics - minimalist documentation and emotional cues in HCI. However, these two areas are linked in an important, if not obvious way. They both develop research lines which focus on the repair of blocks, or difficulties in interaction at the interface. Breakdowns occur as concepts in much of HCI theory, but in the main they occur within a cognitivist orientation where the emphasis is on these phenomena first as explicanda, and secondly as things to be avoided by good design. The emphasis on this research is on the occurrence of breakdowns, and on the design of adequate repair facilities. Even if the need for repair functions is required only as a temporary side-effect of inadequate design, rather than as a prominent feature of any possible universe of human computer interaction, answering that need becomes another important task. Both minimal manuals and the role of emotion research address different parts of the repair issue. The former offer behavioural repair, the latter emotional solice.

### 1.3 An introduction to human-computer interaction

Human-computer interaction (HCI) is a multi-disciplinary domain, covering the

disciplines of Psychology, Cognitive Science, Computer Science, and Sociology. Activities in HCI include suggesting where and in what situations certain technologies and techniques might be best put to use. Another issue is the measuring of human performance at the interface. Measurements of how well or how inadequately a user performs when using a particular interface are good indicators of the appropriate alterations that should be made to improve that particular system and the related research into design and development.

This thesis adopts a humanistic approach to design, associated with providing the proper environment for an interaction, rather than a proposed solution to a problem (Killam, 1991). The concepts of user-control and user-centred system design are humanistic in nature. These concepts are central to the thesis. As Shackel (1985) states, the users of computer systems are no longer computer professionals, but are mostly discretionary users. As designers are no longer typical of most users, we need tools, techniques, design practices and methodologies that will inform design and development teams of how users behave at an interface, and what they require from a system. The needs of the users should dominate the design of the interface, and the needs of the interface should dominate the rest of the system.

At this point, the general background literature and concepts which are central to the thesis will be introduced and explained. It is not the intention to complete an exhaustive literature review of the many different areas mentioned earlier which are relevant to HCI. Only the background literature of the concepts which are directly relevant to the thesis will be reviewed.

Most computer users today are not experts in computer technology, but are individuals who use computers to assist them in the performance of a task. The interests of most 'novice' users lie in their own work and not in the different capabilities of the system that they have to use in order to achieve their goals. The interface must be a link, but also a barrier which protects the user from contact with all other facets of the system with which he or she need not have any contact.

However, there is often a mismatch between user state and system state in such situations, more so when the system user is a non-professional, or novice user; and when the user's goals and intentions are incompatible with the system state. Typically, the user knows the domain, but the computer fails to be transparent, and the user then requires extra knowledge in order to complete his task. This mismatch leads to difficulties for the user and is also the cause of varying degrees of discomfort and distress for the him or her. In 1986 this mismatch between user and system was elaborated upon by Donald Norman. Norman's theory is of particular relevance to Part One of the thesis, namely facilitation by mode of instruction, and thus warrants discussion at this early point.

### 1.3.1 What lies between the user and the system: Norman's theory introduced

In 1986 Norman suggested that difficulties experienced when interacting with a computer arise from what he terms the "gulf" between physical states and mental states. When computers stand between the task and the user, then they require that the user be proficient in both the task domain, for example writing a document, and with using the intermediary (the computer), for example, in knowing how to use the word processing package. Users generally have a goal or task which is expressed initially in a particular way in their mind, and it is an extra cognitive load if a machine requires that that task be translated into some other terms. To grasp this problem means that designers must be able to put themselves in the user's position of not yet knowing. This is a difficult requirement because designers know too much - the system is familiar and obvious to them since it is their creation. In an ideal world the computer would be in a sense "invisible", and the user would not experience the sense of there being an obstacle, or gulf between himself and the task he or she is involved in.

#### 1.3.1.1 Norman's theory of action explained

The theory of action as described by Norman holds that the user sets out with a goal which is to be achieved. Something has then to be done i.e. an action has to be taken. To lead to actions the goal must be then translated into specific statements of

what is to be done, which is an intention. Finally the user needs to check that the goal was attained. The action itself has two major aspects: doing something and checking. These two aspects are termed execution and evaluation. Hence the 'gulf of execution' and the 'gulf of evaluation'.

The real problem for the user lies in determining the relationship between the intended actions and the mechanisms of the computer, and deciding whether the intended actions were carried out successfully. Each gulf reflects one aspect of the distance between the mental representations of the user and the physical components of the environment.

#### 1.3.1.1.1 The gulf of execution

The difference between the intentions of the user and the allowable actions is the gulf of execution. One measure of this gulf is how well the system allows the person to do the intended actions directly, without any extra effort (Norman, 1988).

#### 1.3.1.1.2 The gulf of evaluation

The gulf of evaluation reflects the amount of effort that the person must exert to interpret the physical state of the system and to determine how well the expectations and intentions have been met. The gulf is small when the system provides information about its state in a form that is easy to access, easy to interpret, and also matches the person's view of the system.

Norman posits four steps in the procedure that is necessary in order to close the gap between user and computer. Firstly the intention is formed and the action sequence is specified. It is at this stage that goals are translated into changes that are to be made to the physical variables in question. In the process of bridging the gulf of evaluation, the interpretation of the system state is compared with the original goals and intentions that the user set out with.

### 1.3.2 How this thesis addresses the breakdown between human and computer.

Since this thesis is concerned with the problems, or breakdowns in interaction, it employs Norman's afore mentioned framework for thinking about human interaction with computers in general. The first angle of approach to addressing breakdowns is the design of user documentation. Documentation supplies missing information to the user and is effective if, and only if, it does this. It should not be the purpose of user documentation to supply all possible information. Minimal manuals, as introduced in the following chapter attempt to do this, and can also be analysed in relation to the theory of action which has been elaborated upon by Draper and Oatley (1992). This theory is explained in full in the next chapter.

Such breakdowns are in addition a great source of distress and emotion (observe any new computer user as he or she grimaces and grows hot under the collar), which can be analysed in terms of plan breakdowns (Oatley, 1992). The fact that people experience emotion and can feel anxious when interacting with computers is commonly recognised, but has to date remained for the large part ignored. Thus the investigation of emotion and anxiety within human-computer interaction is the second line of approach taken in the thesis towards helping users interact with computers.

The research which comprises this thesis considers the measurement and attempted remedy of what is essentially the breakdown in human-computer interaction. It is, therefore, a worthwhile and timely exercise to delineate the high-profile issue of errors and slips.

### 1.4 What is an error?

Much can be done to minimise error making, and to facilitate the recovery from error states. Norman (1981, 1983b; Booth, 1989, and Reason and Mycielska, 1982) give both general discussion and comprehensive analyses of errors, but of more direct relevance to the current research is the analysis offered by Lewis and

Norman (1986). Lewis and Norman distinguish mistakes and slips. Their distinction occurs at the level of intention. If the intention is appropriate, then this is a slip. If the intention itself is not appropriate, then this is termed a mistake. For example, if the user selects the rubber tool in a graphics application, but intending to select the brush tool, then this is a slip. However, if he or she selects the rubber tool, with the intention of using it as a brush tool, then this would be termed a mistake. The same processes that allow us all to be creative and insightful by allowing us to see relationships between apparently unrelated things, that let us leap to correct conclusions on the basis of partial evidence, also unfortunately lead to error (Norman, 1988). (For an informative and entertaining analysis of slips and errors, read the chapter in Norman's book "The Psychology Of Everyday Things"). It is commonly witnessed that the automated behaviour of the expert user leads more often to slips, through lack of attention, and occurs less frequently with beginners. The reader's attention is drawn to the fact that it is Lewis and Norman's afore-mentioned analysis that will be used throughout the thesis when reference to errors and slips is made.

### 1.5 The expert and the novice user - a guide to terminology

Much reference will also be made to the notion of 'expert' and 'novice' users. The simplest but possibly the most accurate distinction between an expert and a novice user comes from Draper (1985). He argues that expert system users have the ability to translate their goals into methods of information retrieval, and subsequently into actions. They do not necessarily have more comprehensive knowledge of the computer system in question. Novice users do not have this ability. Draper's framework for considering novice and expert users is the one that is taken by the thesis. The research which follows in this volume involved novice users in all five experiments. These were individuals who had no previous experience of the particular packages in question at the time of testing. As such, they were unable to translate reliably their goals into information retrieval methods.

## 1.6 Iterative design

The final term which is central to the thesis that needs explaining at the outset is that of iterative design, as it plays an important part in particular in the first experimental study of this thesis.

Rapid prototyping and iterative system refinement are methods which allow early observation of system behaviour and opportunities for refinement in response to user feedback (Hartson and Smith, 1991). Knowledge on the part of designers that they do not have to get it right the first time allows the opportunity for greater exploration, with the possibility of more innovative design. As rapid prototyping increases in popularity and maturity, it is already changing the way that interactive systems are developed, thus speeding up the process and making better and more usable products. The rapid prototyping method is applied to the design of user documentation in the first experimental chapter.

## 1.7 The chapters ahead

To summarise, this thesis addresses the breakdown in human interaction with computers according to Norman's (1986) theory of action. As intimated at the start of this chapter, the thesis is presented in two parts. Norman's theory of action in relation to the gulf between user and computer is the underpinning philosophy of Part One (documentation design). The second part of the thesis, which considers human emotion, is considered within Oatley's framework. The following two chapters (2 and 3) respectively introduce the reader to the field of mode of instruction, and to the quest for a greater understanding of human emotional activity within HCI.

**CHAPTER 2**

**USER INSTRUCTION -**

**WHERE THE FIELD STANDS TODAY**

**AND WHERE THE THESIS WILL LEAD IT**

## **CHAPTER 2: USER INSTRUCTION - WHERE THE FIELD STANDS TODAY AND WHERE THE THESIS WILL LEAD IT**

### **2.1 THE AIMS OF THIS CHAPTER**

The aim of this chapter is to introduce the reader to current trends in the design of user documentation, how they were arrived at, and why and how the research presented in Part One of the thesis will further the area.

As touched upon in Chapter 1, a critical problem in the design of interactive computing systems is the problem of how to make them easy to learn and to use (the problems of learnability and usability). The question of ease of learning brings into focus the problem of conveying information to the user, one which is receiving ever-increasing attention due to the increasing numbers of non-professional individuals who use computers on a daily basis. The novice user does not have an in-depth knowledge of the system he or she is using or is about to use, nor is it likely that such deep knowledge is desired. The computer system is a means to an end, and the user seeks to minimise the time and effort spent in using it. By virtue of this limited knowledge the novice user is 'at risk' in the use of the system and as such needs expert recovery facilities.

### **2.2 Documentation and its accompanying problems**

Documentation - the written material which accompanies most computer systems - is an integral part of any computer interface. Of all the means available for closing the gap between user and computer, probably the most familiar to the user population is that of documentation. Manuals play a large part in bridging the gulf between the user's knowledge state and the system state as they support information flow when the interface on its own only supports a more knowledge-based mode. If the novice user has an understanding of the task to be

accomplished, but not of how to execute it, then the purpose of documentation should be to bridge the gulf between user intention and goal fulfillment.

Nonetheless, it is a well-recognised but unfortunate fact, that the majority of the conventional documentation that accompanies software is presented in either a formidable form or length or both. The novice user all too often finds him- or herself faced with unwieldy volumes of prose that would appear to tell him or her everything except what he or she needs to know. This would at least partly explain Mack et al.'s (1983) observation that learners have a tendency to "skip along, ignore information, make ad hoc interpretations and generalise from their inferences". Sifting through text leads to the oversight of vital information, and false or inaccurate interpretation of instruction out of context.

Novice users are active in that they strive to make sense of how the system works, and what is involved in becoming skilled in its use, yet conventional manuals would view the reader/user as a passive agent receiving information without question. Conventional manuals (CMs) neither intuitively promote knowledge acquisition nor pleasure on the part of the user. Such manuals would appear to be designed with the notion that the reader needs as much information as is possible before he or she can do anything at the terminal at all.

Cole (1984) witnessed that although most of the respondents in his experiment, when faced with a computing problem, indeed employed both personal sources (such as asking a neighbour or friend) and documentation (online and hardcopy), 3/4 of these respondents felt the personal source to be of most value in solving the problem. Finding a solution using on-line documentation would take "somewhat longer" for 62% of respondents, (although it would seem to be unclear whether this is a value judgement on the part of the respondents, or an established fact). 6% of his sample used manuals alone. It thus would appear that standard manuals do not support user goal attainment.

If documentation facilitated goal attainment more readily, user learning would be promoted, and error occurrence would decrease. Although error occurrence is an inevitable constituent of the learning process, conventional documentation fails to support readily the recovery from such states. It is important to realise that the aforementioned problems do not merely reflect deficiencies in system documentation, they also provide the researcher with information about human learning propensities, which can guide the design of more effective instructional forms.

### 2.2.1 Moving ahead from conventional documentation forms: introducing the minimal manual

Over a decade ago, problematic issues regarding user documentation were highlighted by Wright (1981), and more recently there has been a radical reformulation of technical writing practices, as heralded by Carroll (1985). Aimed primarily at novice or infrequent users, the minimal manual is an attempt to move away from the problems of conventional documentation forms. Carroll's guidelines for manual design are laid out in the following paragraphs.

#### 2.2.1.1 Less is more

Firstly, the minimal manual has a 'pruned' form, explaining only that which is absolutely essential in order that the new user can get started with the immediate tasks in hand. It omits the 'knobs and bells' and unnecessary tools that do not greatly further the learning of the new user. It thus aims to provide a quick and effective means of training. It is often only 1/4 the length of the corresponding conventional manual, thus allowing the user to spend more time on the screen, and less reading. Minimal manuals are most effective in environments where applications are used for common operations, and in situations where individuals are required to learn a certain amount quickly, in order that they may get ahead with their work. They are less effective where highly intricate operations must be taught

to a small number of specialists.

#### 2.2.1.2 Focus on real tasks and activities

Carroll et al. (1986) and Mack, Lewis and Carroll (1983) witnessed user dissatisfaction and unhappiness when employing conventional documentation, and a prevailing urge on the part of the user to override these instructions, in an attempt to attain his own goals. As this research group found, users do not learn a new computer application for the sake of it. They learn it for a purpose, thus the training materials should, as far as is possible, take heed of user motivation, and identify with these goals. For example, individuals attempting to learn an electronic mailing system should send real messages to other real users. Goal attainment can then be witnessed, thus endorsing the desire to continue to learn.

Humans display an active orientation to learn and materials given to new users often conflict with their natural learning strategies. The minimal manual is an attempt at capitalising on such manifest learning strategies (Carroll et al 1987).

#### 2.1.2.3 Slash the verbiage

Conventional self-instruction materials are often of an unwieldy nature. They contain introductory chapters, previews, sections on "How to use this manual", appendices, and so on, which only serve to aggravate the complexity and length of the material, and repel the reader. The alarming observation has also been made that novice users often attempt to execute previews. Commands and procedures are often repeated in various forms in several sections of the manual under different headings, which can add to the general confusion. Users appear to seek active hands-on experience and as often as not give the reading materials a cursory flick of the pages. The minimalist technique tries to eliminate this by presenting each item once and in a concise form.

#### 2.2.1.4 Support error recognition and recovery

Errors are an inevitable part of any learning experience. It could be said that they are indeed a necessary part of the procedure, as they serve to remind us of where we went wrong, so that we can avoid them in the future. Nonetheless, the philosophy of conventional materials is that if the reader follows the step by step advice presented, then errors will be avoided. In practise, this is seldom the case. The minimal manual method recognises this problem and explicitly supports error recognition and recovery.

Carroll (1985) replaced an existing self-instruction manual with a set of brief training cards. It was found that guided exploration learners spent less than a third as much time in learning as their self-instruction manual counterparts. They spent less than one third as much time reading, made 20% fewer errors, and recovered more often from the errors (10% more often). They also spent 20% more time coordinating their attention between the manual and the display. He also found, however, that this particular form of minimalist assistance would later need to be expanded upon, as users were requiring more information than was being provided.

Findings in relation to minimal manuals are reinforced by Oatley et al's (1990) observation that self-instruction by minimal manuals of less than 1/3 the size of conventional manuals gives slightly improved performance, in the range of 75%-200%, as compared with CMs. Oatley's research group compared the conventional manual for Glossary, a word processing feature against video instruction, and a minimal manual. Those subjects who had used the minimal manual were quicker on the assessment test, and a significantly greater number of that group reported that they would feel confident about writing a glossary on their own. The video group performance results were better than that for the conventional group.

### 2.2.1.5 Coordinate activity between system and user

Too often it is the case with conventional documentation that the user spends a large portion of his time with his 'nose in the textbook' (McElhinney, 1988) and cannot adequately relate written instruction with events on-screen, thus suffering an unnecessary learning hindrance. Minimalist instruction forms seek to improve coordinated activity between the system and user, and if not eliminate, at least smooth out this problem. One example of this is the purposeful incompleteness of procedures, with "try it yourself and see what happens" sections in the documentation. Lorne Olfman's manual for Lotus 1-2-3 consisted of only three information types, namely read-only, instructions and recovery information. He also employed different typefaces and pictorial symbols to allow easy identification of each section.

### 2.2.1.6 Let the learner lead

Learner motivation is an important factor in successful training. Conventional documentation often stifles natural learning tendencies by the imposition of terse procedure-like instruction which in no way enables, let alone encourages active thinking on the part of the novice user. Letting the learner lead and by building documentation around this natural learning tendency, for instance by way of procedural incompleteness, such problems as the desire to leaf through manual pages and the resulting unfortunate consequences which were mentioned above, may be curtailed.

### 2.2.1.7 An example of a minimal manual designed using the afore-mentioned guidelines

In 1988 Song wrote a minimal manual for electronic mail under the Glasgow University ICL 3980 VME operating system. His findings revealed that learners who employed the minimal manual learnt email 11% quicker than those who used

the conventional manual. They were significantly greater task achievers, who made fewer errors, a smaller number of which were unrecovered errors than learners who used the conventional manual. When they did make mistakes, a shorter recovery time was needed. This minimal manual which was designed using Carroll's (1987) minimalist principles was generally held to be a preferred and pleasurable method of learning how to use e-mail.

### 2.3 A problem with minimalist documentation

There remains, however, one fundamental design feature of the minimal manual which has been ignored by Carroll, Song and others, but which has been attended to by McElhinney an IBM worker in 1988. McElhinney proposed that the construction of minimal manuals should occur through a 'from-scratch' design process, which prohibits referring to conventional manuals in the design process. He wrote a minimal manual for a text editor, ISPF at IBM in Greenock, Scotland in this way and saw a superior effect for this manual over the standard one. The design of this manual adhered to the principle that the minimal manual must originate in a thorough analysis of the tasks commonly performed by typical users, without reference to any existing documentation. As a result it appears that there are in effect two sets of rules for manual construction, namely the five laid down by Carroll (1990), and McElhinney's 'from scratch method'.

#### 2.3.1 Bringing the two sets of rules together - the formalisation of the remaining top-level guideline for minimalist design

Carroll applied his design principles to manuals whose contents were essentially the remains of a 'cut-down' version of an original manual. This thesis proposes to link up Carroll's minimalist guidelines with a 'from-scratch' design methodology. As previously stated, conventional manuals very often contain every item of information that the computer user may ever need to know, but most of which he or she will not ever seek out. Would the face of documentation design not be more acceptable if a design rule was adhered to, stating that only that content which is necessary and

resulted from a task-analysis should be included in the user manual? This thesis sets out to do just this in the first experimental study, with the intention of showing how the 'from-scratch' design method may complement Carroll's own guidelines, with no resultant detrimental effect to the manual. If this is possible, then a complete toolkit will have been formalised. Carroll makes the mistake of so many designers, namely that of 'knowing best'. The 'from-scratch' guideline involves asking users about what a novice user will need to know about, and builds on this information.

It is now time to turn to a further issue in documentation design which is addressed by the thesis, namely the fact that despite the quality of user documentation having significantly improved, errors continue to blight interaction. From mere observance, one soon appreciates it is a function of the natural human propensity towards action. The pages which follow discuss this phenomena, and how the problem may feasibly be approached.

#### 2.4 "All the world's a stage..." - the propensity to act

Individuals act in the world, and this holds true of the user in HCI. Minimal manuals are designed to channel this action into a variety of different behaviour forms, which will essentially assist the interaction. Nonetheless, despite this new form of design, errors are still being made, and time is still wasted, as users either draw inferences or misread or get lost when exploring the system. The minimal manual comes with no guarantee an error free interaction. The attainment of fluent, problem-free interactions is one of the last remaining significant 'internal' design hurdles separating the user from a smooth interaction with his or her computer.

The problem essentially lies in the user's evident propensity towards action which is prompted by inference-making and the urge to test hypotheses. Unfortunately for the user, the result is very often an error state. If it were possible to eradicate

the user's making of assumptions, then would we be any closer to achieving a fluent interaction? In order to do this, it would be necessary to provide the user with a timely flow of information on exactly how to proceed, which would leave no opportunity for any hypothesis-testing. It is to be noted at this point that Carroll's design account emphasises the dependence of even learning on action. It is quite possible that this human orientation to action is more fundamental. Several pages back, it was stated that the step-by-step layout of conventional documentation does not help the user. This does not augur well for manual content being displayed in a step-by-step manner. However, one must remember that the minimal manual is targetted at novice or infrequent users who need to complete routine tasks. In this case, it is possible that users may rest easy in the knowledge that if they stick to the instructions, then they will succeed.

With these thoughts in mind, the issue is addressed in the thesis as to whether it is possible within the field of documentation design, to design two minimal manuals, each with a different internal structure. To do this, Carroll's principles, as laid out above would be used in their full form in the design of a minimal manual. The design of the alternative minimal manual would be based on the theory of information flow as provided by Draper and Oatley (1992). Both manuals would be designed 'from-scratch'.

## 2.5 From Descartes to Draper : a history of thinking and doing

Looking back to the early twentieth century, it was Heidegger, as discussed by Suchman (1982) who claimed that thinking only occurs in the event of human action breakdowns. Going back further than Heidegger, to the metaphysical revolution of Galileo and Descartes in the seventeenth century, one can witness the acceptance of the existence of two separate phenomena, namely the objective world of physical reality and the subjective world of thoughts and feelings. The assumptions were that we inhabit a "real world" of objects, with actions occurring in this world. There are objective facts that are not dependent on interpretation.

Heidegger contends that we have primary access to the world through practical involvement with the ready-to-hand world in which we act. For example, when hammering, the hammer only presents itself as a hammer when there is a breaking-down, or "unreadiness-to-hand". He claims it is meaningless to talk about the existence of objects and their properties in the absence of purposeful activity, with its potential for breaking down. For Heidegger, 'things' emerge in breakdown, when unreadiness-to-hand reveals them as a matter of concern. On this basis, it could be argued that a computer user may indeed follow instructional documentation step by step, but be forced to rely on his or her own, and possibly misguided interpretation of the text when the text breaks down. This could be either because the documentation is of a poor quality, or because the user has merely over-interpreted the information given. Thus, it would appear that people function by using two types of knowledge - declarative knowledge (knowledge of) which concerns facts and rules, and procedural knowledge (knowledge how) for example, knowing how to play a musical instrument.

Mayes et al. (1988) reported that users of a highly visual interface show very poor recall of its details (e.g. number, names and content of menus), even though these details are functionally important. This is consistent with the view that people do not constantly memorise information which is always available (i.e. in the interface) whenever it is needed. This is another manifestation of the brain's parsimony principle. It also reflects Heidegger's notion that we do not think, or indeed, need to think, if the necessary information is already ready-to-hand in the world. This is reflected in Draper and Oatley's (1992) treatment of the issue.

### 2.5.1 Taking a closer look: the theory of information flow according to Draper and Oatley

Even when people are learning material for the first time, their activity shows the same general organisation as is seen in other areas of HCI - in particular, users treat the manual as an information source subordinated to an external task. Their actions

do not reflect any "instructional objective", but just the immediate task. In this sense they are behaving in a way fundamentally similar to expert users (at least if the manual is sufficiently easy to use).

Information flow theory emphasises the importance of a unified approach that embraces information sources other than manuals as argued in Norman and Draper (1986). Essentially it concerns the flow of information that takes place among systems, documents and system users. Information flow incorporates all the items of information that need to reach the user if their goals are to be successfully completed. Within the area of information flow there are two principal sub-fields, namely information content and the identification of information sources. Information content includes such things as file names, how to invoke an editor, advanced commands, where to get information, how things work and how to recover from errors (Norman, 1986). Information sources refer to on-line manuals, "Cheat Sheets", Menus, people - replying to specific enquiries and fortuitous pick-up of information from people.

### 2.5.2 The value of information flow

The value of the information flow perspective is that it permits one to look at the amount of information essential to users that is picked up, used and forgotten. The information flow perspective suggests that the designer's task is to firstly calculate what information must be conveyed to users, and then to design special systems of delivery. However, it is held that the following aspect of the information flow approach as being of more importance: namely the timely delivery of the information needed by the user. By providing information in the form of recipes, an action can be described to the user in such a way that it can be performed even if the user understands little about it. This is important whenever completion of an interaction is more important than education of the user. What is being suggested is that forms of user assistance such as manuals may best be viewed as forms of extended external memory aids. Ideally, the search for information on the part of

the user is eradicated through the timely delivery of information. This should ultimately lead to a reduction in error making by the user.

## 2.6 The tasks ahead

In summary, there are two tasks that lie ahead for this thesis in the field of user documentation design. These are as follows:

- (a) Firstly, there is the issue of formalising the last remaining guideline for design. If McElhinney's suggested 'from-scratch' method can be successfully combined with Carroll's existing set of design principles, then a complete documentation design 'tool-kit' will have been formalised.
- (b) The successful completion of the above will result in a strong enough position being secured, from which to investigate the more detailed internal aspects of manual design such as the 'grain size' or level of explanation that is optimally required by the user. The investigation of this issue will be handled within the framework of the theory of information flow as outlined above.

**CHAPTER 3**  
**AN INTRODUCTION TO THE EMOTIONAL LIFE**  
**OF THE COMPUTER USER**

## **CHAPTER 3: AN INTRODUCTION TO THE EMOTIONAL LIFE OF THE COMPUTER USER**

### **3.1 THE AIMS OF THIS CHAPTER**

The aim of this chapter is to introduce the reader to the second main theme of the research, namely the issues of emotion and anxiety which are experienced when using computer systems. Trying to use a computer with a poor interface gives rise to a variety of setbacks in human plans. Users may as a consequence have both unpleasant emotions and internalised attributions. The following pages provide suggestions from the literature as to why this happens, and then follows this up with an outline of how the research presented in this thesis will draw on findings from the literature in order to investigate human emotion within HCI. The chapter begins with an outline of the nature of emotions, and a theory which explains human emotion in relation to these setbacks in plans.

### **3.2 A descriptive and functional analysis of emotions**

Emotion is a multi-faceted phenomenon (Lang, 1968; Scherer, 1984). As a theoretical construct, it comprises appraisal processes, affective experience, thoughts and images, physiological state, action tendencies and behaviour (Watts, 1992). There is, however, little agreement about how many emotions are basic, which ones and why. Mowrer (1960) would posit two - pain and pleasure, whereas Frijda (1986) proposes eighteen. A small number of specific emotions which include happiness, sadness, anger, fear and disgust are believed to have an innate biological basis as they have been found to be similarly expressed in all cultures (Ekman, 1972). The functional value of emotions has been summarised by Rolls (1990): (1) they elicit automatic and endocrine responses that have survival value, (2) they permit flexible behavioural responses to stimuli, (3) they have motivational properties, (4) they contribute to communication, (5) they facilitate social bonding (6) they affect the cognitive interpretation of events, and (7) they permit the storing of memories in an

emotionally tagged form.

### 3.3 A cognitive theory of the emotions

In 1987 Oatley and Johnson-Laird developed a cognitive theory of the emotions which could be included under Roll's second point. The Oatley - Johnson-Laird theory provides the framework for thinking about the emotions in this thesis, as it explains emotion in relation to the breakdown in human plans. This theory emphasises the value of emotions in promoting change. The theory consists of the belief that emotions serve to manage the set of problems that individuals experience when acting with multiple goals and limited resources in a world that is only partially known. Central to their theory is the mechanism of human planning. As originally discussed by Miller, Galanter and Pribram in their 1966 book "Plans And The Structure Of Behaviour", plans are sequences of actions made by an individual that link a current state to a desired goal state. When a plan is either threatened or completely obstructed, emotions help to redirect the person by focusing his or her attention on the matters of the transition. Emotions can be aroused quickly and have the capacity to switch the person from one psychological mode to another. Oatley and Johnson-Laird talk of "junctures". A juncture is the point at which a plan breaks down. There are five basic juncture types, based on five basic emotion types. The criterion for a basic emotion is that it should be recognised from facial expression pan-culturally. Ekman (1973) says that in addition to the above, surprise may be universal. Izard (1972) holds that interest is universal, however it could be argued, as does Oatley (1987), that these are not single emotions, rather they may be aspects of several emotions.

The recognisable junctures in action that trigger emotions, are according to Oatley and Johnson-Laird as follows. The triggered emotion is in brackets.

- (a) Achievement of a goal (happiness), for example passing an exam. Happiness would here possibly prompt the individual to apply for jobs that would be then within his or her reach.

- (b) Failure of a plan, loss of a goal (sadness), perhaps failing an exam. The emotion in this case would force the individual to either sit the exam once again, or to decide upon a completely different course of action.
- (c) Goal conflict or self-preservation goal being threatened (anxiety or fear). This could for example involve fearing that one will not pass an exam which would act as a motivator to do an increased amount of preparation for the exam.
- (d) An active plan is frustrated (anger). An example of an active plan being frustrated would for example involve the same individual trying to study for an exam but being prevented from so doing by noisy neighbours.
- (e) A gustatory goal is violated (disgust).

In general terms, the function of emotions is to encourage the continuation of the current plan in the case of happiness, and to accomplish the transition to a new goal priority in the case of negative emotions - it is one of the most valuable features of emotions that they permit a rapid and comprehensive modulation of psychological orientation. They also occur when the evaluation of success in progress towards any important goal changes - with happiness occurring when an increased probability of reaching a goal is detected, and negative emotions occurring when there is a decreased probability.

As Frijda (1987) observed, emotion theorists persevere in confusing enduring concerns or dispositions, such as trying to avoid illness, with specific actions, which, if interrupted, are likely to induce emotion (Mandler, 1984). Shapiro (1974) saw that depression often arises from chronic conflict or frustration over the achievement of goals. In this case, the emotional reactions serve as a valuable indication that the goals need to be restructured, so that non-achievement of goals is reduced. However, the interruption of sequences of actions can induce emotion without this indicating that long-term goals need

revision. Even when appropriate goals fail to be achieved, emotional reactions of sadness, anger or anxiety can result (Watts, 1992). The adaptive response is not necessarily to change the goals, but to 'manage' the emotion in a way that enables the interruption to be overcome. The functional value of emotion must also be distinguished from the appropriateness of emotion to the circumstances in which it occurs (Greenspan, 1988). Appropriateness is concerned with the link between emotion and the preceding circumstances, whereas functional value is concerned with consequences of the emotion for subsequent adaptation. Emotions can certainly be an appropriate response to circumstances, but dysfunctional in their consequences, for example, they may be excessive. According to Greenspan, an emotion will include a perception of the situation that makes other aspects of the emotion such as action tendencies understandable.

Interacting with computers is a well-known emotion-eliciting situation. This is common knowledge, however the range and frequency of human emotion in the HCI context has not yet been documented. For this reason, this was the first task, before all others in the area of the emotions, for this thesis. (This is a timely juncture at which to point out that even before this first hurdle has been reached, a significant problem has emerged - that of measurement. Does an appropriate instrument for the measurement of emotions during interactions already exist, or will it be necessary to design one? The serious problem of measurement within HCI will be expanded upon shortly in Chapter 4). For the moment, however, the reader's attention should be focused upon the fact that the life of the computer user is often an emotional one. This is usually seen in a more acute form in the case of the novice computer user. The emotions experienced are typically accompanied by related cognitions e.g. "This is dreadful", attributional biases e.g. "It must be me", and facial expressions e.g. frowning. It is therefore clear that the researcher wishing to embark upon an investigation of the emotions within HCI has several 'in-roads' into discovering more about the emotional life of the user at his or her disposal. The purpose of the following paragraphs is to explain the concepts of cognitions, attribution style and the phenomena of facial expressions and their relation to emotion in.

sufficient detail that the reader may understand the eventual direction taken by the thesis.

### 3.4 How dysfunctional thought processes can be understood in terms of attribution theory.

As Fiske and Taylor (1984) observe, people resemble naive scientists, and as such draw conclusions about the potential causes of situations. However, on an everyday basis, people often make attributions in a relatively 'thoughtless' manner. People either simplify complex problems, or they search for rapid, immediate answers, which may not be correct. Attribution research deals with how the social perceiver, in the case of this thesis, the computer user, uses information in the environment to yield causal explanations for events. It examines what information is gathered and how it is combined to form an attribution. As Kelley (1967) observed, knowledge about the world is never complete, and this is also true of the user's knowledge of the computer system he or she is using. Fiske and Taylor argued that if the individual departs from a rational analysis then motivational or emotional factors have interfered with otherwise rational thought. Individuals involved in interactions with computers may either attribute the cause of plan breakdowns to the system e.g. "This machine *never* does anything right", or to him or herself e.g. "It must be me". Psychologists assume that such causal analyses are the bases of behaviour, other cognitions and feelings (see E. E. Jones et al., 1972). Schachter (1964, 1971; also Schachter and Singer, 1962) contributed significantly to attribution research, when he extended attribution theory to the perception of emotions. He posited that there are two necessary conditions for emotion: a state of physiological arousal, and cognitions which label the arousal. He saw that physiological arousal is open to multiple interpretations. The main outcome of Schachter's work that is important for this thesis is that emotional reactions induced by a threatening experience can be reattributed to a less threatening or neutral source. Attribution research has culminated in profound clinical implications, as it provides a general model for the treatment of emotional disorders (Valins and Nisbett, 1972). The misattribution paradigm suggests that

by inducing people to reattribute their arousal to a non-threatening, external source, and by learning to rationalise situations, they may be able to calm down, reassess the situation, and overcome their distress.

Internalised attributions such as the assumption that the cause of a breakdown in an interaction with a computer is a result of one's own lack of knowledge about computer systems as a whole are evidenced through the expression of self-deprecating remarks (Dritschel and Teasdale, 1991). These biases are more commonly referred to as "dysfunctional cognitions" within the clinical psychology profession. More recent evidence in support of Schachter's findings comes from Diener et al. (1985). They found that, within the normal population, certain individuals consistently react more intensely to emotional stimuli than others (Diener, Larsen, Levine and Emmons, 1985). This has been shown to be reliable across different measurement techniques (Diener et al., 1985; Larsen and Diener, 1987), valid against reports of significant others (Larsen and Diener, 1985), and related to a general bias to respond in an extreme manner (Diener et al., 1985). Differences between individuals in their intensity of affective response are also similar for positive and negative material (Larsen and Diener, 1987). According to Larsen, Diener and Cropanzano (1987) this variability in intensity arises because individuals differ in the extent to which they habitually employ certain types of cognitive operations when processing emotional stimuli. The term, "hot cognition" has been adopted by Watt (1991) to refer to the cognition that is found during emotional states. It has been found that "hot cognition" is neither strictly rational nor logical.

If left to persist for a long enough time, dysfunctional cognitions and emotion may feed into anxiety (Beck, 1985). Anxiety and its parameters will be discussed at length in chapter 9, but for the present, attention should be paid to the fact that automatic thoughts and mental pictures accompany anxiety, and are usually focused on the future. The anxiety would be very much less if the individual were to become more aware of these thoughts and changed them to conform with reality. A lot of the clinical and research observations, and

theoretical formulations to date have considered anxiety to be primarily a clinical disorder, yet there has been relatively little investigation into anxiety as a normal state that may have continuity with the various types of clinical anxiety which are recognised.

Computer users often report, when questioned, that they really *do* feel that they could overcome any worries or fears about using a computer if given enough time, help and encouragement in the right environment. Unfortunately learned helplessness (Seligman, 1975) can often result when an individual repeatedly attempts to bring about an event, but persistently fails. If he or she experiences successive instances of lack of such control, then he or she will 'learn' to be helpless. Three deficits are created, firstly motivational, in that the individual will make no future effort in the direction towards his or her goal. The second deficit is of a cognitive nature, in that he or she will fail to make the responses that could help to avoid unwanted outcomes. The third, emotional deficit results in his or her becoming depressed or anxious.

It is now clear that the emotional state of an individual is clearly linked to his or her cognitive processing and attributional style. The current accredited method of handling dysfunctional thought and attributional processes was originated by Beck (1979). Beck proposes that dysfunctional cognitions, or thoughts, are attributable to the individual's underlying interpretations of events. This is essentially a reformulation of Seligman's initial theory. It is not the undesirable event that is at the root of dysfunctional thinking, rather it is a question of choosing the appropriate interpretation of events, which brings one back to Seligman's attribution theory. This cognitive method of considering faulty thought processes is viewed as being superior to behavioural and psychoanalytic approaches, since the behavioural approach essentially refutes the existence of human reasoning powers, and the psychoanalytic approach is very time-consuming and does not allow for any form of human hypothesis testing. The cognitive approach is additionally the most-widely-used and respected method of dealing with aberrations in thinking within the clinical psychology profession

today.

### 3.5 The way forward

There is no reason why the cognitive techniques which are available to clients consulting a clinical psychologist cannot, nor indeed should not, be made available to the distressed computer user, in an attempt to redress his or her often biased interpretation of events. It is not being suggested that exact replicas of full-scale clinical techniques be adopted to this end. What is being proposed, however, is that since the clinical area provides both theory, and research techniques which are readily available to the HCI practitioner, the research presented in the latter part of this thesis seizes on this opportunity to develop research in human emotion within HCI. By so doing, it is anticipated that a respectable framework for dealing with the issues of human anxiety will emerge, along with a toolkit for measurement and assessment.

The next section of this chapter introduces the reader to the principal findings regarding the association between facial expression and emotion that have been provided by the literature in this area, and gives pointers to the application of facial expression research within HCI.

### 3.6 Facial expression and emotion

"There is one aspect of the relationship between facial behaviour and emotion that is universal for man: the association between the movements of specific facial muscles and specific emotions."

Ekman (1972)

"Emotions are ... typically accompanied by certain somatic events, revealed

by facial and other expressions..."

Oatley (1987).

The most widely used research technique which has sought to establish basic emotions is the identification of those emotions which are universally associated with, and recognisable by facial expressions. Ekman, Friesen and Ellsworth (1982) proposed that there is a small number of distinctive facial expressions, which includes the five basic emotions mentioned previously in this introductory chapter - happiness, sadness, anxiety (fear), anger and disgust. There have been a sequence of experiments that employed photographs (Goodenough, 1931), artists' drawings, and sketches of photos of an actor posing (Fernberger, 1928), magazine photographs (Munn, 1940; Hanawalt, 1944; Vinacke, 1949). Subjects in all of these studies were asked to match various facial expressions with emotions. Accuracy in matching was found for each of these three experiments.

It must, however, be noted that a major limitation of previous studies of facial expression (Lanzetta and Kleck, 1970; Howell and Jorgenson, 1970; Ekman, 1965; Ekman and Rose, 1965; Ekman and Bressler, 1964) was that accuracy of judgement was shown only for the distinction between positive and negative emotional states, and not for any of the distinctions within the groupings of happiness, interest, anger, fear and disgust. It was nonetheless possible to obtain accuracy of judgement, but only for posed behaviour. The problem with posing is that poses are possibly extreme, uncontrolled versions of facial expressions. In general it has been found that evidence based on posed behaviour is far stronger than that based on spontaneous behaviour (Ekman, 1972).

Despite this, there is now sufficient accumulated evidence from studies by researchers such as Ekman, Izard and others to say that the following emotions have a universal facial expression: happiness, anger, disgust, sadness and a

combined notion of fear and surprise (Ekman and Oster, 1982). The common research technique has been to show a series of emotion-expressing photographs to subjects from different cultures. The amount of cross-cultural agreement is then assessed. Using this technique agreement is high even when the people in the photographs are from a different cultural and racial group. It is also important to note that the evidence obtained holds good for preliterate as well as literate cultures. It cannot therefore be maintained that high agreement rates are due to shared learning experiences involving common exposure to mass media representations of emotional expressions.

Accurate communication via emotional expression implies correspondence between inner feeling and expression, consistency of expression across people and situations for the same feeling, and discriminability of the expressions, and the ability of the individual judging the expression to reliably label the emotion visible in the target face. The accuracy of judgements shown in the studies mentioned is sufficiently great to lend support to this. This is strengthened by the fact that it appears that specific situations and feelings activate specific facial muscle patterns e.g. stress in labour provokes certain patterns of forehead contractions (Leventhal and Sharp, 1965).

### 3.6.1 Measuring facial movement

Most facial measurement techniques have also shared a focus upon what is visible, namely what a rater can differentiate when he or she sees a facial movement. Little use has been made of naturally occurring, spontaneous situations, as a result of the anticipated methodological difficulties and lack of control. In 1971 Ekman, Friesen and Tomkins developed one of the first systems for the identification of the judgement of a particular pattern of facial muscle activity. This system was called FAST (Facial Action Scoring Technique) and was based on the hypothesis of a link between feelings and expression. They conducted an experiment showing that New Guineans who had never been exposed to Western culture accurately judged facial expressions

of American college students. They also saw that these natives could pose expressions that could be accurately judged by American college students. By choosing targets and judges from cultures which are extremely different and do not share a tradition of emotional expressions, the researchers supported the assumption that there is a link between specific emotional expressions and specific subjective feelings for mankind.

### 3.6.2 Emotion and expression as communication

Nonetheless, the phenomenon of emotional blends, where individuals have been seen to show more than one emotion at the same instant (Plutchik, 1962), complicates the measurement procedure in general, and has led researchers such as Mandler (1984) to propose that emotion is essentially communicative, acting as a signal to others. Additionally, some discriminations among emotions are more difficult to make than others, for example fear and surprise are more similar to each other in both facial components and semantic connotations than either is with disgust. This would suggest that facial expression is not a direct correlate of emotion, but reflects a more general internal state. Laughing and smiling when experiencing difficulties has been documented by Kraut and Johnson (1979). They saw that happiness does not seem to be a necessary mediator for smiling to occur. They discussed two types of hypothesis, the emotional hypothesis and the social hypothesis. The emotional hypothesis held that bowlers should smile when happy for example after a strike, and the social hypothesis held that they smile during social interaction and the score should be irrelevant. Social involvement such as talking to or looking at others, would appear to be a major cause of smiling, and is independent of the smiler's emotional state - bowlers who score a strike usually do not begin to smile when the pins fall, rather they smile after they turn to face their companions. Solitary bowlers who score well usually do not smile at all. They saw that some smiling was done during and after especially clumsy performances, and suggest that smiling is done to placate or appease another, such as when a mistake is made or a social norm is violated, and the smile is a form of apology for this. Similarly, Jones, Collins and Hong (1991) found that 10-month-old babies sometimes

smiled while looking at their toys, but much more often smiled as they glanced from their toys to their mothers.

So it appears that there is both evidence for facial expression acting as an index of human emotion, and for it's acting as a communicative signal, which highlights one of the more serious issues faced by emotion theorists, namely that there is still no consensus of opinion about a general, comprehensive theory of the emotions.

### 3.6.3 Communicative signal or correlate?

The lack of agreement on the function and properties of emotions forced the thesis to make a choice in order to impose structure on the research. It is the positive correlation between facial expression and emotion, as discussed by Ekman (1978) and Oatley (1987) which will be followed up in the HCI context. The alternative view, held by Mandler, and Kraut and Johnstone, that emotion is essentially communicative in nature, - although intuitively credible and experimentally substantiated, - will not be followed up in the research which will follow in this thesis. The rationale behind this decision is that facial expression has been reliably proven to be a correlate of human emotion pan-culturally. If the emotion-facial expression relationship is indeed seen to hold good in the HCI context, then it will herald the feasibility of using facial expression as a form of input to computer systems. The notion of 'interface agents' has been developed further by Cockshott (1991) at Glasgow University, and results which would suggest that facial expression is reliably indicative of emotion in HCI would have an immediate practical application. When humans interact, both with other humans and with computers, they do so on many levels e.g. they use spoken language, which includes literal word meaning, intonation, speed, force and volume. In addition, we use gesture, bodily position, and facial expressions. These resources can all be used as input which can be used to alter the behaviour of an interface agent. The purpose in using facial movement as a form of input instead of emotion itself is that a greater degree of voluntary control can be

exerted over facial expression by the user, in a way that cannot be over emotion. Emotion may be monitored for on-line input in terms of physiological response, e.g. by increased heart-rate, skin conductance changes and pupil dilation. These measures, however, are ambiguous, as they are primarily indicative of extremities of emotion, rather than a particular feeling per se. For example, heart rate may increase and pupil dilation may occur not only when difficulties are experienced, but also when either goals are within the user's grasp, or when they have been achieved, which presumably not a cause for complaint. It is for this reason that the research will look to facial expression. Firstly, to validate it as a definite correlate of emotion within HCI, and in the event of this relationship holding good, as a proposed form of input to an interface.

In summary, the function of this chapter has been to provide the reader with background information about human emotion and the associated variables of cognition, attribution and facial expression, and an understanding of why they need to be considered in general, and how this thesis intends to apply this knowledge in an HCI context. In Part Two of the thesis, where the research interest lies specifically with the investigation of emotion, the frameworks as delineated above will be applied to the research.

**CHAPTER FOUR**

**AN INTRODUCTION TO THE INSTRUMENTS**

**USED IN THE THESIS AND THE INSTRUMENTS**

**THAT NEEDED TO BE DEVELOPED**

## **CHAPTER 4: AN INTRODUCTION TO THE INSTRUMENTS USED IN THE THESIS AND THE INSTRUMENTS THAT NEEDED TO BE DEVELOPED**

### **4.1 THE AIMS OF THIS CHAPTER**

The goal of this chapter is to introduce the reader to the measurement instruments which were used to measure human performance in the thesis. Limiting their accounts to this one chapter alerts the reader to the types of measurements taken, avoids repetition in later chapters, and also allows for a discussion of the measurement problem faced by HCI researchers in general.

### **4.2 A problem of measurement**

There are seven principal instruments of measurement used throughout the thesis as a whole, to gather information and to measure subject performance. A very large number of these instruments are used in combination, throughout. For example, the first experimental study alone employs six of the instruments. In this sense, the thesis could be deemed to be unique. However, it does point to a somewhat more serious issue, one which merits the attention of the HCI community as a whole. This issue is that there is no consensus of opinion amongst HCI researchers as to which instruments, or which combination of instruments can be best used for the varied research purposes. In the light of this problem, the combinations of instruments which were used in the thesis, were selected in a common-sense and intuitive manner.

### **4.3 Instrument number one: the focus group**

The first instrument is the focus group. In a focus group a list of pre-set topics is introduced one at a time to a group of between four and six users. The investigator attempts to promote a free discussion amongst the participants, for about one hour, ensuring that everyone can hear and be heard. It is important to have clarified all relevant concepts at the outset of the discussion. The focus group can be employed

on its own as a measure of investigation, or it can be used as an accompaniment to another tool, such as the questionnaire. Focus groups can be taped visually, acoustically, or both.

Group methods such as the focus group are advantageous, as they do not force a language style on the user. They use the language of the user, elicit distributed knowledge and also avoid the problem of social desirability. It is possible to follow up previously untapped areas which may emerge within the course of the session. It is also important to select a group who share the same background and age etc, to avoid personality forcing. A focus group can be of pre- or post-trial nature.

#### 4.3.1 Pre-trial (prospective) focus group

A pre-trial discussion may take the following format:

- (a) A discussion of the aims of using the particular interface in question.
- (b) The associated subjective feelings of so doing.
- (c) The actual tasks the user has to execute. In other words, the surrounding activities and considerations (higher level goals and plans) the user has to deal with.
- (d) The associated methods and routines of thought and action the users currently employ.

The simplest, and recommended way of eliciting the information is to either ask directly or request anecdotal examples.

#### 4.3.2 Post-trial (retrospective) focus group

A post-trial group should begin with the discussion group leader refreshing the group's memories with a demonstration of the system in question. He or she should explain how the device actually works. The areas which can be covered in this type of focus group should include the following:

- (a) Subjective feelings about the device.
- (b) Would they use this device of their own freewill, and their reasons.
- (c) What are their ideas for problem-solving.
- (d) Proposed design modifications.

There are, however, some difficulties in the use of focus groups. They are inefficient at capturing behaviour, by virtue of the fact that they are either prospective or retrospective in nature. There is also the problem of how to analyse the resulting data, and indeed, which data should be accepted and which should be rejected. A content analysis could be carried out, but moderator effects and group dynamics must be carefully considered. There is also the question of matching focus group results with what emerges from other instruments - there have been no real studies on their reliability. It is an open-ended method, by comparison with other measures. However, the advantages of using a focus group lie in the fact that the discussion has been conducted in the user's terms, and as such, it can prove an enlightening instrument for discovering the user's concepts, the associated vocabulary, and attitudes and emotions. In addition, it is an instrument which allows natural peer interaction.

#### 4.4 Instrument number two: the semi-structured interview

Interviews may vary from being highly structured (i.e. little more than an orally administered questionnaire) to being non-directive, where the interviewer sets the stage and encourages the interviewee to talk as freely as possible (Anastasi, 1988). Two types of information are provided by interviews. Firstly, information about poise, speech and manner of the interviewee, and more importantly, life-history information. The semi-structured interview is a quantitative method of data collection, and is the type of interviewing which is typical in this thesis.

The information resulting from interviews is usually of a higher quality than that which results from questionnaires. This is due to the fact that the investigator can continue to talk with the subject until he is sure that the subject understands the relevant concepts, and the investigator has obtained the necessary information in a

form that can be categorised (Brown and Harris, 1978). Compared to questionnaires which have several slightly differing, carefully worded questions pertaining to each concept, this measurement tool has an agenda which takes the form of a schedule. The interviewer has the responsibility for ensuring that the respondent has grasped the intended meaning of each item, and also the categorisation of responses in terms of agreed concepts and goals of the study.

A common problem is the extent to which measures may be biased by interviewers, e.g., by putting words into subjects' mouths. Subjects may also tend towards giving socially pleasing replies to questions, and for this reason, the posing of vague questions should be avoided as far as possible, and instead, specific, quantitative examples are sought e.g. "What proportion....."

#### 4.5 Instrument number three: the think aloud protocol

Initially used by Ericsson and Simon (1984), the 'think-aloud' protocol is a qualitative instrument which allows rapid, on-line feedback from the user about the experience of using an interface, although it can be used in a quantitative sense, when the protocol is audially or visually recorded. Think-aloud protocols consist of observing users interact with a system, while encouraging them to think aloud. It is an extension of the basic method of user observation. It is essential that the user be put at ease, and the principle of speaking aloud be explained.

As such, the think-aloud protocol is an unnatural situation. During the session, the user is regularly encouraged to keep thinking aloud. Most frequently this method is used with novice users, as problems are more frequent at this stage. When the user does something unexpected, only he or she can tell what the intention was.

The think aloud method is a simple but cheap and powerful way of obtaining information about the quality of the user's interaction with the system. It is open-ended and directive, in that the users are probed during and not after the event. It is useful for locating bugs in a system, rather than for answering predetermined

questions. Many novice users would not know if they are actually making a mistake, and if the designer is on site, witnessing this, then it will not go amiss, if it is happening. However, the think-aloud protocol method cannot highlight very fast mental processes. In practice people can only relate thoughts that take an appreciable time. The advantage of having users talk aloud as they act is that people quickly forget most of the details of puzzles or errors. To ask them afterwards in questionnaires or interviews may mean that all but the most painful experiences are forgotten.

#### 4.6 Instrument number four: the questionnaire.

The questionnaire is a retrospective instrument best suited for tapping knowledge about sense of competence, preferences and pleasures in using interfaces, and is best used in conjunction with semi-structured interviews. It provides quick and prepacked items in the form of questions that the user can agree or disagree with. However, the resulting information is correspondingly limited (Brynnner and Stribley, 1979). Additionally, since the subject may only give information on areas covered by the questions, the investigator needs to decide in advance precisely which areas are going to be of interest. Once designed, the questionnaire can be used in large numbers without the presence of the investigator.

#### 4.7 Instrument number five: the feature checklist

A checklist may comprise, for example, of all the features of the system under investigation, and response categories indicating usage, knowledge, need, and sources of information. It is a simple list and asks what a subject knows about something, for example, a list of all system commands. The subject is usually only required to check a box against each item, thus they are really quick and easy to complete. The reader is referred to Edgerton (1992) for an informative analysis of the checklist instrument.

#### 4.8 Instrument number six: the structured incident diary

This method gives the user a structured and simple means of recording low frequency problems as they happen. It is an inexpensive method of data collection. The user is provided with structured forms on which he can record what happens when certain types of events occur. The usual topic of interest is normally when the user experiences difficulty. The diary records what happens at these points. There are two issues. The first issue is the design of the diary, which involves defining the events you want the user to pay attention to, giving an example, laying out the diary in an easy-to-read manner, and then asking the user how accurate he or she has been in completing the diary. Secondly, the investigator must be sure that the user is aware of which events he or she has been asked to record. Duncan (1992) describes the application and usefulness of the incident diary in full.

#### 4.9 Instrument number seven: the controlled comparison experiment

The experiment is a search for objective measures, independent of biases of the investigator or idiosyncrasies of the particular user sample. It is particularly efficient for the consideration of speed and errors and results in objective measures which are typical of an interface design, independent of biases of the investigator or idiosyncrasies of the particular user sample, and has the advantage of generalisation across users.

#### 4.10 Specialist measurement instruments for a specialist field. The development of new measurement instruments for HCI research.

It can be seen from the above that a wide range of measurement instruments are used in the thesis. Rarely, if ever, is only one measurement instrument used at a time. Nonetheless, as the research in this thesis unfolded, it became increasingly apparent that in order to investigate concepts such as emotion and anxiety, new instruments would have to be developed specifically for this purpose.

#### 4.11 Why new tools had to be developed

The development of new instruments was necessary at two different points in the thesis. The latter part of the research (Part Two) is concerned with how one can feasibly record two distinct human variables during interactions. These are:

- (a) human emotion during interaction
- (b) facial expression during interaction

##### 4.11.1 Measuring emotion during interaction

Although there indeed exists an abundance of scales and checklists of emotion-eliciting situations such as the PSE (Present State Examination), (Wing et al., 1974) and IDA (Irritability, Depression and Anxiety Scale), (Snaith et al., 1978), these scales have been designed specifically for clinical diagnostic purposes. As such, they contain items which often pertain to particular clinical problems. Other measures such as the Computer Attitude Scale (Gressard and Lloyd, 1984a, 1984b) measure attitudes towards computers, but not the wider range of cognitions and emotions. It was therefore necessary to develop an instrument which would measure the emotions that are experienced by computer users as they happen. Chapter 7, experimental study 3 handles the construction of such an instrument.

##### 4.11.2 Measuring facial expression during interaction - Ekman's Facial Action Coding System (FACS)

Just as there is no consensus on a theory of the emotions, nor is there a consensus on how to measure facial behaviour, nor has any instrument been developed which has become the standard used by all investigators. Most facial measurement techniques have, however, shared a focus upon what is visible; what a rater can differentiate when he or she sees a facial movement. In 1978 an instrument was devised by Ekman in order to distinguish among all facial behaviour. This measurement instrument is called FACS (Facial Action Coding System), and is derived from an analysis of the anatomical basis of facial movement. It includes most of the differences in appearance which result from different muscle actions,

and does not record the intensity of the facial expression.

A highly specialist instrument, FACS is used in its full form by only fifty people on average in the world at any one time. As Ekman stated, "..... investigators may wish to selectively score only certain action units or action unit combinations in their main study." Therefore a reduced but nonetheless sufficiently comprehensive set of Ekman's action units was thus used as it was felt that by regrouping the action units into larger, more general groups, the facial coding system could remain sufficiently comprehensive i.e. cover the principal areas of the face, namely forehead, eyes, cheeks, mouth, and whole face in general.

The original FACS was reduced to a 19-item form for use in Chapter 8. Rather than continuing with the original anatomically-labeled facial movements, the individual facial movements were relabeled in a readily-understandable form. The reduced size and increased comprehensibility of the resultant FACS meant that not only was another measurement instrument now available to HCI researchers, but that the resultant analyses would be quicker, more manageable and more easily understood.

In summary, this chapter has highlighted two things. Firstly, the dilemma of choice of measurement instrument faced by the HCI researcher. Secondly, it has indicated the necessity of the HCI researcher to both construct his or her own specialist measurement tools, and to modify measurement instruments taken from other areas of research. This issue of measurement will be returned to in the concluding chapters of the thesis.

**PART ONE**

**USER DOCUMENTATION**

**CHAPTER 5**  
**COMBINING MINIMALIST GUIDELINES FOR**  
**MANUAL DESIGN WITH A 'FROM-SCRATCH'**  
**METHOD**

## CHAPTER 5: COMBINING MINIMALIST GUIDELINES FOR MANUAL DESIGN WITH A 'FROM-SCRATCH' METHOD

### 5.1 SUMMARY

This chapter presents the first piece of experimental work. This experiment builds on Carroll's guidelines for minimal manual design by developing a minimal manual which incorporates all of his guidelines, but which additionally employs a 'from-scratch' design philosophy. This design philosophy has not been used by Carroll, but was suggested by McElhinney (1988), and would intuitively seem to be pointing design in the right direction. Carroll devised his guidelines to cater to the needs of designers who were applying a 'top-down' process in the construction of manuals, by drawing on existing manuals and compiling this information to form the new manual. The 'from-scratch' design strategy prohibits the reference to and dependence upon conventional documentation and the consequential importation of potentially irrelevant/redundant content, and although McElhinney used the 'from-scratch' method to design a manual, he did not also apply Carroll's recommended methods. McElhinney showed beneficial effects of using the 'from-scratch' method over conventional documentation forms. The present study takes this research a step further by combining the 'from-scratch' method with Carroll's guidelines.

The 'from-scratch' design guideline, by making no fallacious presumptions about the content of the manual should in effect fill the remaining, and important gap in current guidelines for manual design and in so doing cure one of the headaches of design. In the event of superior effects in a comparison experiment from use of a manual built along these combined guidelines, then the 'from-scratch' guideline should be advocated as an additional formal principle for manual design. Only once this remaining meta-level design concerns have been attended to is the field of documentation design in a position to consider the more internal aspects of design, such as the exact degree of explanation required by the user.

A minimal manual for electronic mail was designed using both Carroll's and McElhinney's guidelines. The design process involved acquiring from a set of experts information about e-mail use that would be helpful to novices, and acquiring from novices information that would guide subsequent versions of the manual. The seventh version of the manual was tested against a commercial manual, in a comparison experiment, with 30 novice subjects. It had 13% of the number of pages of the commercial manual; it resulted in 30% faster learning, and more effective use of the e-mail system overall. There was also significantly better performance on individual subtasks; including the recovery from errors. Significantly more users were satisfied with it than with the conventional manual.

It would therefore appear that designing 'from-scratch' can now be accepted as a formal method for manual design. The last top-level guideline for design has been clarified, which now enables the consideration of aspects of documentation such as the level of explanation that should be provided to users.

## 5.2 Introduction to the experiment

An important element in this study was that a large number of subjects be available, who would be required to use the electronic mailing system for international and local networking, intra-departmental message sending, general broadcasting, and the handling of data and text files. The e-mail instruction that was available at the time in the university was of an obscure nature with system knowledge being handed down from one individual to another. There existed a minimal manual for VME e-mail but the norm was to use Unix, the favoured academic operating system. Various Unix guides were indeed available but they were general guides to Unix, and not particularly to e-mail. The on-line e-mail manual, although helpful, was not of immediate use to the new user as it would emerge that few were aware of the on-line help facility, and fewer still knew the command for accessing it. Thus there was the opportunity for the development of a minimal manual.

### 5.2.1 Carroll's principles

Carroll (1990b) expanded upon the observations made in the introductory chapter. He makes reference to five resulting minimalist principles which are as follows -

- (a) Allow the user to get started fast, i.e. slash the verbiage, give the user meaningful tasks.
- (b) Rely on the user to think and to improvise - leave out material that can be inferred.
- (c) Direct training at real tasks - introduce real work immediately.
- (d) Exploit what people already know - although the fact that reasoning is subject to interference from other similar situations (such as the return and spacebar keys which sometimes alter text as well as moving the pointer), which can be misleading, it is an intuitively practical exercise to build on the information that people already possess.
- (e) Support error recognition and recovery - error recognition and recovery is not always obvious, and this must be recognised and catered to.

### 5.2.2 How were these principles achieved in the design of this minimal manual?

The real tasks were specified by expert opinion at the outset, the designer had a minimum of text to start with, and slashed the verbiage from iteration to iteration. Comparisons with the commercial manual were favourable regarding length. It was anticipated that such paring of the text would be conducive to a quicker task completion time. The support of error recognition and recovery was achieved on the principle that if a user could not recover from an error by using the interface alone, then recovery information must be entered into the manual. Lastly, guided exploration was achieved through the use of 'hints' sections and an encouraging tone throughout.

### 5.2.3 The user as consultant.

Manuals are written for users. The notion of user-centredness which has won popular acclaim and practice, best explored by Norman and Draper (1986), is of fundamental importance to the design of the minimal manual. It was anticipated that the opinion of expert users would best cater to the issue of manual content, and that novice user opinion would direct the design of the manual towards an appropriate layout, and throw light on textual ambiguities. Expert feedback would thus be relegated to the initial design stage, and novice feedback to the iterative design loop.

Expert and long-term electronic mail users were questioned regarding which aspects of the mail program a novice would need to be acquainted with in order to get ahead and start using it effectively to serve his or her own immediate purposes. The output of this exercise formed the backbone of the manual content, which would remain static throughout the design cycle. The user-centredness principle was perpetuated throughout the designing of the manual in that feedback from novice e-mail users was employed in the alteration, upgrading and reformatting of the manual layout, and clarification of terminology as each draft of the manual evolved.

### 5.2.4 The hypotheses

(a) It was hypothesised that user performance along the dimensions measured in a mail test would prove superior when using the minimal manual compared to the conventional manual.

(b) It was further hypothesised that the use of McElhinney's guideline would be supported.

## 5.3 Method

### 5.3.1 The design process

The design process broke down into three stages, namely, - design analysis, sub-skill testing and criterion testing.

### 5.3.2 Design analysis

This involved an analysis of the current training situation, and an empirical understanding of the core tasks which novice users would be motivated to do.

The design analysis of this study was carried out by the administration of three instruments, a semi-structured interview with 16 novices, 8 male and 8 female, mean age 26, (range 20- 43) and 16 experts, 9 male and 7 female, mean age 30, (range 21-49), and a feature checklist and incident diary to the expert mail user population, mean age 27, (range 21-51). These individuals were approached in the departments of Computer Science and Psychology at Glasgow University.

### 5.3.3 The semi-structured interview (appendix 5.3.3)

Semi-structured interviews were conducted with both expert and novice users. The purpose of this was to ascertain from the expert users those tasks which were most commonly undertaken, which tasks a new user would be most likely to need from the outset, and a window on the type of errors that would most likely be committed in the early stages of using e-mail. New users were interviewed in order to establish the nature of their goals; what types of activity they envisaged using the system for, and what they ideally would like to use the system for. Users of both type were also asked about their use of and thoughts about currently available documentation, in order that the documentation context in which users were currently working would be clearly mapped out.

Interviews held with novices revealed that most of them had been aware of the e-mail facility for an average of 8 months. 75% wanted a new manual to be only a couple of pages long, and 93.3% wanted to learn only the necessary rudiments. Interviews held with experts revealed that 56% had been using e-mail for between 1-3 years, 56% used it on a daily basis, the main reported problem was vi, the desired length of a new manual was a couple of pages, the complaint about current manual forms was the poor layout, and the majority had learnt how to use e-mail from other people.

Eight main areas novice users must know about emerged from the expert interviews

- (a) logging on
- (b) logging off
- (c) How to receive mail
- (d) How to send mail
- (e) How to send urgent messages
- (f) An awareness of aliases
- (g) Files
- (h) Directories

#### 5.3.4 The feature checklist (appendix 5.3.4)

The same expert users that carried out semi-structured interviews completed a feature checklist of system commands, which allowed identification of the core commands which were in most frequent use. These high frequency core commands formed the basis of the minimal manual.

#### 5.3.5 Expert Checklist Results -

The following commands were the most frequently used -  
mail, mail jane, r, mailsjinv, t1, who, more mbox, ., passwd, lpr mbox

These commands would form the basis of the manual contents. A comparison of the semi-structured interview and checklist results showed that although the feature checklist was of a more comprehensive nature, the semi-structured interview was of more use in revealing the broader areas of activity that novice users would be involved in.

#### 5.3.5.1 The most frequent e-mail commands used by experts

Table 5.3.5.1 below shows the percentage of expert users who use any command frequently.

Table 5.3.5.1 The percentage of expert users who use any command frequently.

Command	Percentage use frequently
mail	100
mail jane	95
r	80
mailsjinv	75
t1	65
who	65
vi F	65
B	65
more mbox	60
.	60
p	50
j	50
D	50
dd	55
dw	55
passwd	55
lpr mbox	55

Table 5.3.5.1 cont'd

---

f	55
cw text ESC	45
:ef	45
q	45
d	45
u	45
g	40
write	40
ctrl-d	40
n	40
o	40
x	35
yy	35
i text ESC	35
R	30
:rf	30
p	30
w	30
?pat ESC	30
pat ESC	25
ed nofile	25
a text ESC	25
u	25
rx	25
w	25
\$	25
du	20
q	20
ed fred	20
b	15
s mess filename	15
pre	5

---

It is important to note at this stage that although vi rated as being highly frequently used by experts, vi was not dealt with in the manual since the experts did not consider it to be of essential use to the novice when learning the rudiments of email. Vi was not one of the categories about which the novice user would need to know; if it had been, the interviews would have thrown this

to light. Therefore, the resulting input to the manual on these grounds excludes vi as a more advanced feature. Both the interviews and the checklist must be taken together, and although "write" and "ctrl-D" were only used on a frequent basis by 40% of experts, the need to know how to send urgent messages was revealed in the interviews. This may be due to the fact that it is important to know how to send urgent messages, but in practice you may only need to use the command on an infrequent basis. It transpired that "ctrl-D" was not as commonly used as the "logout" command.

#### 5.3.6 The incident diary (appendix 5.3.6)

An incident diary was completed by four expert users from the Psychology Department (3 males, 1 female) to throw light on low frequency problems when they occurred. Every time the individual 'got stuck', a page of the diary was to be completed, asking what happened, and how a recovery was attempted.

#### 5.3.7 Experts' incident diary results -

A post-hoc categorisation revealed detailed and specific problems, falling into two main groups, namely operating system difficulties, and word-processing problems such as forgetting about line-wraps.

#### 5.3.8 Sub-skill testing - the user as consultant : Procedure

This was an iterative process which involved the successive drafts of the manual being piloted, with user feedback highlighting problem areas and user misinterpretations, and the suggesting of improvements by novice users. A first draft of the minimal manual was prepared for piloting on the basis of the design analysis. (See appendix 5.3.8).

### 5.3.8.1 Subjects

Subjects were approached in the departments of Psychology and Computer Science, and asked if they would mind taking part in a small experiment. Pupils attending the G. U. Psychology Summer School, and pupils from Junieur Honours Psychology also took part as subjects. Table 5.3.8.1 below displays the number of individuals involved in each iteration of the manual. The development of the manual ran over an 8 month period.

Table 5.3.8.1 The number of individuals involved in each iteration of the manual.

Manual Version	Subject nos.	Male	Female
1	10	4	6
2	12	7	5
3	14	9	5
4	7	3	4
5	21	6	15
6	12	8	4
7	14	8	6

Novice subjects used the manual to do the mail test but their performance was not recorded at this stage. This was done with each successive draft of the manual (repeated measures on different subjects). The mail test as given to the subjects can be found in appendix 5.3.8.1.

### 5.3.9 Semi-structured interview (appendix 5.3.9)

Think aloud protocols and semi-structured interviews were conducted on new users with each draft of the manual as it evolved. Iteration occurred until the manual won user approval. The versions of the manual are to be found in appendix 5.3.9.1

### 5.3.10 Questionnaire (appendix 5.3.10)

A questionnaire was administered at each draft stage, and users were asked to rate each aspect of the manual.

### 5.3.11 Structured incident diary

Incident diaries were also administered to novice users, however, these did not prove as helpful as the questionnaire and interview, as the completion rate was low.

### 5.3.12 Criterion testing - the proof of the manual

At this stage the final version of the minimal manual (appendix 5.3.12) underwent comparative testing against the conventional manual by means of a performance test and post-test interviewing (appendix 5.3.12.1).

A few think-alouds, both of an individual and constructive interaction nature were conducted in the hope that some additional information would be elicited that was not teased out of the other measures. Chapter 3 of the Unix User Manual Beginner's Guide entitled "Mail" would appear to be the chapter of most immediate use to the new user. This chapter alone was three times as long as the minimal manual. For the comparison, 15 subjects received the minimal manual, 15 the conventional Beginner's Guide for the test.

## 5.4 The procedure for criterion testing

For the purpose of a comparison, subjects were randomly assigned to one of two groups. All were novices. Group 1 received the minimal manual and Group 2 the Sun Beginner's Guide to Mail and Messages. The comparison was done on Sun Workstations since future generations of e-mail users, especially undergraduate classes, would use this terminal type to access the e-mail facility.

#### 5.4.1 The e-mail test

The mail task required that each individual

1. Log on successfully
2. Access his or her own mail
3. Send a short message to another individual (the experimenter, who was logged on)
4. Use the 'write' command successfully
5. Create a file and a directory
6. Check that the file and directory were successfully created
7. Log off successfully

Each task was to be done in the prescribed order (above), and each task was treated as separate from the others for the purpose of clear test recording. With a view to the experiment's ecological validity, there were no practice trials, as it was necessary to witness user behaviour and performance on his or her initial interaction with the documentation, and have subjects commence the test from the same base state. Practice trials with the two differing forms of assistance may have led to different base states when commencing the test session and consequently confound the results.

#### 5.4.2 Performance Measures

A record was made of-

1. How long it took before he or she got started at the computer (the first attempt at a task), from the start of the training session.
2. How much time was spent consulting documentation before hands-on work started.
3. How long it took in total to achieve successful completion of the mail task.
4. Whether logon was successful or not, and how long it took.
5. Whether mail access was successful or not, and how long it took.
6. Whether a message was successfully sent or not, and how long it took.

7. Whether write was used successfully or not and how long it took.
8. Whether a file was successfully created or not and how long it took.
9. Whether a directory was successfully created or not, and how long it took.
10. Whether a successful check on these was made or not, and how long it took.
11. Whether the log off was successful or not, and how long it took.
12. The number of errors made.
13. The type of errors made.
14. The number of attempts made to recover from an error state.
15. How many errors were recovered from.

## 5.5 Results

The results section has three parts, namely a consideration of the development of the manual, the results of comparisons between minimal and conventional manual, and the outcome of post test interviews.

### 5.5.1 The development of the manual

One way anovas were conducted on the subjects' ratings (independent groups) of various aspects of the minimal manual as each new version was piloted. Figure 5.5.1 shows the subjects ratings of the appropriateness of the length of the manual. In this and all the other results of this part, subjects made ratings on a scale from 0 to 10, with zero being a very negative rating, and 10 a very positive one. A one-way anova for independent groups was significant ( $F=8.975$ ,  $df=6,93$ ,  $p<0.0001$ ). Scheffe values, for all possible paired comparisons are to be found in Appendix 5.5.1

Figure 5.5.1.1 Mean subject ratings of appropriateness of manual length across versions

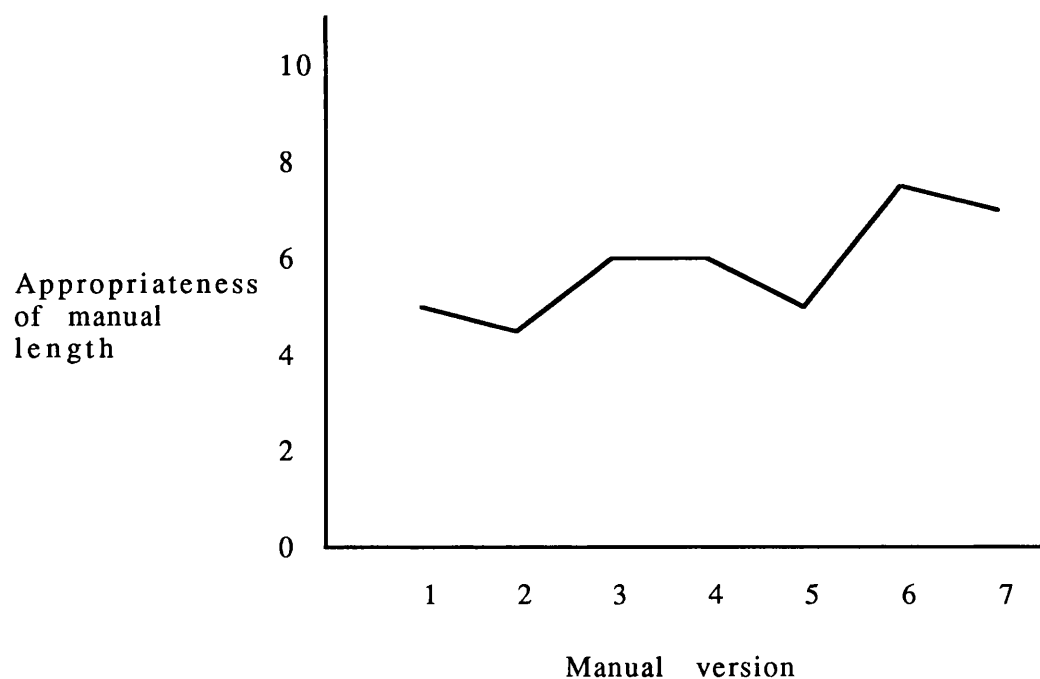


Table 5.5.1.1 F table for manual length by version

One Factor ANOVA  $X_1$ : version  $Y_1$ : length

Analysis of Variance Table

Source:	DF:	Sum Squares:	Mean Square:	F-test:
Between groups	6	117.857	19.643	8.975
Within groups	93	203.533	2.189	$p = .0001$
Total	99	321.39		

Model II estimate of between component variance = 2.909

Figure 5.5.1.2 overleaf shows that subjects' ratings of how easy the manual was to use significantly improved as the manual developed ( $F=2.981$ ,  $df=6,93$ ,  $p=0.0104$ ). There were more significant differences among the iterations, (Appendix 5.5.1) and an overall modest improvement of two scale points from version one to version seven.

Figure 5.5.1.2 Mean subject ratings of how easy the manual was to use across versions

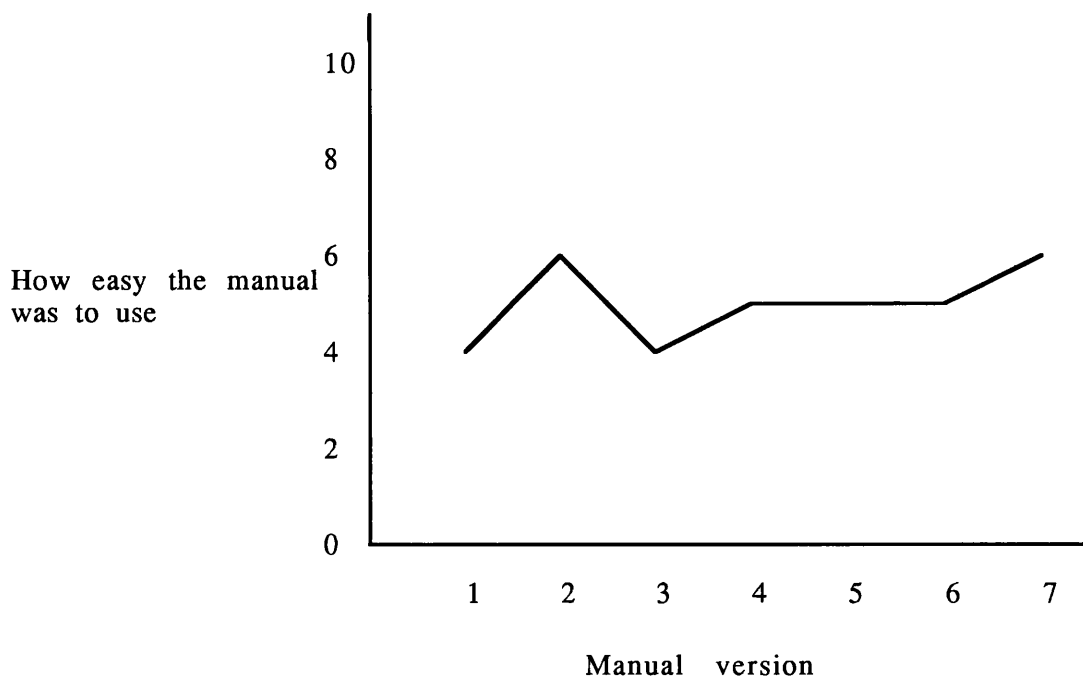


Table 5.5.1.2 F table for ease of use by version

One Factor ANOVA  $X_1$ : version  $Y_2$ : help

Analysis of Variance Table

Source:	DF:	Sum Squares:	Mean Square:	F-test:
Between groups	6	48.371	8.062	2.824
Within groups	93	265.469	2.855	$p = .0143$
Total	99	313.84		

Model II estimate of between component variance = .868

Looking at figure 5.5.1.3 overleaf, it can be seen that how helpful the Hints sections of the manual were seen to be, received significantly different ratings ( $F=2.461$ ,  $df=6,93$ ,  $p=0.0297$ ) across the versions, (always remaining above the midpoint), possibly assisted by an increase in the number of hints boxes provided.

Figure 5.5.1.3 Mean subject ratings of how useful the hints were

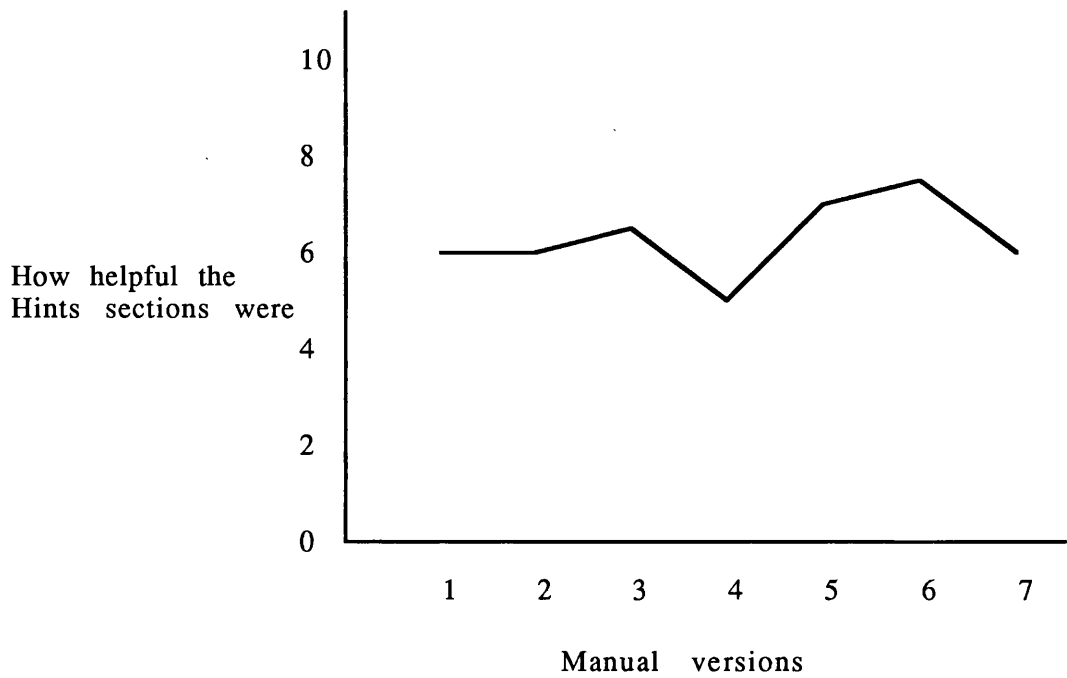


Table 5.5.1.3 F table for helpfulness of hints by version

One Factor ANOVA  $X_1$ : version  $Y_3$ : hints

Analysis of Variance Table

Source:	DF:	Sum Squares:	Mean Square:	F-test:
Between groups	6	42.334	7.056	2.461
Within groups	93	266.626	2.867	p = .0297
Total	99	308.96		

Model II estimate of between component variance = .698

As seen in figure 5.5.1.4 below, ratings regarding the clarity of the manual's layout differed across the iterations ( $F=6.435$ ,  $df=6,93$ ,  $p=0.0001$ ) but always received an above average mean rating.

Figure 5.5.1.4 Mean subject ratings of how appropriate the manual's layout was

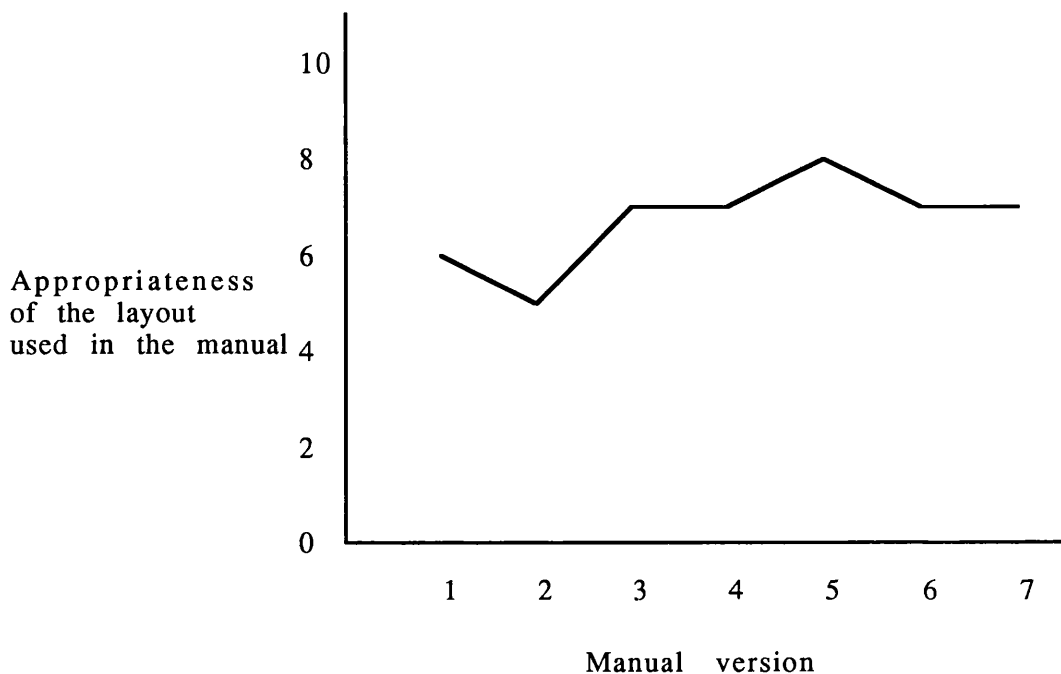


Table 5.5.1.4 F table for layout by version

One Factor ANOVA  $X_1$ : layout  $Y_1$ : version

Analysis of Variance Table

Source:	DF:	Sum Squares:	Mean Square:	F-test:
Between groups	8	71.359	8.92	2.941
Within groups	91	276.031	3.033	$p = .0057$
Total	99	347.39		

Model II estimate of between component variance = .736

Figure 5.5.1.5 below shows that although the subjects did not rate the minimal manual as comparing any more favourably with other forms of assistance ( $F=1.988$ ,  $df=6,93$ ,  $p=0.0752$ ), the ratings were adequately high throughout.

Figure 5.5.1.5 Mean subject ratings of how well each version of the minimal manual compared with other forms of documentation

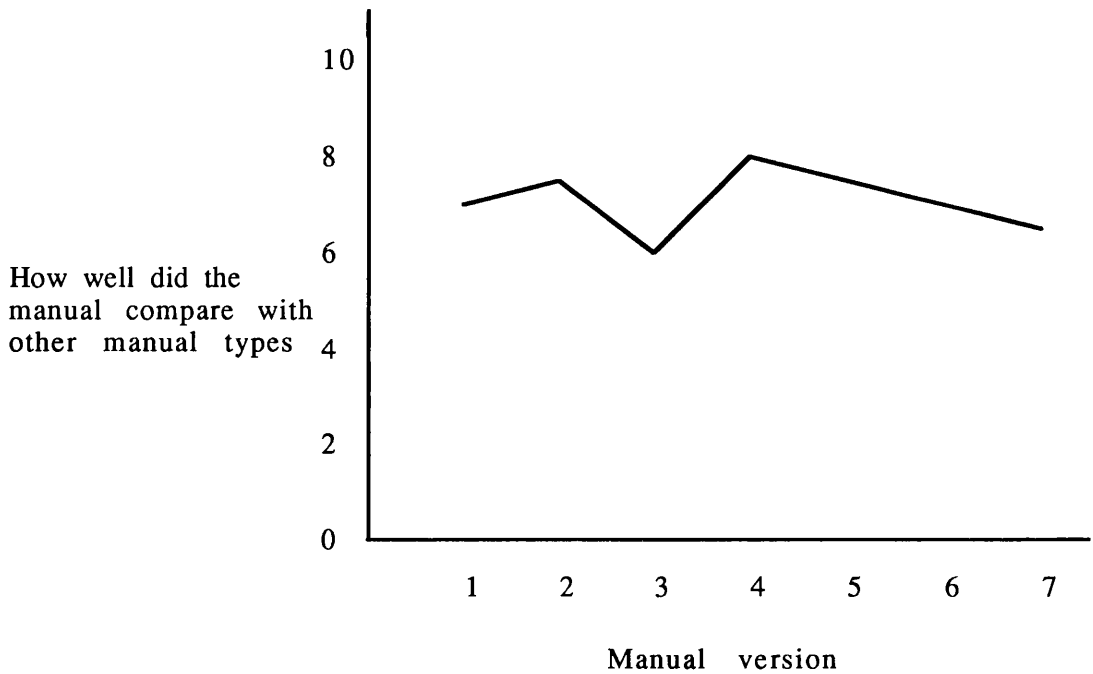


Table 5.5.1.5 F table of comparison with other manual types by version

**One Factor ANOVA X<sub>1</sub>: version Y<sub>1</sub>: compare**

Analysis of Variance Table

Source:	DF:	Sum Squares:	Mean Square:	F-test:
Between groups	6	26.458	4.41	1.988
Within groups	93	206.292	2.218	$p = .0752$
Total	99	232.75		

Model II estimate of between component variance = .365

Looking at figure 5.5.1.6, it can be seen that between versions one and seven (the final version) the language mean ratings increased slightly, though without significance ( $F=1.604$ ,  $df=6,93$ ,  $p=0.1547$ ). Nonetheless the rating means were all above the 11 point scale's midpoint of 5, the lowest mean ratings occurring in version one with an average of 6.9. This was expected as the terminology was not altered to any great extent.

Figure 5.5.1.6 mean subject ratings of how easy the language was to understand

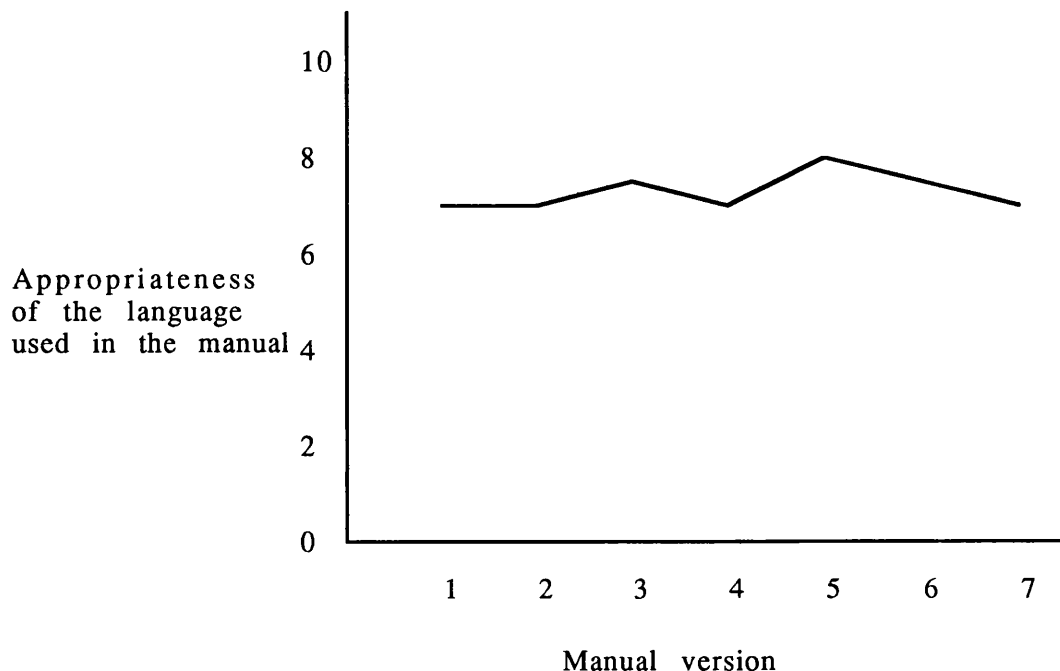


Table 5.5.1.6 F table for language by version

**One Factor ANOVA**  $X_1$ : version  $Y_1$ : lang

Analysis of Variance Table

Source:	DF:	Sum Squares:	Mean Square:	F-test:
Between groups	6	19.968	3.328	1.604
Within groups	93	192.942	2.075	$p = .1547$
Total	99	212.91		

Model II estimate of between component variance = .209

For the variables of how helpful the manual was, and of how much they would like to use such a manual again, the scores again did not improve across iterations, but means were within the range 6 to 7 ( $F=2.824$ ,  $df=6,93$ ,  $p=0.0143$ ) (figure 5.5.1.7).

Figure 5.5.1.7 mean subject ratings of how helpful the manual was

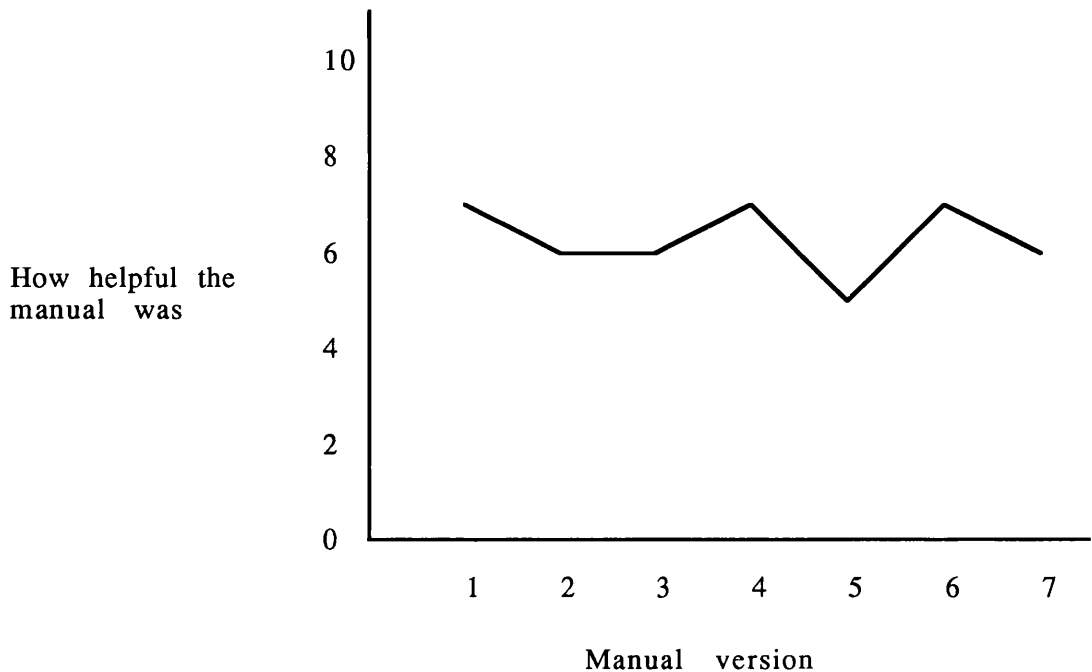


Table 5.5.1.7 F table of helpfulness by version

One Factor ANOVA  $X_1$ : version  $Y_1$ : help

Analysis of Variance Table

Source:	DF:	Sum Squares:	Mean Square:	F-test:
Between groups	6	48.371	8.062	2.824
Within groups	93	265.469	2.855	$p = .0143$
Total	99	313.84		

Model II estimate of between component variance = .868

As figure 5.5.1.8 below displays, user ratings of how much they would like to use the manual again failed to reach significance ( $F= 1.976$ ,  $df=6,93$ ,  $p=0.0769$ ), but it must be noted that the minimum mean rating was 6 so the manual would appear to have been satisfactory nonetheless.

Figure 5.5.1.8 Subject ratings of how much they would like to use this manual again

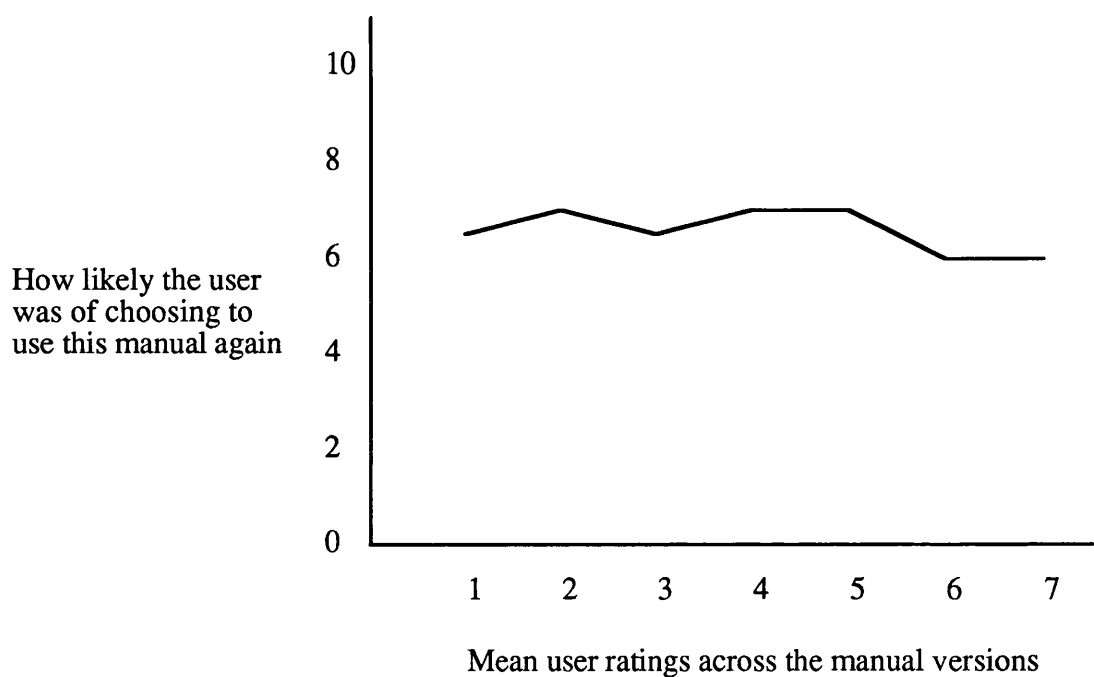


Table 5.5.1.8 F table of likelihood of using this manual type again by version

**One Factor ANOVA X<sub>1</sub>: version Y<sub>1</sub>: use again**

Analysis of Variance Table

Source:	DF:	Sum Squares:	Mean Square:	F-test:
Between groups	6	32.574	5.429	1.976
Within groups	93	255.536	2.748	p = .0769
Total	99	288.11		

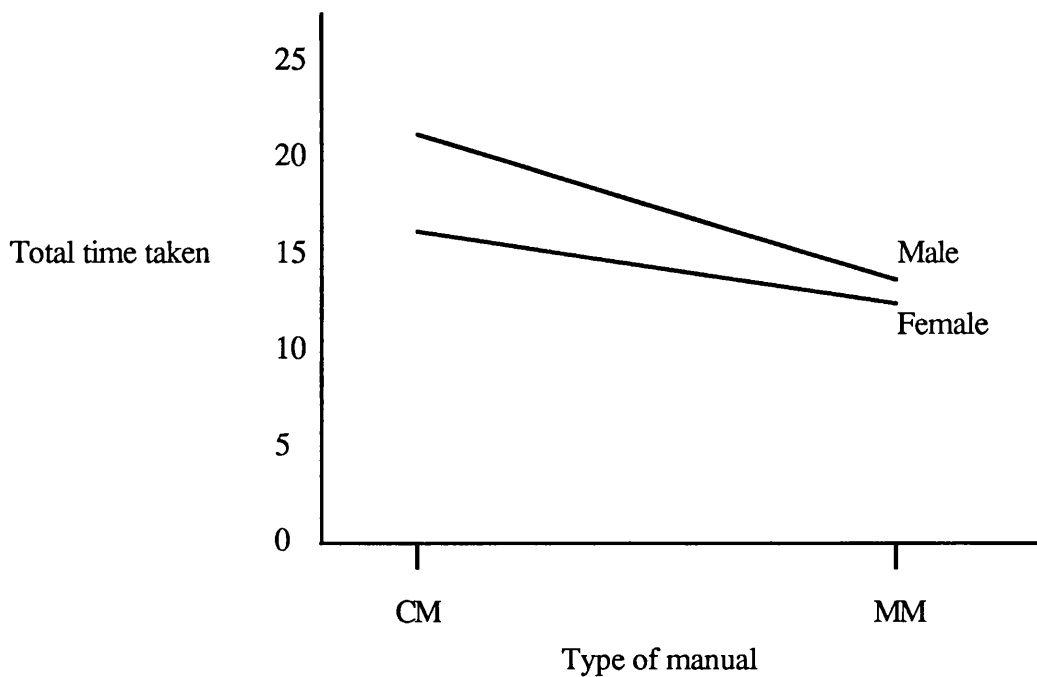
Model II estimate of between component variance = .447

As stated earlier at the start of section 5.5.1, the reader is referred to Appendix 5.5.1 which displays Scheffe F, Fischer PLSD and Dunnett's t values for all possible paired comparisons, and accompanying sten scores.

### 5.5.2 Comparisons between minimal and conventional manual

As previously mentioned in section 5.4, for the purpose of a comparison, subjects were randomly assigned to one of two groups. All were novices. Group 1 received the minimal manual and Group 2 the Sun Beginner's Guide to Mail and Messages. The comparison was done on Sun Workstations since future generations of e-mail users, especially undergraduate classes, would use this terminal type to access the e-mail facility. 15 subjects received the minimal manual, (6 male, 9 female), and 15 received the conventional manual (7 male, 8 female). These subjects were recruited from the ordinary and junior honours psychology classes. The two main measurements on the performance task were total time taken to complete the task and errors made. The mean times to complete the entire test, as a function of the type of manual (conventional or minimal) and of sex can be seen in figure 5.5.2.1 overleaf.

Figure 5.5.2.1 Means in minutes of the total time taken to complete the performance tasks as a function of type of manual



As may be seen from this figure, subjects in the minimal manual condition took 30 % less time than those with the conventional manual. Moreover, women were faster overall than men. On a two way analysis of variance the difference due to manual type was significant ( $F=10.789$ ,  $df=1,1$ ,  $p=0.0029$ ) whereas the sex difference was not significant ( $F=3.191$ ,  $df=1,1$ ,  $p=0.0857$ ). There was no significant interaction effect ( $F=0.747$ ,  $df=1,1$ ,  $p=0.3953$ ), as can be seen from Table 5.5.2.1 overleaf.

Table 5.5.2.1 2-way anova for total time taken by manual type.

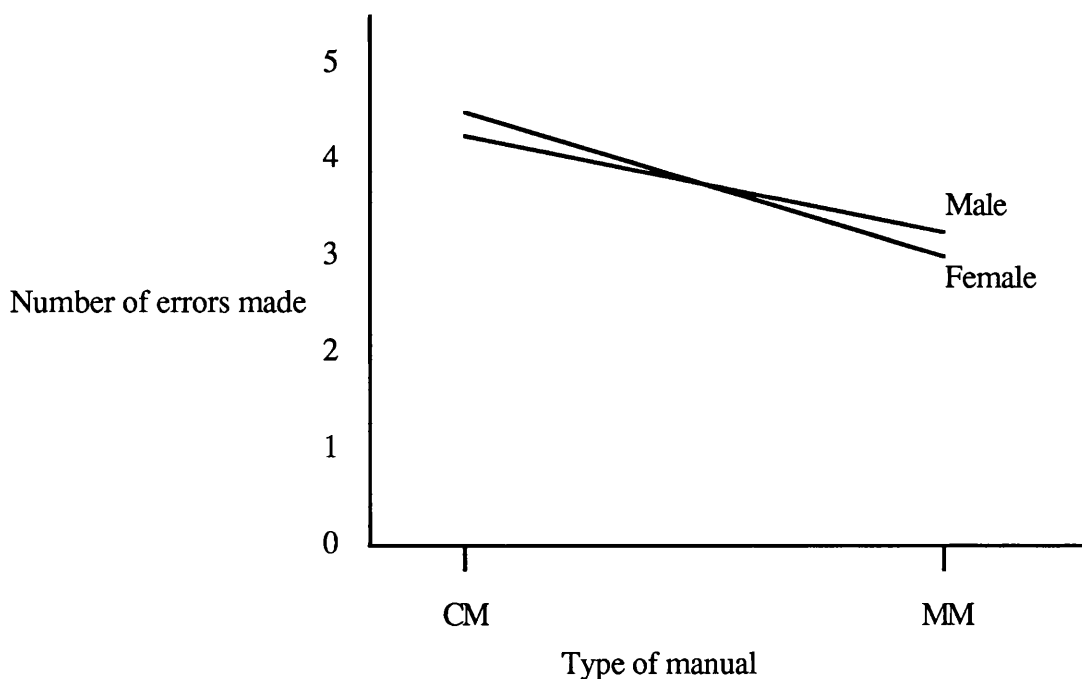
Anova table for a 2-factor Analysis of Variance on Y<sub>1</sub>: totaltime

Source:	df:	Sum of Squares:	Mean Square:	F-test:	P value:
document (A)	1	7.736	7.736	10.789	.0029
sex (B)	1	2.288	2.288	3.191	.0857
AB	1	.536	.536	.747	.3953
Error	26	18.643	.717		

There were no missing cells found.

As can be seen in figure 5.5 2.2 below, the total number of errors made was not significantly different as a function of manual type, on a two way analysis of variance, ( $F=3.255$ ,  $df=1,1$ ,  $p=0.0828$ ), nor was there a sex effect ( $F= 0.001$ ,  $df=1,1$ ,  $p=0.9709$ ), nor any interaction effect ( $F=0.185$ ,  $df=1,1$ ,  $p=0.671$ ).

Figure 5.5.2.2 Mean number of errors made as a function of type of manual



This can also be seen from Table 5.5.2.2 below.

Table 5.5.2.2 2-way anova for number of errors by manual type.

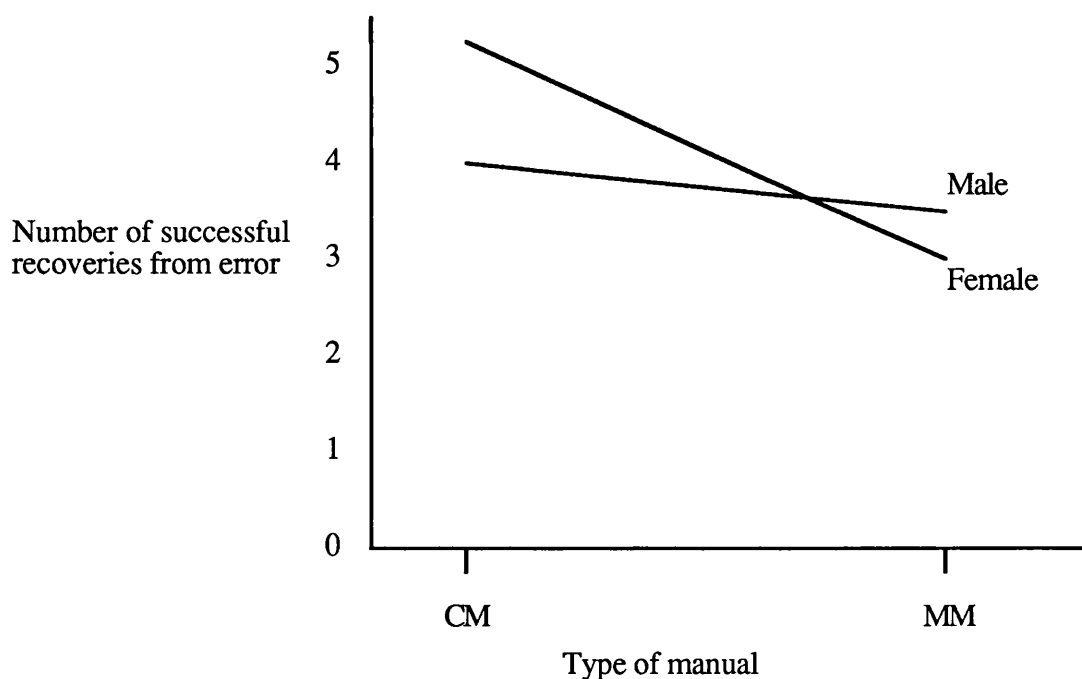
**Anova table for a 2-factor Analysis of Variance on Y<sub>1</sub>: noerrors**

Source:	df:	Sum of Squares:	Mean Square:	F-test:	P value:
document (A)	1	12.862	12.862	3.255	.0828
sex (B)	1	.005	.005	.001	.9709
AB	1	.729	.729	.185	.671
Error	26	102.732	3.951		

There were no missing cells found.

It is clear from figure 5.5.2.3 overleaf, that more errors were recovered from in the minimal manual condition, ( $F=4.85$ ,  $df=1,1$ ,  $p=0.0367$ ), but despite displaying more active recovery behaviour as we can see from this figure, males failed to have a more successful recovery rate, a two way analysis of variance failing to reach significance, ( $F=0.369$ ,  $df=1,1$ ,  $p=0.5488$ ). There was no interaction effect ( $F=9.75$ ,  $df=1,1$ ,  $p=0.3326$ ).

Figure 5.5.2.3 Mean number of successful recoveries from error as a function of type of manual



This can also be seen in full in table 5.5.2.3 below.

Table 5.5.2.3 2-way anova table for number of errors recovered from by manual type

**Anova table for a 2-factor Analysis of Variance on Y<sub>1</sub>: norecoverable**

Source:	df:	Sum of Squares:	Mean Square:	F-test:	P value:
document (A)	1	18.021	18.021	4.85	.0367
sex (B)	1	1.371	1.371	.369	.5488
AB	1	3.621	3.621	.975	.3326
Error	26	96.607	3.716		

There were no missing cells found.

Although males do not make greater numbers of errors, they made significantly greater numbers of attempts to recover from each error when they did ( $F=9.528$ ,  $df=1,1$ ,  $p=0.1391$ ), irrespective of document type ( $F=2.329$ ,  $df=1,1$ ,  $p=0.1391$ ) as is seen in figure 5.5.2.4.

There was no significant interaction effect ( $F=2.329$ ,  $df=1,1$ ,  $p=0.1391$ ). The anova details can be found in table 5.5.2.4 below.

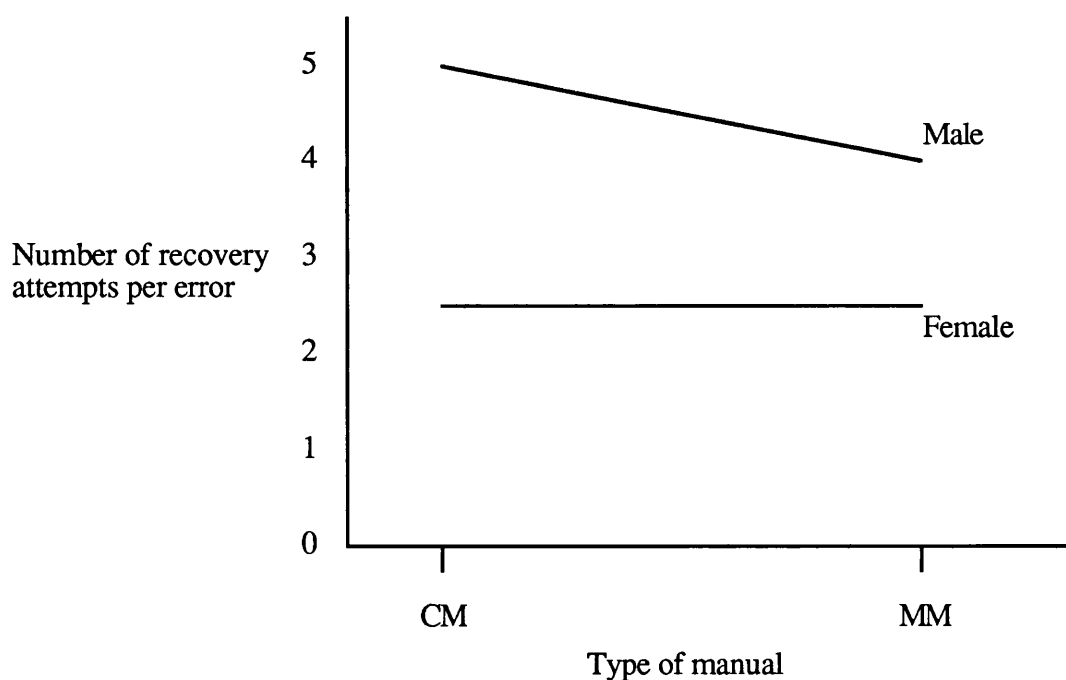
Table 5.5.2.4 2-way anova table for number of recovery attempts per error by manual type

Anova table for a 2-factor Analysis of Variance on  $Y_1$ : recovattempts

Source:	df:	Sum of Squares:	Mean Square:	F-test:	P value:
document (A)	1	4.61	4.61	2.329	.1391
sex (B)	1	18.86	18.86	9.528	.0048
AB	1	4.61	4.61	2.329	.1391
Error	26	51.464	1.979		

There were no missing cells found.

Figure 5.5.2.4 The number of recovery attempts made per error as a function of type of manual.



Females made significantly fewer recovery attempts and their recovery behaviour

was not influenced by manual type.

Referring to table 5.5.2.5 overleaf, one can see that not only did the minimal manual prove superior with respect to total time taken, the subjects using this manual also took less time to access mail ( $F=10.365$ ,  $p=0.0034$ ), less time to send a message, ( $F=12.987$ ,  $p=0.0013$ ). A sex effect was evidenced here, ( $F=4.241$ ,  $p=0.0496$ ), with females taking longer to access mail when using the conventional manual compared to the minimal manual. A significant sex by document interaction was also in evidence, ( $F=4.675$ ,  $p=0.04$ ). Those using the minimal manual were better at using the 'write' command ( $F=4.756$ ,  $p=0.0384$ ), and wasted less time before using it ( $F=20.693$ ,  $p=0.001$ ). They were quicker to create a file ( $F=22.431$ ,  $p=0.0001$ ) and a directory ( $F=38.769$ ,  $p=0.0001$ ), quicker to check whether a file had been created ( $F=11.626$ ,  $p=0.0021$ ). They were quicker to login ( $F=45.384$ ,  $p=0.0001$ ) and to logout ( $F=14.47$ ,  $p=0.0008$ ). They spent less time consulting the documentation before hands-on experience began ( $F=9.708$ ,  $p=0.0044$ ).

Table 5.5.2.5 Proportions of group using minimal or conventional manuals who completed each subtask expressed as percentages, times to complete each task in minutes

Task	Conventional	Minimal	$\chi^2$ value	Sig Diff
Consult manual				
before starting	100%	100%	10	NS
Time (mins)	1-5	< 1		<0.01
Login	93%	100%	1.034	NS
Time	10 mins	< 1		<0.01
Accessing mail	80%	100%	3.333	NS
Time	1-5	<1		<0.01
Send message	80%	93%	1.154	NS

Table 5.5.2.5 cont'd.

Time	1-5	5-10		<0.01
Use write	73%	100%	4.615	<0.05
Time	1-5	<1		<0.01
Create file	53%	93%	6.136	<0.05
Time	5-10	<1		<0.01
Create directory	73%	100%	4.615	<0.05
Time	5-10	<1		<0.01
Check file	73%	100%	4.615	<0.05
Time	1-5	<1		<0.01
Check directory	80%	93%	1.154	NS
Time	<1 min	< 1 min		NS
Logout	87%	100%	2.143	NS
Time	1- 5 mins	<1 min		<0.01

In addition to this, more subjects in the minimalist condition succeeded in using the write command (chi-square=4.615,  $p=0.0317$ ), creating a directory (chi-square=4.615,  $p=0.0317$ ), and checking whether a file had been successfully created (chi-square=4.615,  $p=0.0317$ ). Although the ability to access mail was not significantly different for the two conditions (chi-square=3.333,  $p=0.0679$ ), three individuals failed to access mail in the conventional condition whereas all subjects succeeded in the minimal condition. Chi-squares did not yield any sex differences for any of the variables mentioned in this paragraph.

### 5.5.3 Post-test semi-structured interviews

Post-test interviews revealed that subjects in the minimal manual condition were significantly more satisfied with their type of manual (chi-square=17.733,  $p=0.0001$ ), and would like to use it to learn about more advanced features of email, (chi-square=22.941,  $p=0.0001$ ). Referring to table 5.5.3 below and 5.5.3.1 overleaf, one can see how the two manuals influenced user performance on the

tasks given.

Table 5.5.3 the number of subjects in each condition (minimal or conventional) and their reported satisfaction with their respective manual types

	CM	MM	Totals
Yes	2	13	15
No	9	0	9
Don't know	4	2	6
Totals	15	15	30

Table 5.5.3.1 The number of subjects in each condition who would use their respective manual type again (CM or MM)

	CM	MM	Totals
Yes	2	15	17
No	13	0	13
Totals	15	15	30

## 5.6 DISCUSSION

### 5.6.1 The success of the 'from-scratch' guideline

The experimental hypothesis that the minimal manual would prove a more effective form of user assistance in general was borne out, lending further support to the utilisation of Carroll's guidelines when designing user documentation. The results indicated that users employing the minimal manual were able to achieve their goals much more quickly and with a consistently greater success rate than did those users who were supported by the conventional manual. It now appears that designing 'from-scratch' does not alter the efficacy of minimalist instruction, whilst providing a formal guideline to designers about where and how to obtain the information they present in their manual.

#### 5.6.1.2 "Novice users don't know what they want nor what they need" - The 'from-scratch' method disproves an oft-voiced claim.

The novice user does have a valuable role to play in designing documentation, as shown by the 'from-scratch' method. The question of naive users making ill mappings between what they expect to need to know and be able to do and what they will need to do in reality is accommodated in that a sample of the users acquainted with the problem space in hand, namely expert users (in this case using an electronic mailing system as a mode of communication) will already have mapped out the space, so that there is less freedom for misconceptualisation on the part of the novice. Negotiating the question in this way also draws upon Draper's (1985) observations on the nature of expertise, the distinguishing feature of experts is that they not only recognise the nature of their goals; they have the ability to translate these goals into action sequences thus bridging the user-system gulf between goal recognition and goal attainment. Expert advice on the appropriate action sequences leading to goal achievement should be used maximally by being gathered at the initial stages of design for input to the manual, furnishing the new

user with the necessary information he requires, so putting him in a much stronger position to execute his tasks.

The complement of novice-expert input and feedback can be considered in a top-down fashion with expert input feeding into the design process from the bottom up and novice opinion essentially serving to modify and fine-tune this at the subskill testing phase of design with attention being paid to non-command/content aspects of the manual as stated above. However, novice users should be allowed to voice their thoughts and desires in a bottom-up fashion as well, if the manual is to be properly user-centred. In this study user wishes regarding manual format, length and so on were heard at the outset, but this itself could be considered as the starting point of the design cycle.

#### 5.6.1.3 The novice and the expert - knowing their place in the user consultation process

By looking to expert opinion on rudimentary manual content and novice opinion on format/layout, the eradication of unnecessary and potentially misleading or confusing tasks, commands and information was achieved. It is postulated that expert advice be the appropriate source regarding which tasks should be included in the manual, and which commands are needed, with novice opinion being best employed in the iterative design cycle, giving feedback on the more 'cosmetic' aspects of the manual, such as layout, length, font sizes, page-turning problems etc., which are just as important as the actual manual content.

#### 5.6.2 Sex differences

Both males and females completed the tasks much faster using the minimal manual but counter-intuitively, females completed the tasks faster overall than men, although not significantly so. Fewer errors were made in the minimal manual condition but failed to differ significantly from those of the conventional manual;

this would be a pointer to an area warranting attention in future versions, but it is also interesting to note that more errors were recovered from in the minimalist condition. It would thus appear that the minimal manual was doing a better job at keeping the user on the right track through its disambiguated and pared text and content, and as a result, fewer errors were committed. Possibly the fact that the error frequency failed to be significantly less than that in the conventional condition is not an artifact of the manual's error assistance, rather it is a positive reflection on the quality of the manual as a whole.

#### 5.6.2.1 Error making and the male user

Although males displayed more active error recovery behaviour, they nonetheless failed to have a more successful recovery rate. Although males were not making greater numbers of errors, they made significantly greater numbers of attempts to recover when they did, irrespective of the type of manual they were using (minimal or conventional). Huff and Cooper (1987) observed that males tend generally to have more trouble-free interactions with computers than females. The present results highlight a fruitless expenditure of energy on error recovery. Huff and Cooper saw that male orientated software generated more anxiety in females and vice versa when interactions with the system were in public, though these results did not transfer in private. In this study the performance test was conducted in private, so this effect should have been ruled out, had the software had a sex bias. It also rules out Spielberger's (1987a) observation that highly anxious individuals engage in social comparison more than do those who have low anxiety. Other contending explanations for this are that it is a reflection of the user interface in question; the trend today is towards interfaces that are easy to understand and which foster error recovery, but it is obvious that the males in this study experienced significant difficulties in this area and it would afford closer attention. If this is a fault of the human-computer interface, it is probable that females would have experienced comparable difficulties but this was not the case. Such ineffectual behaviour is indicative of higher levels of anxiety; alternatively these individuals feel they must be capable of mastering the interface, of overcoming their errors and are less worried or affected by the possibility of making errors. They feel more able

to enjoy a closer involvement with the interface, and so they make more frequent attempts to rectify their errors. If this is the case, Cooper and Huff's observations would indeed appear to hold, with males rather than being ineffectual in their interactions, manifesting a greater propensity to interact with the computer of their own free will.

#### 5.6.2.2 Attempting a recovery

At this point it should be noted that males also made less attempts to recover from error states when using the minimal manual. This is possibly because they felt that more recovery information was to be found in the commercial manual by virtue of its size alone. When using the minimal manual they could see all the available error assistance at a glance, resign themselves to their errors and did not dig about looking for solutions in the manual. A cross-validation of this and the exact nature of these observations is necessary.

Another point needing consideration is the fact that only 33% of errors made in the minimal manual condition were recovered from whereas a greater percentage (40%) were recovered from in the conventional condition. A possible interpretation is that the conventional manual provides superior error recovery assistance, however, it is more probable that since a greater number of errors were being made when using this manual, a greater number were there to be recovered from in the first place.

#### 5.6.3 Satisfying the user by altering the manual. An examination of the changes

Variations in the observer ratings of the manual across the iterations can be accounted for. For example, version 3 was condensed to half its physical size and rotated on the page, something that was appreciated by the users as the ratings of appropriateness of manual length rose by two points, and it rose again between version 5 and 6 when size was returned to A4 portrait for version 6 after having

been condensed and rotated and double-sided for version 5 which did not get a good reception. Having to turn pages would appear to confuse and annoy the reader. General preference lay with text on a single side. The rating of the Hints sections increased between versions 4 and 5 possibly because they were able to be distinguished as such after these sections were boxed off. Hitherto they merged in with the general text. The ratings of the manual layout rose steadily, but especially between versions 4 and 5 which is attributed to the squaring off of the respective manual sections, giving a much clearer appearance to the manual from then on. As regards the ratings of how well the minimal manual compared with other commercially produced manuals, although an unequivocal graph was produced, the ratings did not at any point drop below the scale midpoint (the lowest average rating was 6) so this would be deemed acceptable. How helpful the manual was deemed to be produced just as unequivocal a graph, yet again the final iteration (version 7) received an acceptable average rating of 6, and when all the other rated dimensions were taken into consideration, the design cycle was arrested at this point. How helpful the manual is seen to be is really the summation of the other aspects measured i.e. length, layout, and so on, and thus this will depend upon these other factors.

#### 5.6.4 A word about measurement

Throughout the study repeated use was made of a number of measurement tools, which illustrates the point made in the previous chapter about the measurement dilemma. In the design stage use was made of two semi-structured interviews a feature checklist and a structured incident diary. At this stage the task in hand was an information gathering one, both of a general and a particular nature. The semi-structured interviews proved to be successful in that they put the subjects at their ease (by virtue of being semi-structured) whilst gathering the necessary information about user needs and abilities. The checklist was a more exacting technique that placed more demands on the subject in that he or she had to match commands against those he or she knew, yet this traded off against the fact that the designer stood to acquire a large corpus of invaluable data.

At the subskill stage two semi-structured interviews, a questionnaire, and a structured incident diary were employed. Again, the tailored interviews best served the job of obtaining information without having first forced the respondent into categories. In this way a vast range of responses were able to be heard and catered to. The incident diary helped to trawl for low frequency events which might otherwise have gone unnoticed or unrecorded, and so this acted as a worthwhile supplement to the other measures.

The criterion test involved a performance test and a semi-structured interview. Not only were the user performances recorded; the users were also invited to voice their feelings and opinions towards the minimal manual.

This study and the Carroll studies consider 'first time performance' when using the minimal manual, but it would be a worthwhile exercise to investigate learning and performance trends over time using both the minimal and the commercial manual.

#### 5.6.5 The propensity to act

In the light of the present findings it is now possible to reflect upon all of the minimalist design principles, and the nature of humans' natural learning and thinking tendencies. A reconsideration of the principles laid down by Carroll is perhaps necessary here. Allowing the user to get started fast on real tasks relies upon user action. It is ultimately the user who allows the manual to exert an effect upon the world. And by supporting error recognition and recovery is this not, in effect, supporting and directing user action? These questions force a consideration of the nature of thought and action, as introduced in Chapter 2.

Intuitively, acting in the world, and thinking would seem to be mutually dependent. If users are going to act anyway, perhaps it is possible to advance to a more

minimalist extreme in the construction of manuals, by providing the user with only the most essential information, which would provide him with a launchpad for action.

Thus, a new goal has been set, that is, to attempt to tease apart action and thinking such that two distinct manual forms, each with their own accompanying design principles emerges. In so doing, it should be possible to discern which manual, or at least which set of principles, if any, is more conducive to the enhancement of user performance.

**CHAPTER 6**

**EXPERIMENTAL STUDY 2**

**ANOTHER GUIDELINE FOR MANUAL DESIGN?**

**THE QUESTION OF INFORMATION FLOW**

## 6.1 SUMMARY

Chapter 5 formalised the method by which documentation designers should 'slash the verbiage' of manual content. The 'from-scratch' guideline keeps designers on the right lines regarding manual what should be included as content, and where they should get this information from. At the same time, this method allows for more user-centred participation in the design of their own material without affecting the efficacy of the manual.

A strong enough position has now been attained, from which it is possible to address one of the principal competing theories of manual design. This is the theory of information flow (Draper and Oatley, 1992). Neither Carroll nor McElhinney provide any pointers to the optimal level of explanation that should be provided to the user. This could be clarified by comparing the efficacy of the original minimal manual from the previous chapter with a manual with little or no explanation, and with no invitation to try things out - only that information which is of direct relevance to the user, for him or her to get ahead with the tasks in hand, would be provided: Differences in user performance across the two different manuals would indicate whether users need micro or meta-level information. The findings would effectively tighten the last screw on the appropriate design of minimalist documentation.

The manual which was designed in the preceding chapter was compared with a new minimal manual which was designed in a format where the instructions were presented without extra information and invitations to try things out, so that all that remained was the flow of information from page to user. This new manual was termed the procedural manual. The minimal manual which was designed in Chapter 5 was termed the exploratory manual for the purposes of this study.

This exploratory manual had been designed in such a way that users were actively encouraged to explore the system. This comes under Carroll's fifth guideline "Let The Learner Lead". The procedural manual incorporated Carroll's same first four

guidelines, but instead of encouraging active exploration on the part of the user (guideline five), an alternative principle was used. This was the principle of information flow from page to user. It was hypothesised that the procedural manual would lead to faster task completion times and to a reduction in the number of errors made by users. All explanatory information which couched the instructions in the exploratory manual were omitted in the procedural manual. On this basis, it was further hypothesised that since the exploratory manual would promote learning and the procedural one inhibit it, those subjects using the exploratory manual would show better memory for commands on a surprise recall test.

However, it was found that there were no differences in performance times between the two manuals, nor was there a significant reduction in the number of errors being made by users. There was also only a slight increase in learning by users using the exploratory minimal manual.

Thus, it would appear that supplying a flow of information alone does not serve to further facilitate interaction any more than does the active exploration principle.

## 6.2 Introduction to the experiment

It should be possible to design a minimal manual that incorporates all of Carroll's and McElhinney's design recommendations as laid out in previous chapters, but which has the added feature of inhibiting user hypothesis-testing and inference making.

### 6.2.1 How much explanation the user requires: a question of granularity

Research in natural language has shown that people, when talking or writing, generally select quantitative expressions with differing degrees of precision. The level of description employed is a function of the purpose for which the information will be used. This is also true of the level of detail of information provided in a user manual. McGinley, Sanford and Moxey (1992) saw that these variations in

granularity affect comprehension. As initially delineated by Hobbes in 1985, granularity refers to the level of detail or 'grain size' of the reference point that is being discussed. There is a hierarchy of units of varying degrees of coarseness. For example, one may say that New York is between London and Los Angeles, but not that the Empire State Building is between London and Los Angeles. Sanford quotes the example of the difference between giving a stranger directions to the underground station and describing how to best scale a rock face when actually involved in the activity. A description of how to get to the underground would be of the following nature: "Go down the street, take the first left, then go left again.". Scaling the rock face would involve: "Move your foot slightly to the right, up a fraction, pull the rope, and repitch the axe". The rock face example involves a finer, more detailed level of granularity. A pilot investigation of the scope of meaning of round numbers, non-rounds and decimalised numbers has shown that some numbers are 'rounder' than others. 'About 25' has a smaller range of potential meaning than "about 40" (Habel, 1992; Sanford and Ramsay, 1992). Habel's projected work on the effect of grain size of different natural language units on comprehension will eventually throw light on the appropriate level of description that a manual designer should optimally use. However, at this point, it is enough to realise that the grain size of explanation is influenced by the purpose for which the information is to be used. What is of particular relevance to this study is the effect of having no accompanying explanatory information, and no invitation to discover more by exploring the system.

The exploratory minimal manual, by letting the learner lead and think for himself, is more likely to promote knowledge acquisition. In the case of the procedural manual this information is readily available in the world, thus it may not be stored in memory. Resultantly, memory for action sequences will be poorer. Although both this study and the previous one are essentially concerned with fluent first time use, it is of interest to see whether the procedural manual does result in less learning (transfer of knowledge across time) when compared to the exploratory minimal manual. Prior work on minimalist documentation has not measured how well a user performs tasks after learning, but without a manual to refer to. This study is a first attempt to do this.

## 6.2.2 Hypotheses

1. It was hypothesised that there would be superior user performance when using the procedural manual, compared with the exploratory minimal manual, namely that users in this group would take less time and make less errors than those using the exploratory manual.
2. It was also hypothesised that there would be fewer errors made by subjects using the procedural manual.
3. Lastly, it was hypothesised that less "learning" (i.e. recall of commands used etc.) would occur with the group using the procedural manual.

## 6.3 METHOD

### 6.3.1 The procedural manual

The procedural manual was developed by removing the Try It! sections and additional information from the exploratory manual.

### 6.3.2 The resultant procedural manual - a review (Appendix 6.3.1)

The procedural manual delivers information to the user at the appropriate time to enable completion of the task. The intention is to make the subject follow the layout of the manual, without encouraging them to try anything which is not included in the manual, i.e. exploration should be avoided.

### 6.3.3 The exploratory minimal manual

The exploratory minimal manual (appendix 5.3.12) encouraged users to think for themselves. For a full analysis of this manual the reader is referred to chapter five.

### 6.3.4 How the two manuals differed

The differences between the two manuals is illustrated in table 6.3.4 below.

Table 6.3.4 How the two manuals differed

	Exploratory	Procedural
Less is more	Yes	Yes
Slash the verbiage	Yes	Yes
Use of real tasks	Yes	Yes
Supports error recognition and recovery	Yes	Yes
Encourages exploration	Yes	No

### 6.3.5 Subjects

35 students, ( 15male, 20 female), were used as subjects, from the faculties of social science, arts, engineering and law. None of them had ever used e-mail before. The ages of the subjects ranged from 17 to 58, with an average age of 26 years.

### 6.3.6 Procedure

Subjects in both manual groups were issued with a questionnaire enquiring about

their level of experience in using computers (appendix 6.3.6). This allowed them to be matched to the two independent groups on the basis of sex and previous experience.

It was then explained to the subjects that the experiment would take place over a two day period. The second part of the experiment would be held on the following afternoon. There were initially forty subjects available for testing, however, five failed to turn up for the second part. Day one consisted of the mail test, as seen in appendix 5.3.8.1. Day two consisted of a surprise recall test.

#### 6.3.6.1. Day one

The subjects were issued with their own copy of the manual (procedural or exploratory), and were told that their task was to learn how to use the e-mail system by working through the manual.

#### 6.3.6.2 The mail test (appendix 5.3:8.1)

The mail task required that each individual

1. Log in successfully.
2. Access his own mail.
3. Send a short message to another individual (the experimenter, who was logged in).
4. Use the 'write' command successfully.
5. Create a file and a directory.
6. Check that the file and directory were successfully created.
7. Log out successfully.

Each task was to be done in the prescribed order (above), and each task was treated as separate from each other for the purpose of clear test recording.

#### 6.3.6.3 Performance measures

A record was made of-

1. How long it took before he got started at the computer (hands-on), from the start of the training session.
2. How much time was spent consulting documentation before hands- on work started.
3. How long it took in total to achieve successful completion of the mail task
4. Whether login was successful or not, and how long it took.
5. Whether mail access was successful or not, and how long it took.
6. Whether a message was successfully sent or not, and how long it took.
7. Whether write was used successfully or not and how long it took.
8. Whether a file was successfully created or not and how long it took.
9. Whether a directory was successfully created or not, and how long it took.
10. Whether a successful check on these was made or not, and how long it took.
11. Whether the log out was successful or not, and how long it took.
12. The number of errors made.
13. The type of errors made.
14. The number of attempts made to recover from an error state.
15. How many errors were recovered from.

#### 6.3.6.4 Subjective ratings of the manuals

Each subject was issued with a post-session questionnaire (appendix 5.3.10). This required that the subject rate different aspects of the manual, such as its general helpfulness, and aesthetic aspects such as layout and length.

#### 6.3.6.5 Memory for actions

The subjects had to complete the second part of the experiment a day later. This consisted of a surprise recall test. The subjects were all given the same task sheet that they had been given the day before, and were requested to attempt each of the tasks without a manual. Their success or failure at each item was recorded. If they failed to recall how to do any one task, then they were eventually shown, and then

invited to attempt the next task.

## 6.4 Results

The results are in two sections. Section One considers the results of the performance test across manuals. Section Two deals with the ratings that the users gave to the respective manuals.

### 6.4.1 SECTION ONE: Results of the performance test

#### 6.4.1.1 Multivariate analysis of variance

A multivariate analysis of variance was initially attempted, taking into account all of the performance data from the comparison of manuals. There were however too few data points ( $n=35$ ) for 20 variables. This was not enough to estimate a covariance matrix to allow the analysis to proceed. In the light of this, the most straightforward way of analysing the data was to conduct two-sample t-tests on all of the performance data.

#### 6.4.1.2 Two sample t - tests

The following variables are the performance measures which resulted from the performance tasks which the users in each of the two groups carried out. The performance measures were measured in minutes and are as follows in table

6.4.1.2 overleaf.

Table 6.4.1.2 Comparison of performance measures between groups.

Performance measure (mins.)	Original (mean)	Exploratory (mean)	t ratio	p value
How long it took to logon	1.84	1.25	1.20	.24
How long it took to send a message	2.8	2.5	.37	.71
How long to save a message in a file	3.4	1.2	1.5	.04
How long it took to read a message	1.58	1.43	.48	.64
How long it took to look at a file	2.11	1.37	1.48	.15
How long it took to remove a file	1.31	1.25	.33	.74
How long it took to logout	1.15	1.06	.56	.58

Two sample t - tests failed to reveal any significant differences between the two groups for all of these metric variables except for the length of time it took to save a message in a file ( $t = 1.56$ ,  $p = 0.04$ ,  $df = 33$ ). Subjects using the exploratory minimal manual took longer overall. There is no clear reason for this particular variable proving to be significant. It is quite likely that this finding is more a result of the multiple testing problem (if a large enough number of tests are carried out, the chances are higher that significant difference will be found by chance). There were no differences between groups for the number of errors made, type of errors or number of recovery attempts made.

#### 6.4.2 Users' subjective opinions of the manuals. An analysis of the rating scale data.

After the criterion comparison test each user completed a questionnaire which asked for their opinion on various aspects of their manuals. The questionnaire comprised of a set of eleven point rating scales. Each user gave a rating of 0 to 10 for each aspect. The mean ratings, t ratios and significance levels are reported in table 6.4.2 below.

Table 6.4.2 Mean ratings for each group, *t* values and significance levels between group ratings

Rating scale item	Original (mean)	Exploratory (mean)	<i>t</i>	p value
How appropriate they felt the language of the manual to be	7.32	7.69	-.60	.55
How helpful the manual was seen to be	8.58	9	-1.24	.23
How easy the manual was to use	8.42	8.62	-.60	.55
The length of the manual	8.94	9	-.13	.89
The layout of the manual	8.52	7.31	2.32	0.03
How well the manual compared with other manuals	8.05	8.19	-.30	.77
The likelihood of the user wanting to use a minimal manual again	7.79	7.62	.31	.76
How educational the manual was felt to be	7.05	7.62	-.87	.39

#### 6.4.2.1 Mann-Whitney Tests

Mann-Whitney tests were also conducted as rating scale data were being dealt with. The only variable from the rating data to be rated significantly differently between groups was the layout of the manuals. ( $U = 404.5$ ,  $p = 0.0344$  (adjusted for ties),  $df = 20$ ). The average rating for the exploratory manual's layout was 9 out of ten. For the procedural manual it was 7. Although the procedural manual was given a lower rating overall, a rating of 7 is nonetheless acceptable.

#### 6.4.2.2 Two sample t - tests

To cross check, two sample t tests were additionally calculated for all of the rating scale variables, and again only the layout variable reached significance ( $t = 2.32$ ,  $p = 0.031$ ,  $df = 20$ ). The exploratory minimal manual was deemed as having a better layout.

#### 6.4.2.3 Differences in the amount of information remembered

The subjects all attempted to complete the e-mail tasks a day later, without the help of a manual. A record was made of how many users from each group remembered correctly how to log on, send a message, save a message, read a message, look at a listing of their files, remove a file, and how to log off.

Chi-square analyses conducted on the above variables showed that the two groups only differed significantly on one variable, namely the number of subjects that remembered how to logon (Chi-square = 4.804 ,  $p = 0.0284$ ,  $df = 1$ ). A significantly greater number of subjects who used the exploratory minimal manual remembered how to logon. This can be seen in table 6.4.2.3 below.

Table 6.4.2.3 The proportion of subjects in each condition who correctly remembered how to logon to e-mail

	Procedural	Original	Totals
Remembered	6	11	17
Forgot	13	5	18
Totals	19	16	35

#### 6.4.2.4 User Satisfaction

All subjects completed a questionnaire on day 2 asking them about general issues of satisfaction with their respective manuals. Firstly they were asked if they would use their type of manual again if given a choice against other available manual types. There was no significant difference between groups, (chi-square = 0.029,  $p = 0.8653$ ,  $df = 1$ ). This is seen in Table 6.4.2.4 below.

Table 6.4.2.4 The number of subjects in each group who would use their type of manual again if given a choice against other available manual types

	Procedural	Original	Totals
Yes	15	13	28
No	4	3	7
Totals	19	16	35

This questionnaire gave users the opportunity to voice their feelings about the particular manual that they themselves had used, and their opinions about documentation in general.

## 6.5 DISCUSSION

### 6.5.1 Completing the tasks

The principal finding from this experiment was that the procedural manual did not lead to faster completion times, nor to any significant reduction in the number of errors that are being made. If by facilitating interaction is simply meant facilitating fast task completion, then both styles of manual serve this objective well. It would now appear that designing a minimal manual that is devoid of accompanying information and an invitation to try things out does not affect the likelihood of the user attaining his or her goal. It merely alters the way in which the user reaches the goal. It may be that the minimal manual as designed in chapter 5 is essentially a procedural manual which has been couched in a small amount of information and Try It! sections. A stronger effect may have been found in a larger task domain - the e-mail one was quite limited (Although this was a function of the suggestions given by expert users at the outset).

### 6.5.2 The necessity of errors

Users employing the procedural manual could not in any sense be discriminated from those using the exploratory manual on the basis of the number of errors made, type of errors or number of recovery attempts made. Despite receiving a sequential flow of instruction from the manual, users were still making errors. Whether they are encouraged to explore or not, whether there exists a need for them to think for themselves, users will nonetheless explore and pay the resultant consequences of their actions. Active information seeking and hypothesis testing would appear to be an overriding and natural human propensity. It is quite possible that there may exist a ceiling effect, whereby it is impossible for the documentation designer to make user instruction any more explicit and unambiguous. Users would nonetheless persevere in thinking beyond the information given. This became clear from merely observing the users in action. One procedural manual user was consistently careless and missed out several of the steps in the manual. If one step was skipped past, then an attempt at the consequent step was foiled. Exploring, trying things

out and error making is a localised example of the larger scale human activity. In the light of this evidence, Hartson's (1991) formulation for thinking about errors comes to mind. An error not as a bad thing which is to be avoided at all costs, rather it should be seen as the user's iteration towards his goal.

Although he may resultantly find himself in intractable error states after exploring, it is not inevitable. Active exploration on his part may often turn out to be fortuitous - he may discover useful commands. However, this is more likely to be true of individuals who are using manuals for packages which employ pull-down menus, which offer several options simultaneously to the user. There is very little effort expended, as the user is en route to his current goal, whilst at the same time noticing an interesting menu option next to the one he needs. He does not need to interrupt his current activities, as he may complete what he is doing, and then go back sometime later to investigate the menu option. Some of the options available under the various menu headings in packages for the Macintosh have very attractive and curious labels which make immediate exploration irresistible. For example, "Fat Bits" in MacPaint screams out for an investigation. In this study, users were working with a command-driven interface which does not readily suggest other items or options which are available to them. In this sense, the baseline scope for exploration for both groups was relatively restrictive - if a command existed, then it was to be found in the manual. There were no serendipitous findings made as a consequence of a motor slip which resulted in the mouse selecting an unintended menu item on the screen.

### 6.5.3 Memory for actions

The principal finding from the surprise recall test was that of the five surprise items, the sole procedure that was remembered more faithfully by the exploratory manual users was how to logon to email - slightly more than two thirds of the group. Slightly less than a third of the other group (six users) managed it. So, although not a large number in themselves, those six individuals showed that an element of memory for actions is taking place as some level, some of the time, despite their not needing to memorise it. As memory for only one series of actions from this battery of action series was reliably displayed, it is possible that users may be imposing

their own structure for comprehension onto the action sequences in the procedural manual. It is possible that the amount of explanatory information provided in the exploratory manual was not of a great enough amount, or of the wrong nature to promote a significant amount of learning. It is at this juncture that the debate about the purpose of the minimal manual again holds centre stage. If the purpose of such manuals is to act as a form of tutorial which promotes learning, then more information, or an alternative form of information must be provided to the user. If the purpose is simply user action and goal attainment then both manual type suffice.

#### 6.5.4 What the users had to say

After the surprise recall test on day two, the subjects from both groups were interviewed. What they had to say was very illuminating. The general feeling, as voiced by several users, was that there was a need "to know about computers" before they felt confident enough to do anything at all. The problem possibly lies in people's perceptions of the wide-ranging applicability of computers. They know that they are in widespread use in society, and "are used for practically everything - even football". One person observed that the football score results on television had been accompanied by the IBM logo. As he astutely observed, "It doesn't take a computer to tell you it's 1-0". He then went on to voice his assumption that the computer in this case was being used for other purposes which were not obvious to him. Another user talked of the "mystique" in which all things computational are enveloped. "Everyone uses one, but I don't really know what for", although she understood what a secretary would use one for, or an accountant. (She also added that she had never seen somebody having problems when using one).

This appreciation of widespread computer usage and computer literacy may add fuel to the new user's notion that he has to be initiated into the whole process first and foremost, by reading explanations first, or by having practice sessions before any real task is attempted. Users clearly felt that by having "computer knowledge" before even approaching a computer would give them an advantage, and boost their confidence. Carroll's work on minimalist documentation showed that the minimum amount of information is sufficient to carry the user from switching on his

computer to accomplishing his task.

For one particular user this experiment was her first encounter with a computer and she was delighted with her procedural manual. "I am amazed that I managed all the exercises first time!". She also showed an element of glee in the idea that she had not had to learn or practice anything first, "I feel like a computer fraud!". The fact that she had had a successful first encounter with a computer had given her some confidence. Prior to this she had been lamenting the fact that she had had several opportunities to have hands-on computer experience, but had always shied away from it. She also went to great lengths to impress on the experimenter that she anticipated a severe amount of disablement when faced with the list of exercises. Of all the subjects interviewed in both this study and in the previous one, she seemed to have made the greatest personal gain.

#### 6.5.6 Documenting the way forward.

It is clear that stripping action sequences of their surrounding information and the encouragement to explore does not affect user performance on the dimensions measured. In the light of this study it is posited that the theory of information flow is already captured within Carroll's guidelines. Behind the minimalist guidelines lies the necessary flow of information necessary for the user to get ahead with the task in hand.

It is, as mentioned, possible that a ceiling effect may have occurred in the design of such manuals. It may be a fruitless endeavour to attempt to further the minimalist cause in the sense that the best has already been demonstrated. The evidence points to a reversion to Carroll's fifth principle for design, namely the principle of letting the user explore for himself, as it captures an aspect of manifest user activity. These findings, in addition to those of chapter 5 are discussed further in the concluding chapter of the thesis.

**PART TWO**

**INVESTIGATING USER EMOTION**

**CHAPTER SEVEN**

**THE DESIGN AND DEVELOPMENT OF A NEW  
MEASUREMENT INSTRUMENT FOR USE IN HCI**

## CHAPTER 7: THE DESIGN AND DEVELOPMENT OF A NEW MEASUREMENT INSTRUMENT FOR USE IN HCI

### 7.1 SUMMARY

As intimated in the introductory chapters, a problem facing HCI researchers is that of finding the appropriate measurement instrument for particular needs. This chapter develops a checklist of emotion and cognition which is short enough in length to be administered during interaction. By a factor analytic procedure a set of fifty two cognitions and emotion statements was reduced to the more manageable form of ten. These ten basic elements comprised the resultant feature checklist which was to be used in the experiment in the next chapter. The ten factors (elements) additionally enabled a validation of Oatley and Johnson-Laird's theory of human plans and emotions. The short-term purpose of the checklist was its eventual application in the following study (Chapter 8), which looks at emotion during interactions with computers. Its long-term purpose is the provision of a measurement instrument to other HCI researchers who choose to investigate emotion. By developing such a measurement instrument, this chapter also draws attention to the hitherto unmapped cognitive and emotional territory of the computer user.

### 7.2 The need for a checklist

Observe any computer user, especially those who are learning how to use a computer for the first time. Their faces flicker, flush and fall. They voice concern, fear and disbelief. When things go well they are sometimes even seen to cheer and clap. Computer users visibly experience a wide variety of thoughts and emotions, both pleasurable and uncomfortable. It would therefore appear to be worthwhile to design and develop a tool which would capture and measure these thoughts and emotions. Cognitive events such as thoughts and emotions can usually be retrieved upon request. As discussed chapter 3, the nature and content of emotions and thoughts can influence how one feels and behaves. As Sarason (1975) has noted, individuals under stress tend to become preoccupied, often displaying a variety of

self-defeating and interfering thoughts and feelings. Engaging in such self-defeating thoughts and feelings is likely to lead to less than optimal performance. This will further increase an already high level of emotional and behavioural dysfunction. Making explicit those thoughts and emotions which occur at the computer terminal is the obvious starting point. Statistically regrouping the principal ones together into a smaller set of 'themes' enables the design of a feature checklist. The initial mapping out of the cognitive and emotional 'territory' of the computer user, and the subsequent designing of an instrument to measure their occurrence and extremity, is likely to provide a sense of direction for further research of this nature.

It is possible that although many cognitions (thoughts) experienced within HCI are of an uncomfortable nature in the short-term, they can nonetheless be directive. This hypothesis is developed within the framework of the Oatley - Johnson-Laird Communication Theory (1987) which was explained in the introduction (Chapter 3).

As literature on the measurement of thoughts and feelings has essentially been aimed at the clinical population to date, as was discussed in the introduction, by designing a comparable feature checklist of thoughts and emotions for a non-clinical population, namely computer users, this study provides a measurement tool which can readily be administered by other HCI researchers. The measurement instrument which results from this piece of work is small enough to allow information to be gathered in an on-line manner, with the minimum amount of intrusion into the interaction between human and computer.

### 7.3 The construction of the feature checklist

The first step was to draw up a test specification showing the content areas to be covered by the checklist (Section 1 below), the objectives to be tested (2 below). Drawing on the findings of Chapter 4, the checklist was designed in the recommended 'from-scratch' method.

### 7.3.1 The goal of the checklist

The purpose of the checklist was to give an indication of those cognitions experienced when interacting with an interface, and the respective strengths of these cognitions. The goal of the design process is a checklist of dysfunctional cognitions of the type "I never was any good at this sort of thing". Each item would have an eleven-point rating scale, with five as the midpoint, indicating the extremity of the reported cognition.

#### 7.3.1.1 The content areas

The content areas covered all those cognitions and emotions experienced during an interaction with a computer.

## 7.4 Method

### 7.4.1 Think aloud protocols

Twelve computer users were approached and asked if they would mind thinking aloud whilst the experimenter observed them working. Four of these users were learning how to use Mini Tab in the Department of Statistics, the remaining eight were doing elementary Turbo Pascal programming exercises in the department of Computing Science I.T. Diploma Course. During these think-aloud sessions, a record was made of their thoughts and emotions. (It is worth noting here that some individuals, although experiencing difficulties did not at any stage mention any feelings or thoughts about what was happening.)

### 7.4.2 Semi-structured interviews

In addition to the focus groups and think-alouds, semi-structured interviews

(Appendix 7.4.2) were conducted with 33 members of the general population (age range 17-61, average age 22), which covered topics such as pleasant and unpleasant experiences with computers, the thoughts and emotions that they typically felt, and how these events compared with other stressful and non-stressful situations they experienced on a day-to-day basis. The semi-structured interview inquired about cognitions and emotions, but despite the emphasis placed on these areas, people invariably reported concomitant physiological effects. This was so common that these statements were included in the set of statements

#### 7.4.3 The focus groups

Three focus groups were conducted. On each occasion the group consisted of three males and three females from the general population, who were encouraged to talk freely and openly about their various experiences and thoughts, good and bad, about using computers. The agenda for the focus groups was the same as that for the interviews. This enabled the experimenter to amass a series of critical incidents and statements. The focus groups were recorded by video-tape, which allowed the experimenter to obtain additional comments that might otherwise have been missed.

A list of forty one statements of thoughts and emotions resulted from the think aloud sessions, focus groups and interviews, along with a smaller set of eleven physiological events. (The think-aloud protocols provided the most specific expressions). This is set out in section 7.4.4 below.

#### 7.4.4 The set of cognitions

- 1 : I feel confused
- 2 : I can't wait to leave this situation
- 3 : I know it is silly that this task affects me in this way
- 4 : I always feel like this in this sort of situation
- 5 : I do not know why I am affected in this way

- 6 : I feel that I could do this task if it were not on the computer
- 7 : I feel that I could never do this task
- 8 : This task is making me nervous
- 9 : This task is affecting me adversely
- 10 : I feel that this situation is not a true reflection of my abilities
- 11 : I would rather be somewhere else
- 12 : I feel more nervous than usual
- 13 : I feel more anxious than usual
- 14 : I feel like I am falling apart
- 15 : I feel that everything is alright
- 16 : I feel that nothing bad will happen
- 17 : I feel that everything is getting on top of me
- 18 : I feel stupid
- 19 : I have got butterflies
- 20 : I am useless at this type of thing
- 21 : I feel that I am a failure
- 22 : I feel tense
- 23 : I never was the type of person who could do this sort of task
- 24 : I feel like I am going to pieces
- 25 : I cannot concentrate on this task
- 26 : I could do this task if I had unlimited time
- 27 : I can feel my heart beating fast
- 28 : I feel uncomfortable
- 29 : I am breathing heavily
- 30 : I am hopeless at this type of thing
- 31 : I feel upset
- 32 : I have got palpitations
- 33 : I feel harrassed
- 34 : It must be me
- 35 : I don't have enough knowledge
- 36 : I feel angry
- 37 : Other people will think I am incapable
- 38 : I feel too silly to ask someone else what to do
- 39 : I feel frustrated

- 40 : I am scared of looking silly
- 41 : My mouth is dry
- 42 : I am sweating more than usual
- 43 : My mind is blank
- 44 : The task is impossible
- 45 : I am having a bad day
- 46 : If the task were something else then I could do it
- 47 : I feel involved in the task
- 48 : I know I could never do this task
- 49 : I worry about what others will think of me
- 50 : I cannot think clearly
- 51 : I feel unhappy
- 52 : I feel panicky

## 7.5 Results

The list of statements in section 7.4.4 above was reduced by factor analysis to highlight the underlying themes at work, and to make the checklist more acceptable for eventual on-line use. The use of a brief checklist is likely to maximise response rates, and minimise the number of response errors and unanswered items, thus improving the validity and reliability of any findings. Brevity also reduces the checklist completion time, and the time taken to score the results.

### 7.5.1 The factor analysis explained

Factor analysis was the chosen technique of data analysis as its aim is to simplify the description of the data, by reducing the number of necessary variables to a manageable size. It is used when dealing with a data set, rather than independent and dependent variables. Essentially, common factors are being looked for. If it is revealed, for example, that five factors are sufficient to account for all the common variance in a battery of twenty tests, then it is possible to substitute those five scores for the original twenty without sacrificing any essential information. The usual

practice is to retain from among the original tests or scores, those providing the best measures of each of the factors.

#### 7.5.1.1 Principal components versus factor analysis

In factor solutions, there are two basic types of analysis - factor analysis, and principal components analysis. A factor analysis was conducted as it allows for specific and joint factors. This takes account of unique as well as common variance, and allows for factor rotation. It is a somewhat more sophisticated technique. The principal components method calculates a factor which explains the maximum variance in all the variables. Then a second factor is calculated which explains the maximum amount of the remaining variance. Factor two cannot therefore be correlated with factor one ie. they are orthogonal. This process is continued until all the variance in the variables is explained. (Until the number of factors equals the number of variables - this means that the data set is not any smaller than it originally was).

#### 7.5.2 The present data set

The list of fifty two statements of cognition, emotion and bodily state was put into the form of a feature checklist of fifty two statements each with its own eleven point rating scale (appendix 7.5.2). This checklist was administered to thirty four computer users (21 male, 13 female) when they had problems whilst using their computer. At this point it should be noted that the checklist was excessively long, with many differently worded statements meaning the same thing. The objective of the exercise was to obtain a rating for each statement from each individual user. The resulting data matrix of raw scores was then reduced by factor analysis to produce the factor matrix.

### 7.5.2.1 The factor matrix

The factor matrix is the first stage at which information appears about which statements have common meaning. Each statement receives a "loading", on each factor. The factor loading is the correlation, in this case any one statement with a factor. The factor matrix appears in appendix 7.5.2.1.

#### 7.5.2.1.1 The rotated factor matrix

Rotation is a method of simplifying factors so that each variable tends to load highly on only one factor. Factor one was calculated to maximise the total amount of variance it could explain. In adopting this procedure, factor one may have distorted somewhat, to accommodate some of the variance of variables that are not an integral part of the factor. Rotating the factors helps correct this distortion. A varimax rotation was carried out as this maximises the tendency of each variable to load highly on only one factor. The variables are now more extreme in their loadings, thus the interpretation of results is simplified. The rotated factor matrix is in appendix 7.5.2.1.1.

#### 7.5.2.2 More on rotation

The first factor to be extracted usually correlates with some aspect of everything - the loadings are quite high with all of the variables. It was not desirable to have the first factor taking out fifty percent, and the second taking out ten percent, and for the rest to be insignificant. The matrix was rotated therefore after the first extraction. The second factor thus gives a much clearer distinction between the variables.

#### 7.5.2.3 Halting the factor extraction process: Cattell's Scree Test

Cattell's Scree Test allows the identification of the optimum number of factors which can be extracted before the intrusion of non-common variance becomes significant.

A graph of the latent roots is plotted against factor number, and the point where the curve levels out is the point at which extraction should stop. This is illustrated in appendix 7.5.2.3. For an item to qualify as a factor, it had to reach the four percent level; this is an arbitrary but standard figure which means that 73.5% of the variance was explained. All factor loadings exceeding a positive criterion level of 4% were noted, as well as all the negative loadings in excess of -4%. The cut off point in the plotted scree test occurred after ten eigenvalues. After factor ten, the factors became 'nonsense factors'. If labelled, the labels would have been too vague to represent what each factor really summarised. The factors themselves are dealt with more fully in the following section.

### 7.5.3 The factors

After rotating the factor matrix it was then possible to interpret and name the factors. The cognition and emotion statements which revealed high loadings on a certain factor were the ones of interest, and the eventual aim was to discover their common psychological processes. The more items having high loadings, the more clearly the nature of the factor may be defined. Those factors with both negative and positive loadings are called bipolar factors. They embody contrasting variable groups. This contrast of elements within a factor is instrumental in the eventual labelling of such a factor. The following sections 7.5.3.1 to 7.5.3.10 give an account of:

- a) The amount of variance explained by each factor.
- b) Which statements are loaded onto which particular factors.
- c) The strength of each of the loadings (in brackets).

---

#### 7.5.3.1 Factor 1

This factor accounted for 11.2% of the variance and had positive loadings from the following items:

46 47 52

46 I am having a bad day (.407)

47 If the task were something else then I could do it (.768)

52 I feel unhappy (.641).

There were also negative loadings from the following items:

9 12 24 40

9 This task is affecting me adversely (-.474).

12 I would rather be somewhere else (-.723).

24 I never was the type of person who could to this sort of task (-.738)

40 I feel frustrated (-.549).

The items involved in this factor relate mainly to depression, wanting to be somewhere else, having a bad day and feeling unhappy. Thus it was termed the 'bad day' factor.

#### 7.5.3.2 Factor 2

This factor accounted for 8.8% of the variance. It had heavy positive loadings from the following items:

25 45 51

25 I feel like I am going to pieces (.665).

45 The task is impossible (.845).

51 I cannot think clearly (.619).

There was a negative loading from the following item: 31

31 I am hopeless at this type of thing (-.446).

This factor was concerned with feelings of going to pieces, being confused, but of not giving up hope. It was termed "confused but not hopeless".

---

### 7.5.3.3 Factor 3

This factor accounted for 8.4% of the variance, and had positive loadings from the following items:

17 21 38

17 I feel that nothing bad will happen (.491).

21 I am useless at this type of thing (.442).

38 Other people will think I am incapable (.562).

It also had a negative loading from the following item: 13

13 I feel more nervous than usual (-.895).

This factor highlighted that this situation was a bad social reflection, but it did not lead to more anxiety than normal.

---

### 7.5.3.4 Factor 4

This factor accounted for 7.3% of the variance. There was a positive loading from the following item:

44

This factor said one thing only. "My mind is blank" (.861)

---

### 7.5.3.5 Factor 5

This factor accounted for 6.6% of the variance. There were positive loadings from the following items:

17 39 48 49

17 I feel that nothing bad will happen (.479).

39 I feel too silly to ask someone else what to do (.513).

48 I feel involved in the task (.424).

49 I know I could never do this task (.876).

There was also a negative loading item which was item: 18

18 I feel that everything is getting on top of me (-.577).

This factor indicated that everything was going along well, with feelings of involvement in the task.

#### 7.5.3.6 Factor 6

This factor accounted for 6.5% of the variance. Those items loading positively were:

8 23

8 This task is making me nervous (.785).

23 I feel tense (.476).

There were two items loading negatively onto the factor, which were:

10 51

10 I feel that this situation is not a true reflection of my abilities (-.467).

51 I cannot think clearly (-.458).

The items loading onto this factor indicated feeling tense and nervous.

#### 7.5.3.7 Factor 7

This factor accounted for 5.7% of the variance, and had two positive loadings:

39 50

39 I feel too silly to ask someone else what to do (.4).

50 I worry about what others will think of me (.878).

This was a social-reflection factor. The two positively loading items involved feelings of stupidity when asking others what to do, and of worrying about what others may think.

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#### 7.5.3.8 Factor 8

This factor accounted for 5.5% of the variance, and had only positively loading factors:

15 32 43

15 I feel like I am falling apart (.812).

32 I feel upset (.873).

43 I am sweating more than usual (.437).

This factor related to feelings of falling apart, being upset, and sweating.

---

#### 7.5.3.9 Factor 9

This factor accounted for 4.7% of the variance. Those items loading positively were:

7 28

7 I feel that I could never do this task (.583).

28 I can feel my heart beating fast (.494).

Those items loading negatively were:

19 26

19 I feel stupid (-.847).

26 I cannot concentrate on this task (-.503).

This concerned an increased heart rate, and feelings that the task is impossible.

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#### 7.5.3.10 Factor 10

This factor accounted for 3.8% of the variance.

Two items loaded positively: 29 41

29 I feel uncomfortable (.827).

41 I am scared of looking silly (.781).

No items loaded negatively.

This appeared to be a second social-reflection factor, with feelings of discomfort and fears of looking silly. It is distinct from the previous social-reflection factor, i.e. factor three, as this factor caused concern, whereas factor three indicated bad social reflection but with no accompanying anxieties.

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#### 7.5.4 Validation of the factor labels

Two independent raters each labelled the resultant factors with an appropriate 'theme' label. The correspondance between the themes of the independent raters and my own were 50% (5/10) and 60% (6/10). This was seen to be an acceptably high level of agreement between my themes and their's. Factor five proved the most difficult to label. The problem lay with the fact that item forty nine (I know that I could never do this task) loaded so highly, and it seemed to mean something different from the other items.

Out of these ten themes, as listed above in the section explaining the factors, emerged the ten most representative statements, one encompassing each theme or factor. These statements became the eventual feature checklist (appendix 7.5.4.1).

### 7.5.5 An alternative analysis: The principal components analysis

There is, however, an acceptable alternative analysis which may be applied to the data. This is a principal components analysis, which was briefly mentioned earlier in this chapter (section 7.5.1.1). A principal components analysis was conducted on the data set, but the rotation was based on only the first four factors in order to give a clearer factor solution. The unrotated and rotated matrices can be found in appendices 7.5.5 and 7.5.5.1 respectively. The factors which resulted are explained below.

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### 7.5.6 Factor One (PC analysis)

This factor had the following positively loading items: 23 26 34 35 46 47

23 I never was the type of person who could do this task (.659)

26 I could do this task if i had unlimited time (.473)

34 It must be me (.468)

35 I don't have enough knowledge (.415)

46 If the task were something else then I could do it (.813)

47 I feel involved in the task (.454)

The following items loaded negatively: 9 12 20 24 25 37 44

9 This task is affecting me adversely (-.629)

12 I feel more nervous than usual (-.657)

20 I am useless at this type of thing (-.599)

24 I feel like I am going to pieces (-.484)

25 I cannot concentrate on this task (-.455)

37 Other people will think I am incapable (-.612)

44 The task is impossible (-.454)

This factor related to feelings of depression, as did the first factor from the previous

analysis.

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#### 7.5.6.1 Factor Two (PC analysis)

This factor had the following positively loading items: 1 5 17 27 32 43

- 1 I feel confused (.505)
- 5 I do not know why I am affected in this way (.429)
- 17 I feel that everything is getting on top of me (.508)
- 27 I can feel my heart beating fast (.508)
- 32 I have got palpitations (.449)
- 43 My mind is blank (.447)

The following items loaded negatively: 45 51

- 45 I am having a bad day (-.473)
- 51 I feel unhappy (-.716)

This factor's items related mainly to feelings of confusion, of not being able to cope. This is reminiscent of Factor Two from the original factor analysis.

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#### 7.5.6.2 Factor Three (PC analysis)

This factor had the following positively loading items: 13 16 30 48 52 53

- 13 I feel more anxious than usual (.454)
- 16 I feel that nothing bad will happen (.501)
- 30 I am hopeless at this type of thing (.559)
- 48 I know I could never do this task (.474)
- 52 I feel panicky (.722)

The following items loaded negatively: 18 24 27 40

- 18 I feel stupid (-.402)

- 24 I feel like I am going to pieces (-.444)
- 27 I can feel my heart beating fast (-.518)
- 40 I am scared of looking silly (-.502)

This factor highlights feelings of panic, and not being able to cope, as did Factor Two.

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#### 7.5.6.3 Factor Four (PC analysis)

This factor had the following positively loading items: 16 18 35 42 43

- 16 I feel that nothing bad will happen (.414)
- 18 I feel stupid (.647)
- 35 I don't have enough knowledge (.584)
- 42 I am sweating more than usual (.719)
- 43 My mind is blank (.414)

The following items loaded negatively onto the factor: 2 11 39 49 50

- 2 I can't wait to leave this situation (-.622)
- 11 I would rather be somewhere else (-.477)
- 39 I feel frustrated (-.424)
- 49 I worry about what others will think of me (-.437)
- 50 I cannot think clearly (-.435)

In the initial analysis, Factor Four related to having a blank mind. This item (item 43) is also reflected in this, alternative Factor Four.

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## 7.6 DISCUSSION

In this study a large amount of statements by users were regrouped into a set of ten basic factors or dimensions covering the range of emotions and thoughts which users express when using computers. These emotions and cognitions were then accorded the form of a feature checklist which will be employed in the next study in this thesis. This feature checklist was designed to measure the occurrence and extremity of cognition and emotion. As a result, a new measurement instrument is now available to HCI researchers.

### 7.6.1 The expressed statements of thought and emotion

In the first instance a set of forty nine statements of thoughts, emotions and bodily feelings were made explicit. These were seen to be startlingly wide-ranging, from fear of looking bad in the eyes of other people, to feelings of desperation and hopelessness, to reports of having a racing heart and sweating a lot. There are a multitude of ways of saying any one thing. Of the three methods of gathering these statements (think-aloud protocols, interviews and focus groups) the most interesting and animated proved to be the three focus groups.

#### 7.6.1.1 Anecdotal evidence taken from the focus groups

This is a good point at which to relate some of the users' anecdotes and a few of the points they made during these discussion sessions.

There seem to be other situations in our daily existence that cause levels of fear that are comparable with the fear that is sometimes experienced when using a computer. One female user immediately mentioned having a fear of all types of banking transactions, and phone calls. Another related that she only really felt constantly threatened by two things - numerical calculations and using computers. One user claimed her hands shook when trying to use the computer. The only other time this

happened with regularity was when she had to make important phone calls. She felt she was receiving poor instruction in how to use a computer, and also complained that she had never been advised how to use a telephone. It would appear that for her, the worry of having to do something which had not been taught was the cause of the problem.

This led to the issue of to whom they attribute blame when things go wrong. There was a consensus of opinion that when in the early learning phase, one tends to assign blame to bad teaching. There is a lot of mystique around e.g. 'hard drive'. Users felt they really did need to have every single step explained in the early stages, with every term fully explained. As has already been shown in chapter 6, this may sometimes be desired by users, but it will not necessarily be the answer to a smooth interaction. Amongst more advanced computer users it was felt that the blame shifted from other to self. When you feel confident and know what you are doing, carelessness creeps in and causes problems which could easily be avoided. With more experience, when things go wrong, emotions such as frustration are more evident, with the blame being placed externally, i.e. with the computer. The factor analytic procedure which was eventually used, identified and grouped together all those statements which really meant the same thing.

#### 7.6.2 The question of construct validity - how well do these findings corroborate Oatley And Johnson-Laird's Theory of Human Plans?

In the introductory paragraph to this chapter reference was made to Oatley and Johnson-Laird's theory of human plans and emotions. To recap, this theory maintains that when human plans are jeopardised then emotions will occur. These emotions are seen as being of a directive nature, i.e. they force the individual to assess his present situation and consider what his next step should be.

At this point, it is interesting to note the extent to which this theory is proved in the light of this chapter's findings. Were those factors which were discovered

empirically here, also those which Oatley et al. discuss in theory? By observing and recording the utterance of cognition and emotion whilst users are operating a computer, the notion of human plans being jeopardised became very apparent. However, the precise nature of the thoughts and emotions which are thrown to light needs to be looked at in closer detail.

In general, factors one two and three are indeed relate to plans where there are problems. The biggest factor, factor one was the depression or unhappiness factor. Factor two revealed confusion, and an inability to think clearly. Factor three related to a concern about looking bad in front of other people. (This factor is distinct from the other 'social reflection' factor, factor seven, in that factor seven included a real feeling of concern about this. Factor three voices the fear, but there are no accompanying reports of feeling bad about it.). The fourth factor was to do with having a 'blank mind'.

To what extent do the factors support Oatley's basic emotions? Oatley et al.'s theory involves five basic emotions, namely happiness, sadness, fear, anger and disgust which emerge when a plan is threatened.

#### 7.6.2.1 Happiness

Although happiness did not manifest itself as a factor, it is probable this basic emotion does indeed occur when using a computer. It remains unspoken, however. Happiness is possibly an example of the human tendency to complain when things go wrong, but when things are going well, it is just accepted and taken for granted. This is also reminiscent of Piaget's (1928) complaint that parents are more likely to scold a child when he has misbehaved, than to praise him when he has behaved himself. Only one quasi-happiness factor emerged from the factor analysis. Factor five relates to events progressing satisfactorily, feelings of involvement, and having no fears that something bad will occur. So, despite Oatley's 'happiness' not emerging as a factor in this case, it may be considered unfair to state that it has not

been validated.

#### 7.6.2.2 Sadness

Oatley's 'sadness' is matched by the largest factor, the depression factor. This factor includes clear statements of unhappiness.

#### 7.6.2.3 Fear

Fear is identified through the frustration items, namely factors five, six and seven, which include items such as being too scared to ask someone what to do. However, it is spread out across these factors and thus is not a clear factor in itself.

#### 7.6.2.4 Anger

Anger is identified through the first, depression factor. The items that load onto this factor include feeling frustration when plans break down.

#### 7.6.2.5 Disgust

Disgust per se is not so common within an HCI context. In more general life plans such as those discussed in Oatley's analysis of George Elliot's "Middlemarch", disgust is seen to be a more frequent emotion. In the light of his analysis, disgust would appear to be experienced in connection with other people, and with their accompanying behaviour. The closest approximation to expressed disgust which emerges from this experimental work, is the inwardly-directed feeling of personal inadequacy and frustration which is periodically observed. It is considered to be of a slightly different nature from the disgust which is dealt with by Oatley. After the factor reduction procedure, it was seen that these statements were tantamount to feelings of frustration and fears of bad social reflection.

### 7.6.3 The relationship between thought and feeling

Whereas Oatley talks primarily in terms of emotions, the present analysis would appear to have an additional important cognitive element, i.e. an aspect which takes a secondary place to the emotions in Oatley's discussion. The strong cognitive element which is manifest in this chapter's results would indicate that emotions alone are not the sole mechanism that takes effect when a plan is foisted.

As previously mentioned, it was Schachter and Singer (1962) who first identified the concomitant relationship between cognitions and emotions. The notion that a complete emotional experience involves both physiological and cognitive elements is a basic premise of their work. They examined the effects of manipulating different cognitions in individuals who had received an injection of epinephrine. Some of their subjects were correctly informed of the drug's physical effects. Others were given incorrect information, and thus only expected numbness and a slight headache.

A third group was told nothing about the effects of the drug. They reasoned that those subjects who were injected with epinephrine, but who were not informed or were misinformed about the physical effects would be in a state of physiological arousal, but would have no appropriate cognitions to explain the arousal. The researchers suggested that these subjects would try to seek appropriate explanations for their arousal. To determine this, they provided differing environments which would provide different explanations for their arousal state. In both environments the subject waited with another person who had supposedly received the injection. In one of the conditions the other person, who was actually another experimenter, acted angrily, and in the other condition he acted euphorically. As was expected, the uninformed subjects were more influenced by the other person's behaviour than were the informed subjects. They acted more angrily or euphorically, and also reported themselves as feeling more angry or euphoric, depending on the other's behaviour. Schachter's theory is appealing as cognitive factors often do contribute to the determination of emotional experience, especially when the eliciting situation

is ambiguous or unclear. Other cognitive factors that have been associated with emotional distress include patterns of dysfunctional emotional processing (Clark and Teasdale, 1982), an increased occurrence of irrational beliefs (Nelson, 1977), self-debasing attributional patterns (Seligman, Abramson, Semmel and Von Bayer, 1979), increased negative self-statements (Hollon and Kendall, 1980) and learned helplessness deficits (Seligman, 1974, 1975).

All of the factors identified in this chapter related to the interruption of plans, which gives rise to both cognitions and emotions. In this sense it is suggested that Oatley and Johnson-Laird's theory be accepted as a general framework for considering human plans and emotions. However, for HCI research purposes, a need for a re-analysis of the general theory is called-for. This reanalysis is now possible by looking to the ten basic cognition and emotion elements which were revealed in this chapter. It is suggested that the ten factor model which has emerged serve as a "fine-tuned" version of the more general theory.

#### 7.6.4 The comparable development of the short-form of a checklist in common research use - The State-Trait Anxiety Inventory (STAI)

The State-Trait Anxiety Inventory (Spielberger, 1987a) which is used as a measure of anxiety in applied psychology research has recently been reduced to a six-item short-form in a way similar to this study (Marteau and Bekker, 1992). Marteau and Bekker chose to reduce the full form since the main drawback with the STAI is its length (forty items long). This is a barrier for some populations who are unable or unprepared to complete lengthy scales with seemingly repetitive items. Some researchers (Foa, McNally and Murdock, 1989; McNally, Foa and Donnell, 1989; Smith, Ingram and Brehm, 1983) have used a ten item STAI, these ten items are alternate anxiety-present and anxiety-absent items from the full form. Where time is a consideration, Spielberger recommends using the ten item anxiety score of the State-Trait Personality Inventory (Spielberger, 1979). None of these shortened forms had, however, been standardised. Marteau and Bekker conducted a correlational analysis to reduce the forty items to a six-item form. This short-form

offers a briefer and more acceptable scale for subjects, maintains results that are comparable to those obtained using the full form of the STAI, and remains sensitive to different degrees of anxiety.

#### 7.6.5 Cognition and emotion as the way forward?

That computer users experience a wide range and intensity of thoughts and emotions would indicate the necessity of pursuing this particular line of research. The following two experimental chapters to do this. Armed with the new measurement instrument which resulted from this chapter, chapter eight looks specifically at emotion and a correlate of emotion, facial expression. Chapter nine considers more closely how thoughts and emotions both affect human interaction with computers, and explains an experimental programme which draws on this abundant resource of cognitions.

**CHAPTER 8**

**HUMAN FACIAL EXPRESSION AND EMOTION**

**AS A WINDOW INTO HUMAN-COMPUTER**

**INTERACTION**

## **CHAPTER 8: HUMAN FACIAL EXPRESSION AND EMOTION AS A WINDOW INTO HUMAN-COMPUTER INTERACTION**

### **8.1 SUMMARY**

A checklist of emotions and cognitions having been developed in chapter 7, it was now possible to apply it in the present study. The present study draws on Ekman's and Oatley's (1987) claims that facial expression is a correlate of emotion. It is clear from the previous chapter that users have a wealth of emotional experience during interactions with computers. If facial expression acts in a similar manner within an HCI context, then it will have been proved worthy of use by researchers such as Cockshott who are developing interface agents for emotion and facial expression. To investigate this, an instrument measuring emotion was required (the checklist designed in chapter 7), and one to measure facial expression. Ekman's FACS, as introduced in chapter 4 was reduced to a 19-item form for this purpose.

30 naive computer users completed a MacPaint computer graphics task. During the task, their facial expressions were recorded on video, and their cognitions (thoughts) and state of progress were recorded, to see if any relationship exists between different types of episodes during interactions with the computer (getting stuck, making progress, and neutral episodes where nothing good and nothing bad is happening) and facial expression. The analysis of the users' facial expressions was conducted using an abridged version of Ekman and Friesen's (1978) Facial Action Coding System, and the occurrence and extremity of cognition and emotion experienced when users were stuck was measured by a checklist of cognitions previously designed and developed for this purpose.

The facial expressions which were evident during episodes of progress, episodes of getting stuck, and neutral episodes were not significantly different from one another. This was evidence against the hypothesis that by looking to facial expression it would be possible to gain a further window into what is happening during interactions. It is more probable in the light of the results that facial

expressions are acting as communicative signals in HCI, rather than as a direct correlate of emotion. This would lend weight to Mandler's hypothesis that emotion is communicative in essence, and in so doing provides some direction for the future consideration of research into the emotions.

There is one clear outcome, and that is that a range of emotions are being revealed by administration of the checklist, which would not be predicted from the facial expressions. This alone warrants an investigation of human feeling in the large sense in HCI.

## 8.2 Introduction to the experiment

### 8.2.1 Facial expression and emotion

"We would forecast that not only will study of the face be useful, but that full understanding of emotion depends upon understanding of the face"

Ekman (1973)

#### 8.2.1.2 Classifying facial movement

The face contains fifteen pairs of muscles and the orbicularis oris (surrounding the mouth) which can contract in various combinations. There is abundant neural connection between the face and the hypothalamus, a key centre for control of emotional reactions (Gellhorn, 1964). Also, the neuromuscular movements making up the facial motor system show relatively little habituation (Tomkins, 1962). The face therefore can provide rich and continuing feedback for the creation of emotional states. Accurate communication via emotional expression implies correspondence between inner feeling and expression in the target person, consistency in expression across people and situations for the same feeling, discriminability of the expressions, and the ability of the judge to feel or conceptually label the emotion visible in the target face.

### 8.2.1.2.1 Ekman's Facial Action Coding System (FACS)

In this study we use a modified form of a tool designed by Ekman (1978), was used in order to distinguish among all facial behaviour, namely FAC. The entire enface area of the face was taken into consideration, in an attempt to capitalise on Coleman's (1949) and Frois-Wittman's (1930) findings that no consistent dominance of the eyes, mouth, or removal of nose and cheeks in presentation of facial stimuli was in evidence.

FAC is constrained in that certain changes in muscle tonus are not detected; it is also limited to what humans can reliably distinguish. Facial sweating, tears and rashes are all excluded from FAC. The coding system measures only movement. It includes most of the differences in appearance which result from different muscle actions, and does not record the intensity of the facial expression.

Table 8.2.1.2.1 below shows Ekman's original Facial Action Coding System.

Table 8.2.1.2.1 Ekman's FAC: Single Action Units (AU) in the FACS

AU	Muscular Basis	Facial Action Code Name
1.	Inner Brow Raiser	Frontalis, Pars Medialis
2.	Outer Brow Raiser	Frontalis, Pars Lateralis
4.	Brow Lowerer	Depressor Glabellae; Depressor Supercilli; Corrugator
5.	Upper Lid Raiser	Levator Palpebrae Superioris
6.	Cheek Raiser	Orbicularis Oculi, Pars Orbitalis
7.	Lid Tightener	Orbicularis Oculi, Pars Palebralis
9.	Nose Wrinkler	Levator Labii Superioris, Caput Infraorbitalis
10.	Upper Lid Raiser	Levator Labii Superioris, Caput Infraorbitalis
11.	Nasolabial Fold Deepener	Zygomatic Minor
12.	Lip Corner Puller	Zygomatic Major

Table 8.2.1.2.1 (cont'd)

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13.	Cheek Puffer	Caninus
14.	Dimpler	Buccinator
15.	Lip Corner Depressor	Triangularis
16.	Lower Lip Depressor	Depressor Labii
17.	Chin Raiser	Mentalis
18.	Lip Puckerer	Incisivii Labii Superioris Incisivii Labii Inferioris
20.	Lip Stretcher	Risorius
22.	Lip Funneler	Orbicularis Oris
23.	Lip Tightener	Orbicularis Oris
24.	Lip Pressor	Orbicularis Oris
25.	Lips Part	Depressor Labii, or Relaxation of Mentalis
26.	Jaw Droop	Maseter; Temporal and Internal Pterygoid Relaxed
27.	Mouth Stretch	Pterygoids; Digastric
28.	Lip Suck	Orbicularis Oris

---

FAC was derived from an analysis of the anatomical basis of facial movement. Since every facial movement results from muscular action, a comprehensive system could be obtained by discovering how each facial muscle acts to change visible appearance. The system is constrained, however, in that it deals with what is clearly visible; there will be certain changes in muscle tonus which are not detected; it is indeed also limited to what humans can reliably distinguish. Only facial movement is considered, therefore facial sweating, tears and rashes are all excluded from FAC.

### 8.2.2 A closer look at what the facial muscles do

The frontalis muscle raises the eyebrows and forms the transverse wrinkles of the forehead. It has sometimes been referred to as the surprise muscle, but it also participates in fear and other expressions. The orbicularis oculi controls winking

and blinking, and its contraction causes 'crow's feet'. The corrugator muscle controls the frowning movement. The buccinator serves to compress the cheek, and its contraction pushes air from the mouth and it enlarges the opening of the mouth in laughter. The temporalis and masseter are used for chewing, and for lowering of the lower jaw in fear or surprise whilst the triangularis and caninus are responsible for pulling the lips backwards and upwards to show the teeth, for instance, during rage. The labii superior shape the borders of the upper lip and the orbicularis oris shapes and controls the movement of smiling, and as such is sometimes referred to as the kissing muscle.

FAC is seen by Ekman as being "complete for scoring the visible, reliably distinguishable actions of the brows, forehead and eyelids ..... FAC probably does not include all of the visible reliably distinguishable actions in the lower part of the face - the hinged jaw and the rubbery lips allow a nearly infinite number of actions". Ekman says that FAC may serve to alert the researcher in his choices, so he may be more explicit in his decisions about what to ignore in the measurement. As Ekman stated, "..... investigators may wish to selectively score only certain action units or action unit combinations in their main study." as intimated in the introduction, a reduced but nonetheless sufficiently comprehensive set of Ekman's action units was thus used as it was felt that by regrouping the action units into larger, more general groups, the facial coding system would remain sufficiently comprehensive i.e. cover the principal areas of the face, namely forehead, eyes, cheeks, mouth, and whole face in general, and the resultant analysis would be more manageable.

#### 8.2.2.1 Initial Method: The coding system

For the purpose of this study, the face was partitioned into 9 separate areas of movement, giving a total of 19 individual movements. The following 9 sections in table 8.2.2.1 incorporate all of Ekman's action units. In addition to a regrouping of Ekman's units, the action units have been renamed, to allow them to be easily understood by the reader. The regrouping of Ekman's original muscle action units is also explained in table 8.2.2.1 overleaf, in the number codes taken from table

## 8.2.1.2.1.

Table 8.2.2.1 The Reduced Facial Action Coding System

Facial area	Expressions	
1. Forehead	Frown	Brow raised
2. Eyes	Eyes widen	Eyes narrow
	Peer	
3. Mouth	Mouth open	
4. Lips	Pout	Pucker
	Pursed lips	Lip chew
	Lip lick	
5. Chin	Chin frown	
6. Head	Head shake	Head tilt
7. Face	Face screw	
8. Smile	Regular smile	Socially induced smile
9. Laugh	Regular laugh	Socially induced laugh

Table 8.2.2.1.2 below shows how the original action units were regrouped into broader facial categories, and it also shows the additional facial events that were added into the analysis. All of the original action units were thus reliably regrouped into broader semantic categories.

Table 8.2.2.1.2 The regrouping of Ekman's muscle units

Facial category	Original AUs incorporated
Frown	1, 2
Brow raised	1, 2
Eyes widen	4, 5, 10
Eyes narrow	6

Table 8.2.2.1.2 cont'd

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Peer	7
Mouth open	25, 26, 25
Pout	20, 21
Pucker	11, 18, 27
Pursed lips	12, 13, 14, 15, 16, 23
Lip chew	24
Lip lick	28
Chin frown	17
Head shake	new
Head tilt	new
Face screw	9
Regular smile	new
Socially induced smile	new
Regular laugh	new
Socially induced laugh	new

---

### 8.2.3 The expression of emotion

In emotion-eliciting circumstances we attribute causality; interacting with computers is a well-known emotion-eliciting situation, with the individual involved in the interaction either attributing the cause of plan breakdowns to the system e.g. "stupid machine", or to him/herself, as witnessed through self-deprecating remarks e.g. "I am not clever enough to use this machine". The expression of such self-deprecating remarks, indicative of underlying dysfunctional cognitions, presents the case for the development of highly interactive interfaces. These dysfunctional attitudes, if measured (both frequency and extremity), give a gauge of the extent of the gulf between the user and the computer; and are also indicative of disruptions in human plans. By recording emotion and facial expression, it would then also be possible to see if there existed any relationship between emotion and facial expression.

## 8.2.4 Hypothesis

It is hypothesised that there are different facial expressions for different types of episode in the interaction, that is progressive, getting stuck and neutral episodes.

### 8.2.4.1 Definition of the different types of episode

After the pilot study, the following categorisation of episodes resulted, which were used in the main experiment.

#### 8.2.4.1.1 Progressive Episode

A progressive episode involves an explicit advancement towards a goal. It also includes those times when they managed to unstick themselves on their own (intentionally or unintentionally), and realised that they had unstuck themselves.

#### 8.2.4.1.2 Neutral Episode

Neutral episodes are all those times time periods during the course of the user's entire session at the computer that were not classified as progressive or stuck episodes. Time spend in drawing lines, filling colours, time spent deciding what to do are typical of these neutral episodes.

#### 8.2.4.1.3 Getting stuck episode

An episode of getting stuck includes for example, attempting to write with the rubber tool, which is a fruitless endeavour, or they may do a double click on the screen with the eraser and resultantly clear the entire window. Whether accidental or intended courses of action, if the user spent more than two minutes trying to repair the situation, then that episode was classified as an episode of getting stuck.

#### 8.2.4.2 Categorisation of episodes

1. Progressive episode: the experimenter worked back from the time-slot at which occurred explicit advancement or 'unsticking' from a difficult situation for a period of one minute. This was then taken as the starting point of a progressive episode, for the analysis.
2. Getting stuck episode: the experimenter worked back for a time period of one minute from the point at which it was necessary to 'unstick' the subject from a difficult situation. Thus, by additionally taking the one minute time period to the other side of the incident, the whole two minute episode emerged.
3. Neutral episode: All remaining episodes were partitioned into sets of two minutes.

### 8.3 Method

#### 8.3.1 The pilot study

A pilot study was conducted, with a view to resolving any potentially problematic methodological issues. The subjects were 7 male and 8 female undergraduates at Glasgow University, age range (19-35).

##### 8.3.1.1 The task: A MacPaint graphics task

MacPaint is a Macintosh painting application providing a set of tools which can be used to build pictures on a page. In addition to the usual menus providing a range of file, edit and style options, MacPaint offers three permanently displayed on-screen menus providing for the selection of drawing tools, the selection of line and border widths, and the selection of "fill-in" patterns. A MacPaint graphics task was administered (appendix 8.3.1.1). None of the subjects knew how to use MacPaint, and they were reassured that it was in fact of importance that they did not know this application. This task not only ensured that there are set tasks that each user has to

do, but it also allowed for inter-subject variability, in that the subject was free to choose after a certain point what he would do. This was intended to increase the subject's motivation, as he was also informed that he could have a printout of his work if he wished. The subjects' faces were recorded on video for a maximum of 20 minutes. Whilst doing the graphics task they were encouraged to think aloud. Whenever the user got stuck, he was asked to complete the checklist of thoughts and emotions which was designed in chapter 7 (appendix 7.5.4.1). A record sheet (appendix 8.3.1.1.2) was completed, recording what the subject was doing at the point in which he got stuck, and what he said about it. Afterwards, in a debriefing session, they were shown how the task should be done, and any other points of interest were discussed.

#### 8.3.1.2 Analysis of the video data

The analysis of the facial expressions on the video tapes was done using the reduced version of Ekman's facial expressions coding system. The video tapes from the pilot study were sequentially analysed by two independent raters. The experimenter had previously sat with the independent rater, and instructed her in how to recognise and accurately code the expressions on the screen, until she was deemed able to do this, and could do it on his own. Coding sheets, one for each subject, were filled out (appendix 8.3.1.2). Whenever the rater saw one of the facial expressions appear on the screen, a check mark was made on the rating sheet for that subject, with the number on the bottom right of the screen being recorded. For example, if the rater noted a frown at point 1242 on the tape, then she would record '1242' in the space beside 'frown'.

The two resulting sets of coding sheets were then correlated, to see how much consensus of opinion/inter-rater reliability there was. For example, if rater 1 saw a frown at 1242, then did rater 2 also record the same facial expression at the same point on the tape? The correlation was expressed as percentage agreement, with the number of consensus expressions divided by the total number of recorded expressions for that subject multiplied by 100. Overall this was 75%, when a margin of +/-3 seconds around the expression was allowed, and 80% when a margin of +/-4 seconds was taken, thus the coding procedure was deemed reliable

enough to be used in the experiment proper.

### 8.3.2 The experiment proper

#### 8.3.2.1 Method

Subjects were brought to a quiet room in the Social Sciences Building at Glasgow University. Each subject was recorded for a minimum of 20 minutes, and a maximum of 35 minutes.

##### 8.3.2.1.1 Subjects

The subjects were 30 naive computer users. Subjects' ages ranged from 17 years to 45 years, with an average age of 20. There were 19 males and 11 females. Subjects' facial expressions were video taped using a Hitachi VM-300E video camera. The MacPaint task was displayed on a Macintosh SE30 computer with internal hard drive.

### 8.4 Results

The location of a facial expression within any one episode was carried out as follows. The video record of each user's face was timed, and an independent, timed record of events was recorded in a subject action record sheet (appendix 8.3.1.1.2) by the experimenter. The two records were subsequently matched, thus yielding information about the frequency of facial expression per type of incident.

#### 8.4.1 Analysis of facial expression according to episode type

Each subject's facial expressions were classified into three distinct groups, namely neutral episodes, progressive episodes and episodes of getting stuck. No significant differences were found in facial expressions as a whole between the totals of these three episode types, (Chi-square 44.221,  $p = 0.1633$ ,  $df = 36$ ). The results of this classification are in table 8.4.1 below.

Table 8.4.1 Contingency table of type of episode against facial expression

Expression	Neutral	Progress	Stuck	Totals
chin frown	1	1	0	2
frown	20	27	21	68
head shake	9	6	6	21
head tilt	1	1	1	3
laugh	11	9	11	31
lipbite/chew	9	7	6	22
narrowed eyes	1	5	0	6
face screwed	0	3	5	8
open mouth	6	7	1	14
peer	12	12	10	34
pouted lips	6	2	4	12
puckered lips	6	5	2	13
pursed lips	8	10	5	23
raised brow	10	26	26	62
smile/grin	24	33	15	72
sneer	0	2	1	3
social *	4	10	9	23
licks lips	4	10	2	16
widened eyes	1	4	2	7
Totals	133	180	127	440

\* = social laugh or smile

#### 8.4.2 Analysis of facial expressions during episodes of getting stuck

Addressing the problem from a somewhat different direction, it is possible to analyse the expressions during periods when the subject was stuck. Are they

predominantly the expressions one would expect of a frustrating experience? The frequency of occurrence of each facial expression during episodes of getting stuck was calculated, as can be seen in table 8.4.2 below.

Table 8.4.2 Frequency table of facial expressions occurring during episodes of getting stuck

Expression	Frequency	Percentage
chin frown	0	0
frown	21	16.535
head shake	6	4.724
head tilt	1	0.787
laugh	11	8.661
lip chew/bite	6	4.724
narrow eyes	0	0
face screw up	5	3.937
open mouth	1	0.787
peer	10	7.874
pouted lips	4	3.15
pucker lips	2	1.575
pursed lips	5	3.937
raised brow	26	20.472
smile/grin	15	11.811

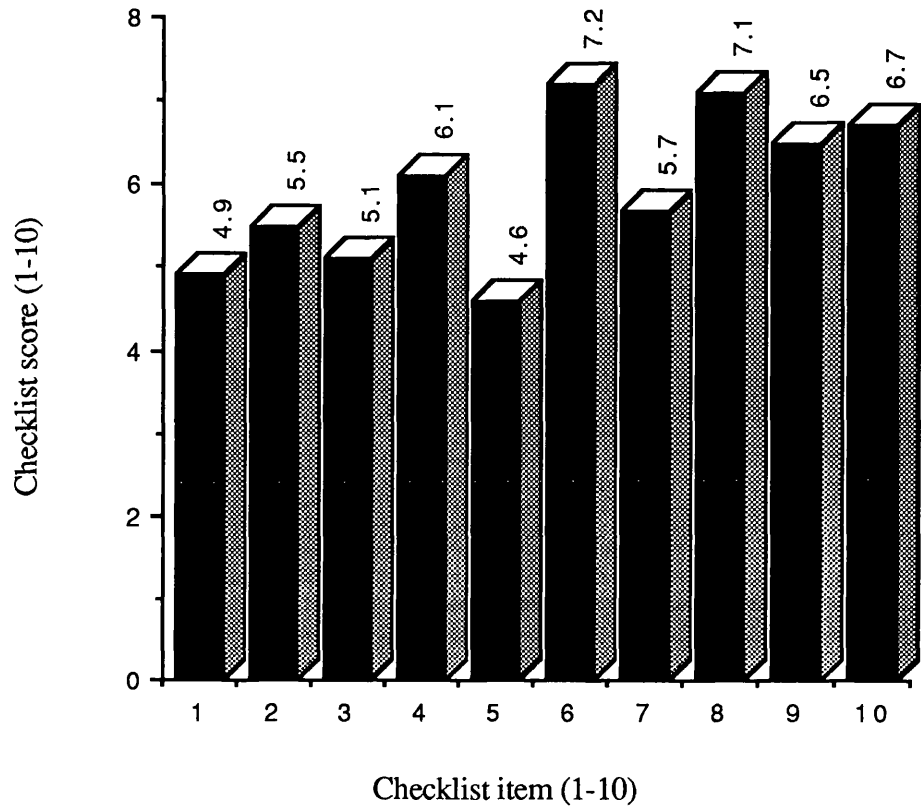
As can be seen from the above, all expressions occur during episodes of getting stuck except two, namely chin frown and narrowing of the eyes. From the literature on emotions, it is clear that not all of these expressions are what one would expect, to occur when frustrated. In particular smiling (12% of expressions), and laughing (9%) would not be predicted on the idea that these expressions were indices of inner states.

#### 8.4.3 Analysis of the checklist

Whenever a subject became stuck, they were required to complete a copy of the feature checklist which had been designed in chapter seven. To recap, this checklist

asked them about their thoughts and feelings at that particular time. The average score for each checklist item was calculated as in figure 8.4.3 below.

Figure 8.4.3 Average score for each checklist item



The checklist contained 10 items and each item had a ten-point rating scale. Each subject thus received a Total Score, by adding his or her ratings of each of the ten items together. It is clear that according to these data subjects were experiencing rather intense emotions subjectively - emotions that would not be predicted from the facial expressions.

#### 8.4.4 Most frequent expressions during episodes of getting stuck

Those facial expressions that occurred most frequently during episodes of getting stuck were tabulated for each subject. The most frequently recurrent facial expression for each episode of getting stuck for each subject was recorded. If two expressions or more occurred with equal frequency, then the facial expression which lasted for longest was taken for analysis. This can be seen in table 8.4.4.

Table 8.4.4 The frequency of occurrence of the most common facial expressions during episodes of getting stuck

<b>Expression</b>	<b>Frequency</b>
Frown	4
Peer	3
Pouted Lips	1
Pursed Lips	2
Raised Brow	4
Smile/Grin	1
Social Laugh/Smile	1

#### 8.4.5 Idiosyncratic expressions

If facial expressions were not indicative of the type of episode subjects were in (neutral, progress, stuck), perhaps they were idiosyncratic - i.e. characteristic of individuals. The more extreme facial expressions of frowning, raising brows,

pouting, smiling, and social smiling and laughing were analysed as a function of subject. This was subjected to a chi-square analysis (chi-square = 163.937,  $p = 0.0023$ ,  $df = 116$ ). Again, this analysis must be viewed as merely suggestive since not only are there observations within and between subjects, but many of the cells have zero or small values. The suggestion, however, is that facial expressions vary more with subject than with type of situation (neutral, progress, stuck).

#### 8.4.6 A regrouping of the checklist

If expressions are not directly dependent on success or failure in problem solving, perhaps they are characteristic of individuals. In a further analysis, I therefore looked at whether the predominant thoughts expressed in the checklist were associated with any characteristic facial expressions. To do this, the checklist was divided into four main themes for the purpose of a further analysis. Factor analysis was used to derive these four elements. The Varimax transformation solution revealed the following loadings, as seen in table 8.4.6 below.

Table 8.4.6 The loadings of the checklist items onto the resultant factors

	<b>Orthogonal Transformation Solution-Varimax</b>				
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
item 1	.517	.143	-.065	.625	.277
item2	.436	-.603	.493	-.105	.05
item3	-.091	-.118	.882	.041	.175
item4	.15	.536	.228	-.532	.015
item5	-.819	.004	.047	.229	.138
item6	.038	.899	.084	-.005	-.007
item7	-.083	-.067	.05	.732	-.243
item8	.327	-.016	.062	-.729	-.271
item9	-.079	-.025	.036	.003	.921
item10	.022	.293	.752	-.103	-.169

By this method, the checklist was reduced in size from 10 to 5 elements. Only positive and negative loadings of 5% or greater were taken as significant, thus four

elements (factors) emerged, since element 5 only had one loading. Element Four was not included in the subsequent analysis, as physiological aspects were not of primary concern in this study.

Theme 1: having a bad day and feeling low. (bad day dimension). (item 1).

Theme 2: Mind blank, can't think clearly. (confusion dimension). (items 4 and 6).

Theme 3: bad social reflection. (social dimension). (items 3 and 10).

Theme 4: heart rate increased (physiological dimension). (item 9).

#### Recalculating the checklist

The item scores that were relevant to each theme were added together for each subject. For example, if subject no. 1 had given a score of 6 and 8 for checklist items 4 and 6 respectively, then that particular subject's total score for Theme 2 would be 14.

#### Calculating the most common facial expression for each subjects

Using this method of calculation, each subject's highest element score (the characteristic theme) was cross tabulated with the most frequently occurring facial expressions that each subject made during his episodes of getting stuck. This was significantly different as a function of theme (confusion, social, or bad day), (chi-square = 65.294,  $p = 0.0001$ ), and can be viewed in table 8.4.6.1 overleaf.

Table 8.4.6.1. Cross-tabulations of most common facial expressions and the three main themes of thought in episodes of getting stuck

	Raised brow	Smile/grin	Frown	Social laugh	Pursed lips	Laugh	Peer	Totals
Bad day	0	3	23	0	0	0	0	26
Confusion	24	4	28	10	0	3	3	72
Social	6	0	8	6	9	0	0	29
Totals	30	7	59	16	9	3	3	127

With the reservation that the chi-square is suggestive, this would indicate that themes of thought were somewhat associated with particular expressions - in particular confusion was associated with frowning and raised brows, and concern about looking bad (social theme) with pursed lips, frowning and social laughs. When collapsed into a 2x2 contingency, as in table 8.4.6.1.1 below,  $\chi^2=20.656$ ,  $df=1$ ,  $p=0.0001$ .

Table 8.4.6.1.1 Frowning and all other expressions by bad day and social themes

	Frown	All others	Totals
Bad day	23	6	29
Social	8	21	29
Totals	31	27	68

#### 8.4.7 Sex differences on checklist scores

On comparison of checklist scores for males and females, no significant differences were reported ( $t = 0.887$  ,  $pp = 0.1913$ ,  $df = 28$ ).

### 8.5 Discussion

The main result from this study was that emotional expressions are not highly correlated with how well people are doing in their task at the computer. Facial expressions are very much the same irrespective of whether computer users are experiencing difficulties (getting stuck), are making progress, or are experiencing neither of these. This was evidence against the hypothesis that by looking to facial expression it would be possible to gain a further insight into what is happening during interactions. It would seem that facial expressions vary more according to individual subjects, than with situation type, thus contraining the feasibility of using facial expression as a form of input into computer systems.

However, it does appear that a range of emotions are being revealed by administration of the checklist, which would not be predicted from the facial expressions that were being displayed. This would lend credence to Mandler's (1962) statement, that facial muscular patterns are probably communicative in essence, and do not actually express any underlying emotion. He claims that facial expressions are fleeting, but emotions are not, placing an element of doubt upon their linkage. Although the majority of the research categorises expressions into a number of categories, namely happiness, sadness, anger, fear, disgust, surprise, Mandler states these broad semantic categories would suggest that the muscular patterns with which we are dealing are more probably communicative in purpose, rather than an expression of some underlying emotion; he holds that we cannot assume that all facial expressions have similar origins - some may be communicative, others defensive reactions.

Mandler (1962) held:

".....since it is primarily the evaluative aspect (not the arousal) that is obvious to the observer, we make the inductive leap that whenever we see or hear an evaluative expression, we are in the presence of some emotional event."

This is probably the source of the widely held belief that facial expressions must 'express' emotions. Actors can express emotions without feeling it. We can feel emotion, but not express it. Apraxia sufferers have an inability to use prosody in language - they show an inability to communicate emotions through bodily gesture - though they do not have diminished emotional experience. Thus it seems that facial expressions and emotion occur independently of one another. The externally visible facial expression is not representative of the internally occurring emotions, which were only made manifest through administration of the checklist.

#### 8.5.1 Smiling and audience effects

One of the more interesting findings of this study was that people tend to laugh more when they are stuck, and frown more when they are making progress, which would seem to be a counter-intuitive finding. It could however be argued that frowning in these cases is more a function of increased concentration in an attempt to perpetuate the progress being made, rather than a function of increased negative emotion. It also draws into question the issue of whether the HCI study is a social situation or not. If such HCI studies are indeed to be classed as social situations, due to the experimenter's presence, and due to the user's having to verbalise his every action and thought, then much more attention has to be paid to the effect of social influences upon the user. In this case, the effect it has upon facial expressions. The effect that the think-aloud technique exerts upon a task is elaborated upon in Ericsson and Simon (1984).

Laughing and smiling when experiencing difficulties has been documented by Kraut and Johnson (1979). They saw that happiness does not seem to be a necessary mediator for smiling to occur. Jones, Collins and Hong's (1991) findings which were presented in chapter 3 are also substantiated, as the amount of

socially linked laughing and smiling was approximately the same for episodes of getting stuck, as for episodes of progress, which would point to the hypothesis that this is not a function of episode type, but is more linked to the experimental situation. This would hold more with the social hypothesis of Kraut and Johnson than with a hypothesis that considered emotional expression. Indeed, Ekman (1972) saw that people often smile when experiencing an unpleasant emotion in the presence of others, but he interpreted the smile as a mask for a socially inappropriate facial expression that the emotion would cause, rather than as an appeasement display. Edgerton (1992, personal communication) suggested that laughing when stuck could be a form of sarcasm, maybe laughing at how poorly a computer has been designed.

It would seem appropriate to conclude that of all the facial expressions, smiling and laughing are the least likely contenders for fulfilling the original hypothesis, as this study and previous ones would lend more weight to the notion that such behaviours are of a social nature. This is reinforced by Argyle's (1967) view of man as a social animal. Argyle held that facial expression serves primarily as a signal to others, and from our findings, his view would appear to be substantiated.

It was also found that when the widest range of expressions were witnessed when the user was feeling generally confused, but mainly the user frowned or laughed. When concerned about looking bad in front of others, they tended to frown or laugh again. Desmond Morris in his book "Body Watching" (1985) discussed the notion of people employing frowning as a signal that warns others to stay away. In an HCI context, it could be interpreted as a signal of the form "keep back, as I am concentrating".

### 8.5.2 The user's lot is nonetheless an emotional one

A notable discovery within the study was the frequency and occurrence of emotions that was reported by users. Although there would appear to exist dubious linkage between facial expression and emotion, it would nonetheless appear that although

facial expressions do not provide evidence of underlying events, the underlying occurring emotions are a more reliable indicator. Oatley's (1987) theory of the emotions deals more with emotions in the course of longer term plans, for example in his discussion of "Middlemarch", which deals with the series of life events that occur to one woman. But it is also important to realise that emotions can mean different things to different people. For example, a failed love affair may affect one individual emotionally for a few months, whereas it may affect another for eighteen months or longer. Bearing this important time factor in mind, it could well be the case that when a computer user maintains that he is stuck, it is plausible that he will continue to consider the stuck episode after it has been resolved, and that emotions will still be felt. Indeed, when he is stuck, he may not be completely at a dead end, in that he may well be considering other potential courses of action to advance his current plan. It would appear that there is a need for a consensus of opinion in the literature of emotions about the length and nature of both emotions and plans.

### 8.5.3 Emotion, speech and gesture as input

As facial expression has not proven to be a promising subject for gaining further knowledge into what is occurring during interactions, it may nevertheless be possible to exploit further other human resources. Speech allows the user to work with a computer which is out of arm's reach or is around a corner. It carries the richness of prosody and tone, and is frequently the free channel, for example when otherwise occupied when dressing or driving a car. Gesture too is a fundamental part of human communication, but when we sit down in front of a computer, interaction through gesture ceases. Gesture is an effective element of communication; it may be faster than a key press, or than selecting from a menu.

Emotion is harder to recognise than facial expression, as it has the same constraints as has gesture. The complexity of emotion recognition depends on many factors - the number of degrees of freedom, the number of emotions to be recognised, and whether emotions are to be quantified in a discrete or continuous fashion.

Emotions are essentially dynamic, i.e. they involve movement, over time. For this reason, it would have been useful had facial expression proven to be a direct

correlate of emotion within HCI.

#### 8.5.4 The direction forward

In the light of the findings, it would seem that the resource of human facial expression is not the way forward for a deeper understanding of HCI. It appears that human emotion, and not facial expression is a more promising route forward.

In general, if all computer interfaces were easy to use, effective and satisfying, there would lessen the need to advocate gesture or speech as computer input. But the reality is that interfaces exist that are difficult to use, ineffective and unsatisfying, and as such, user input of this form may help solve some of these problems. Human-computer interfaces that recognise and respond to speech, gesture, will increase the range of application for computers, improve ease of use by increasing the diversity of choices of input, and make our interactions with computers generally more satisfying.

It now appears that the way to think about facial expression within HCI is as a form of communicative signal, and as such, more attention should be paid by researchers to Mandler's work. The fact is that there is a wealth of emotional experience occurring during human interactions with computers which nonetheless requires serious attention. The following, and last experimental chapter, continues in the effort to address emotional issues in HCI.

**CHAPTER 9**

**AN EXPERIMENTAL COGNITIVE PROGRAMME**

**FOR THE MANAGEMENT OF COMPUTER**

**ANXIETY**

"We cannot know things in themselves, we only know our interpretations of events and of ourselves."

Emmanuel Kant (1724-1804)

## **CHAPTER 9: AN EXPERIMENTAL COGNITIVE PROGRAMME FOR THE MANAGEMENT OF COMPUTER ANXIETY**

### **9.1 SUMMARY**

The principal finding that can be taken from the previous chapter was that extensive emotional activity occurs in individuals when they use computers, despite the fact that this is not reliably reflected by their facial expressions. It is possible that the correct way of addressing the issue of user distress is not by the eventual design of interface agents which respond to emotional or facial signals as had been advocated in the previous chapter. The correct method for attending to emotional activity within HCI may instead lie in the realm of coping mechanisms which manage user distress. If the user can be instructed in how to handle his or her emotional distress and anxiety, then this would preempt any need for interface agents based on emotional signals, and would also serve to facilitate interaction.

The experiment which follows examines the design of a cognitive programme for the management of computer anxiety, which was based on Beck's (1985) theory of cognition and anxiety. The anxiety management principles used in the programme are based on a type of therapy used by clinical psychologists in the national health service today, called cognitive therapy. Individuals using this programme were compared with a control group who received problem-solving assistance. This took the form of emphatic information gathering from manuals, on-line help, and asking assistance from the course instructors or demonstrators.

It was found that although individuals in both groups, experimental and control, were just as anxious after having used their respective types of anxiety management for a period of two months, users involved in the cognitive anxiety programme were awarded as many passes for their particular course, and used their computer package just as successfully for the purpose for which they had learnt it. They felt that they had benefited as much from their form of assistance as had those who were receiving the more standard form of help. This would suggest that the cognitive-

behavioural programme was as effective as, and certainly no less effective than standard methods of resolving difficult, anxiety inducing situations when learning how to use a computer.

There was, however, a significant reduction in the frequency and severity of anxiety-related physiological disturbances for both groups over time. This would suggest that it is not the form of assistance that is important to the user, rather that some form of assistance is available, or that over time familiarisation occurs. The implications of this chapter's findings and those of the previous ones are discussed in full in the next chapter.

## 9.2 Introduction to the experiment

### 9.2.1 Setting a precedent: The White Lectures

In 1991 White published four articles in two Scottish newspapers on how to manage stress and anxiety. Given the heterogeneity of thoughts, feelings and behaviours involved in stress, the articles were wide-ranging enough to encompass a range of difficulties, and were specifically aimed at drawing in those readers who may not have yet identified themselves as having a stress problem. A set of lectures based on the articles was held, and the impressions of giving the lectures were similar to running NHS group therapies.

White's project looked at the feasibility of reaching the expected large number of people in the community who are experiencing high levels of stress, and to provide them with information about their problem, and to offer advice and ways of coping with it. The number of people attending the lectures was encouraging, and their evaluation of the project was positive. These NHS clients had been on the waiting list during the time when the project ran. All found White's project useful, during the time when no help would normally be offered by the Clinical Psychology department. It provided a way of significantly increasing the number of people that can be reached while not significantly stretching the limited resources available.

White's project has shown that it is possible to impart information on anxiety and stress management to large numbers of individuals in a non-clinical context. It was with this in mind that the cognitive-behavioural programme discussed in this chapter was developed.

The issue of interest is whether the help provided by the cognitive support groups is bridging a gap between user and interface which cannot be accommodated by mere standard instruction in computing alone. The cognitive-emotional gap is possibly one of the last and most difficult gulfs between man and machine to be bridged, but is of an essential nature.

### 9.2.2 Anxiety: a descriptive definition

The aim of the programme about to be presented was to provide a variety of methods of managing, or coping with anxiety when using a computer. Anxiety is generally considered to be an emotion or state associated with the experience of fear. Whereas fear has a clearly discernable source which may be realistic in terms of the potential for a real threat to well-being or life, anxiety is a more diffuse state. It is more persistent, and its origin may not always be obvious, although it may sometimes be attributed to some event or stressor. There is no universally agreed definition of anxiety, although there is a consensus about the features of the state (Lewis, 1971). These are as follows:

(a) Anxiety is an emotional state with the subjectively experienced quality of fear.

It can range from feeling a bit uneasy to a sense of continuing dread. When in a situation where they feel calm, most people are able to accept that their fears are irrational or exaggerated, and that there is no rational basis for feeling as bad as they do. Individuals suffering from anxiety often exaggerate others' ability to cope and minimise their own ability.

(b) Anxiety is directed to the future. There is the implicit feeling that there is a threat of some kind.

Anxious symptoms include apprehension, self-consciousness, fear of losing control, lack of assertiveness, fear of failure, loss of confidence, fear of facing the day, fear of being alone, fear of making mistakes, fear of criticism, and a feeling of impending doom.

(c) There may be no recognisable threat, or one which, by reasonable standards, is out of proportion to the emotion it provokes.

The thoughts and attitudes (cognitions) in the anxiety state are related to insecurity, disaster or to appearing foolish (Snaith and Turpin, 1990). Snaith and Turpin's definition is supported by the factor solution of cognitions discovered in Chapter 7 of this thesis. Irrational thoughts which often occur automatically when an individual is anxious include "I can't think straight" and "I can't cope with this", "I'm going to make a fool of myself", "I'm looking a fool".

(d) There may be subjective bodily discomfort and manifest bodily disturbance.

The most common behaviour that accompanies anxiety is avoidance of the stressful object or situation, but individuals are also hesitant in their actions, are unable to sit at peace, have poorer performance, and take longer to complete tasks. The physiological symptoms are the wide range of somatic disturbance governed by the sympathetic outflow of the autonomic nervous system. Bodily sensations cover such feelings as chest and stomach pains, flushing, faintness, shaking, dizziness, sweating, palpitations and breathing difficulties. Hyperventilation additionally brings on muscle spasm and faintness. Clark (1986) gives a comprehensive outline of the somatic sensations that typically accompany anxiety. It should, however, be noted that a person may have marked anxious thoughts without being physiologically overaroused. Studies of this phenomenon are reviewed by Bellack and Lombardo (1984).

### 9.2.2.1 How anxiety is treated in practice

There are three principal approaches which may be used for the treatment of anxiety in current clinical practice.

#### 9.2.2.1.2 The behavioural approach

The behavioural approach to treating anxiety involves graded exposure to the aversive stimulus (Wolpe, 1982). A hierarchy of feared situations is drawn up by the therapist, and the client is gradually exposed to higher and higher levels of the hierarchy, whilst they are taught relaxation. The behavioural approach, however, does not deal directly with thoughts and emotions, and for this reason it has very little to offer a cognitive programme. Also, in more general anxiety states it is often difficult to pinpoint a specific fear from which to produce a hierarchy.

#### 9.2.2.1.3 The psychoanalytic approach

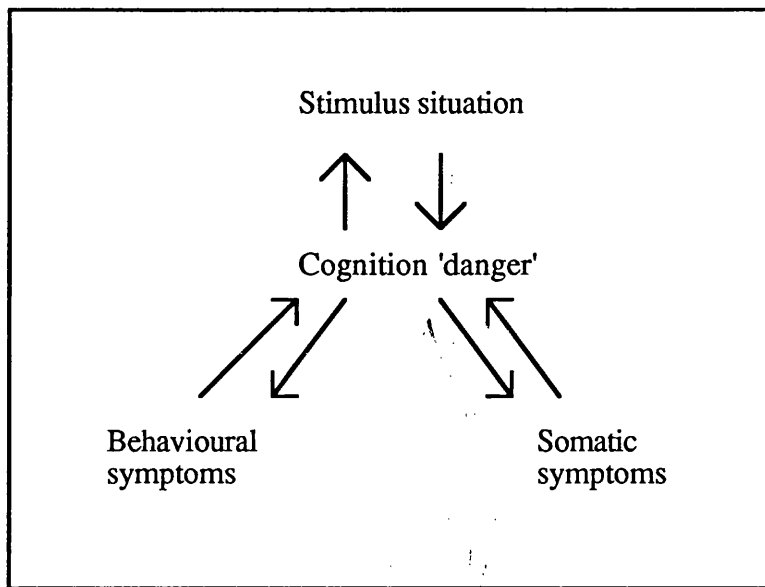
Although the psychoanalytic approach indeed deals with symbolism and inferences, there is very little patient-therapist collaboration. It is more time-expensive, and is not open to patient hypothesis-testing (Wood, 1992, personal communication).

#### 9.2.2.1.4 The cognitive approach

The cognitive approach to the management of anxiety provided the model for the anxiety management programme developed here. The cognitive approach views anxiety disorders as primarily thinking disorders (Beck, 1976; Beck and Emery, 1985). Beck suggests that cognitive structures, such as dysfunctional beliefs and assumptions, may render a person more vulnerable to depression or anxiety in the face of a stressor; that is, the stressor triggers the dysfunctional assumptions which cause a number of cognitive distortions to occur with increased frequency and intensity, which helps to precipitate a depressive or anxious episode. How a person appraises a situation, his assumptions about himself, the world and the future (Beck's 1976 negative cognitive triad) are believed to determine his vulnerability to

emotional disorders. The cognitive model of anxiety is shown in figure 9.2.2.1.4 below.

Figure 9.2.2.1.4 The cognitive model of anxiety (Clark, 1986)



One thing is clear, and that is that most coping strategies in anxiety have a cognitive component. For not only does an individual need to monitor his or her own affective state but they must also be able to discriminate anxious moods from their normal or healthy moods before any mediating actions or contingencies will be undertaken.

### 9.2.3 An outline of cognitive therapy.

The principles underlying the basis of the anxiety management programme were borrowed from what is currently the most popular (and effective) method of treating anxiety disorders in the clinical psychology profession.

This method is termed 'cognitive therapy'. Cognitive therapy is a method of therapy (Beck and Emery, 1985) based on a theory of the emotional disorders (Beck, 1967),

a body of experimental studies (Kovacs and Beck, 1978; Blackburn, 1988a) and well-defined therapy techniques (Beck et al., 1979). The term 'cognitive therapy' is used since the techniques employed are directed at changing clients' cognitions. To the extent that maladaptive thought helps to generate anxiety, cognitive therapy is a logical therapeutic approach. The hallmark of cognitive therapy is the belief that it is not the events per se which are responsible for the production of anxiety, rather it is people's interpretations of events, (Clark, 1986). As Beck (1976) stated, distorted cognitions are produced when a stressful event activates an individual's unrealistic schemata. It is the person's underlying assumptions which constitute a vulnerability to events. The ancestry of the technique can be traced back to the slave Epictetus, and the emperor, Marcus Aurelius.

Epictetus: "Men are disturbed not by things but by the views they take of them".

Marcus Aurelius: "If some external object distresses you, it is not the object itself, but your judgement of it that causes your pain. It is up to you to change your judgement."

The use of cognitive-type techniques is ever-increasing. Scott et al. (1989) discusses a selection of clinical problems and client groups whom therapists have begun to treat using cognitive therapy methods. These problems include panic attacks, agoraphobia, hypochondriasis, obsessional-compulsive disorders, eating disorders and drug abuse. Clients include cancer patients, offenders, inpatients and suicidal patients.

#### 9.2.4 Cognitive factors associated with emotional distress

At this point it is worthwhile to recap on the cognitive factors which are associated with emotional distress, as mentioned earlier in chapter 3. These include patterns of dysfunctional emotional processing (Clark and Teasdale, 1982), an increased occurrence of irrational beliefs (Nelson, 1977), self-debasing attributional patterns, (Seligman, Abramson, Semmel and Von Bayer, 1979), increased negative self-statements (Hollon and Kendall, 1980), and learned helplessness deficits (Seligman,

1974, 1975).

The interpretations and feelings that one has, have consequences for subsequent events and behaviour, therefore care must be taken to ensure that the cognitive therapy undertaken is longitudinal as well as cross-sectional. 'Bare facts' as they stand are of little use to the therapist. What the cognitive therapist requires are the client's interpretations and feelings.

#### 9.2.5 Meichenbaum's guidelines for designing an anxiety management programme

In 1988 Meichenbaum suggested the following guidelines which should be adhered to in the development and implementation of an anxiety management programme.

- (a) Be frank and open with clients about what is and what is not known. The trainer must not regard himself as knowing all the answers, rather he is a collaborator.
- (b) The clients should be enlisted as collaborators in determining the most useful coping approaches. This approach reduces the likelihood of client resistance and increases the likelihood that they will stick to the programme. As Mahoney (1977) suggests, such collaboration encourages subjects to adopt a "personal scientist" orientation. Subjects can be encouraged to perform "personal experiments" in order to determine the adaptive value of specific coping procedures.
- (c) Be flexible in individually tailoring the coping training programme to clients' specific situations and capabilities. As Lazarus (1981) noted, coping is a constellation of many acts that stretch over time and undergo change. What could be a useful coping technique at one time might not be as useful at another time.

### 9.2.5.1 The cognitive principles which were used in the anxiety management programme

The core techniques of cognitive therapy are as follows overleaf:

- (a) Eliciting the client's thoughts, feelings and interpretations of events;
- (b) Gathering evidence with the client for or against such interpretations;
- (c) Setting up personal experiments (homework) to test the validity of the interpretations and to gather more data for discussion.

To accomplish these objectives, the trainer must focus on the here and now. The first step is called "thought catching". This is designed to help stressed clients become aware of the automatic thoughts, images and accompanying feelings they have when they are anxious. The cognitive approach holds that there exist certain standard errors in thinking, which lead to negative automatic thoughts. These are as follows:

- (a) Black and white thinking: "If I cannot work this computer I will fail the whole course".
- (b) Overgeneralisation: "I found it impossible to learn Object Logo, so it'll be just the same with INGRES".
- (c) Exaggerating: "Every single step I take seems to be wrong".
- (d) Catastrophising: "If I press the wrong key something damaging or irreversible will happen".

These automatic thoughts provide interpretation of events, and often include predictions about situations. They can occur outside a person's awareness. When individuals do notice them, they are usually viewed as indisputable facts. The objective of this exercise in increased self-awareness is to help individuals realise that their thoughts and conclusions are often inferences, not facts, and that the way they process information is fallible and subject to cognitive distortion. An example of an automatic thought would be "Everything I do turns out badly". For a review of automatic cognitions, see chapter 7 of this thesis.

As the trainer probes for the meanings of such thoughts, the client begins to question the validity of his conclusions. In this way the automatic thoughts become hypotheses which can be tested, rather than indisputable facts. To accomplish these tasks, a number of techniques are used. The first technique is to hold an interview, as a means of having individuals attend to such automatic thoughts. The interview items include issues such as what he thinks is going to happen, how does he know it will happen, what is the evidence, and how serious it is. The trainer must listen for the words 'should', 'must', 'always' and 'never'. The full agenda which was used for this interview is in appendix 9.2.5.1. After the interview, the trainer can take one of three courses of action, which are as follows:

- (a) He may choose not to respond, and thus not interrupt the person.
- (b) He may focus on the content of what is being said, highlighting a few of the words mentioned earlier in the person's statement. For example, "You *never* manage to do it?". This is designed to make the subject aware of the unequivocal nature of his thinking.
- (c) He may choose to explore the impact of the thoughts on how the individual feels and behaves. For example, he may ask, "How do you feel when you say, 'I'll never be able to do this'?".

The trainer has to repeat this process several times before the person is able to spontaneously engage in self-inquiry of this nature. In this way, the subjects gradually develop a sense of "learned resourcefulness". To help subjects monitor, rationalise and decatastrophise their thoughts they kept a form of diary which should be completed each time they felt anxious. This diary appears in appendix 9.2.5.1.1. The diary invites the individual to describe the situation, the emotion that he or she is feeling, and the automatic thoughts that are occurring. They are then invited to write down what would be a rational response in the circumstances, and then in the light of this, reevaluate their belief in the automatic thought.

### 9.2.6 Advice sought from practicing clinical psychologists

In October 1991 the feasibility of carrying out a study of this nature was discussed with Dr. I. M. Blackburn, top-grade chartered clinical psychologist at the Royal Edinburgh Hospital, and Mr. J. McGovern, basic grade chartered clinical psychologist at Stobhill Hospital, Glasgow. Both individuals gave advice on the choice of measurement instruments available, the experimental design, and the problems often encountered when using cognitive techniques.

In addition, discussions took place every fortnight during the course of the study with two basic grade psychologists, Miss G. Anderson, and Miss V. Wood, both based at Gartnavel Hospital, Glasgow. The complete set of course material which was used for the Master of Applied Science Postgraduate degree course at Glasgow University (1990-1992) was made available to the experimenter. This included comprehensive information on anxiety and cognitive practice. Miss V. Wood coached me in the basic principles of cognitive therapy and in the administration and scoring of the questionnaires which would be used in the study.

In practise, it is generally recommended that between 15 and 22 hourly sessions be held for the efficacy of cognitive therapy techniques to be manifest, and they should optimally extend over a 3 month period. Therefore each group, experimental and control, met twice a week between November and February. However, it is worth noting that in clinical practice the condition of a patient receiving therapy can deteriorate after therapy, improve, or remain the same (Blackburn, personal communication, 1991). For the purposes of this experiment, it was hypothesised that those individuals using cognitive principles would have a reduction in anxiety over the period for which the programme ran.

### 9.3 Method

Introductory computing courses are offered at the university computing service centre. These courses cover word processing, statistical data analysis, expert

systems packages and spreadsheets. There are also annual introductory computer courses for postgraduate students who will be required to use computer tools as a necessary component of their research.

At the first two meetings of each of these computing courses, the project was explained as a series of workshop-type sessions which were aimed at helping people to handle difficulties when interacting with computers. A sheet was passed around, inviting individuals to "sign on" to the project if they thought that they could benefit from a programme which would offer additional help, or if they believed they already had a problem.

Both the control group and the experimental group received standard instruction in the computing package they had to learn for their course. These packages included MiniTab, BMDP, SPSSpc+, WORD, INGRES and Statistica. The instruction took the form of taught labs/classes, where set exercises had to be completed every week. A tutor or lab demonstrator was available at these labs, to answer any queries the students might have.

From these classes, 33 people were interested in attending the support sessions. The group initially met in an empty lecture theatre in the Social Science building of Glasgow University. At this meeting the group of individuals was sub-divided into two separate groups, on a random allocation basis once the individuals had been assessed for state-trait anxiety. Equal numbers of state and trait anxious individuals were in both groups. In addition the subjects were randomly allocated into experimental or control groups on the basis of the type of computer package they were using.

### 9.3.1 Subjects

The subjects came from a variety of backgrounds: Social Science, Arts, Psychological Medicine, Psychology, History, Cell Biology and Biochemistry. There were 19 males and 14 females, with a mean age of 22 (range= 20-33).

### 9.3.1.1 Initial Screening

Cattell and Scheier (1961) identified over 120 instruments which purported to measure anxiety. The number has undoubtedly increased over the last thirty years. For simplicity's sake, the instruments chosen to measure anxiety here are synonymous with those currently used in clinical practice in Britain. Following discussions with Dr. I. Blackburn of the Royal Hospital, Edinburgh, and Mr J. McGovern, Basic Grade Psychologist at Stobhill Hospital in Glasgow, it was concluded that the following anxiety measurement scales would be of most use:

#### 9.3.1.1.1 The HAD Scale (Hospital Anxiety and Depression Scale, appendix 9.3.1.1.1), (Zigmond and Snaith, 1983)

The HAD scale was designed for use in non-psychiatric hospital departments as a screen for the existence of anxiety and depression. The sub-scales are each composed of seven items and each item is rated on a four-point scale. The anxiety scale is composed as follows:

- (a) I feel tense or wound up;
- (b) I get a sort of frightened feeling as if something awful is about to happen;
- (c) Worrying thoughts go through my mind;
- (d) I can sit at ease and feel relaxed;
- (e) I get a sort of frightened feeling like butterflies in my stomach;
- (f) I feel restless as if I have to be on the move; and
- (g) I get sudden feelings of panic.

The ability of the HAD scale to distinguish between depression and anxiety has been validated by Hicks and Jenkins (1988). Due to the scale's non-psychiatric applicability, it enabled the volunteer subjects to be screened for depression and anxiety, and on this basis be matched equally to the two groups, experimental and control. It was seen, however, that all subjects reached "caseness" on the anxiety scale, and only three reached depression caseness. It is a consistently expressed complaint that the HAD has its "caseness inclusion score" set at too low a value to be of any real worth. (Despite this, it should nonetheless be noted that student

populations do tend to reliably score highly on the HAD anxiety items.).

#### 9.3.1.1.2 The Spielberger State-Trait Anxiety Inventory (STAI)

The STAI was administered to all members of both groups whilst they were involved in a computer task. The STAI allowed the experimenter to identify those users who were by nature anxious i.e. those displaying trait anxiety, and those who are anxious in specific situations i.e. were state anxious. The appropriate norm chart for this subject sample was the College Norm. The STAI is in appendix 9.3.1.1.2. The analysis and results of the STAI are detailed below.

The initial raw scores from the STAI's were compared against the norms for male and female students. Each subject thus received a percentile rank and a standard score for both their state and trait raw scores. The percentile rank score for each subject communicates the percentage of individuals in this population i.e. students, who receive this score or under. The standard score (t score) refers to the t distribution, thus 50 is the mean, with a standard deviation of 10.

For example: Subject 1 (Female) had a raw state score of 39. This means a state percentile rank of 58%. Her trait score of 32 resulted in a percentile of 25%. This score of 39 is a state standard score of 50 and the trait score of 32 is a standard score of 42. The t norm is 50; neither the state nor the trait score in this case is above average. Therefore this subject appeared to manifest neither state nor trait anxiety. In addition to looking to see whether the scores are above average, if any one person's state and trait scores differed from each other by more than one standard deviation (10 units), this was taken to signify the existence of either a high state or a high trait score present.

To reduce the subject error, attempts were made to make the groups broadly comparable for state and trait anxiety. However, this was not treated as a totally matched groups design. 18 subjects from a group of 33 were classifiable using this method. These subjects were matched for state/traitness and sex and were assigned

to the two groups on this basis. The remainder were matched for sex. A chi-square analysis revealed that there existed no significant difference for state-traitness across the two conditions, (chi-square = 0.259,  $p = 0.8786$ ,  $df = 2$ ). Table 9.3.1.1.2 overleaf shows the number of state anxious and trait anxious individuals who were in each group.

Table 9.3.1.1.2 The number of state anxious and trait anxious individuals who were in each group

	Experimental	Control	Totals
State anxious	4	5	9
Trait anxious	5	4	9
Neither	7	8	15
Totals	16	17	33

### 9.3.2 The cognitive support session: the experimental (cognitive therapy) group

The group met twice a week (Monday and Wednesday) at 5 o'clock in an available room in the Social Sciences Building. This time of day suited most individuals, as it did not coincide with classes. It also seemed to be a time of day at which some people are in a mood which seems conducive to reflecting upon events.

At the outset of the sessions, the goals to be achieved were identified. It was explained that each session was intended to be problem-oriented, with the aim of solving presenting problems. It was essential that each individual understood about the cognitive model and how it works. The following section outlines the form that this explanation took. The source of this information came from White's (1991) treatment manual which was based upon Beck's (1979) treatment manual.

### 9.3.2.1 The explanation of the workshops at the initial session

(a) Information was provided about the cognitive model, anxiety and how the body reacts to stress. This led onto the issue of progressive muscle relaxation.

Relaxation tapes that are used with individuals at The Royal Scottish National Hospital, Larbert, Leverndale Hospital and Glasgow's Southern General Hospital were available on loan to members attending the support group, with instructions on how to use them. To the extent that physiological activation plays a role in anxiety generation and maintenance, relaxation tapes are applicable.

(b) An introduction to identifying your anxious thoughts. It can be difficult to identify negative thoughts in anxiety for the three reasons given below (Clark, 1984).

(a) State-dependent memory: (Clark and Teasdale, 1982, 1985; Teasdale, 1983) makes it hard for them to access the cognitions associated with previous anxiety states.

(b) Cognitive avoidance: several forms of cognitive avoidance seem to occur; often you have a brief image or thought related to a disastrous event, become distressed and then quickly attempt to avoid the thought or image thus preventing the detailed processing of the thought, thus it is hard for the individual to become aware of the exact nature of anxiety-related cognitions.

(c) The fleeting and bizarre nature of anxious cognitions - images that trigger strong anxious reactions can be very brief (less than 1 second).

Time and opportunity was allowed for open discussion of these points. An explanation of Beck's following identification methods followed:

(a) Blackboard technique: thoughts put on a board are less frightening, and serve to provoke other thoughts. Often the last written thought is the most frightening.

(b) Imagery techniques: the person relives the experience by imagery.

(c) Exposure: the person is encouraged to identify the cognitions whilst he is exposed to them.

(d) Challenging your anxious thoughts.

Here you can think of all the thoughts you may have had instead of the automatic thoughts. The way you thought about the situation is only one of a number of possible interpretations. This will let you see the errors in your thinking, which fall into the categories of:

- (a) Black and white thinking
- (b) Overgeneralisation- if I fail once, I will always fail
- (c) Ignoring the positive
- (d) Exaggerating
- (e) Catastrophising- assuming that the worse possible thing is bound to happen.
- (f) Jumping to conclusions
- (g) "Should" statements- this refers to automatic thoughts that cause excessive anxiety or guilt because they inappropriately include the words 'should' or 'must'. We can have such thoughts when we try to live by personal rules or standards that are actually overdemanding or unrealistic.
- (e) Learning to substitute rational responses for the automatic thoughts. Instead of automatically responding to situations with negative thoughts, you will learn to respond to situations in more reasonable ways. If you begin to appreciate that the experience of acute anxiety is always limited in time, you will learn to control anxiety by not over-reacting to the symptoms.
- (f) Modifying any underlying assumptions you may have that made you vulnerable to being anxious. Modifying the ways you tend to look at yourself and the world.

### 9.3.3 The control group support sessions - a problem solving programme

The additional sessions attended by the control group took the form of computer advice sessions. These sessions were held as often as those for the experimental group. The aim of these sessions was to provide practical 'tips' and a problem-solving orientation towards helping users interact with their package. To this end, manuals, help and advice sheets and computer pamphlets were obtained from the Computer Services Department at Glasgow University. Emphasis was placed on the

fact that these forms of assistance were readily available and that they were there to be used. This form of information was obtained for all of the computer packages the users were being expected to learn to use. It was discovered that the Statistika manual was already available to and was being used by students in the sample. In addition to being able to easily access this written information during these sessions, the experimenter could offer explanations about "how a computer works". This entailed such details as what a mainframe is and how it operates, file and directory structure, explanation of menu options, and explanation of some statistical terms. It included advice such as short-cuts, or keypress alternatives for menu choices. It also involved for example, in SPSSpc+, the entire backup procedure by keypress as an alternative to by menu selection, which is a much easier and quicker method of backing up. These support sessions, rather than providing cognitive support to the users, provided direct behavioural routes to solving problems. Most current teaching methods have a problem-solving orientation, and the techniques used for the control group served to highlight this. Members of both groups were additionally able to get in touch with the experimenter by telephone whenever they wanted.

### 9.3.3.1 Administration of the scales

At the first meeting of the group, the HAD and STAI were administered. Table 9.3.1.1 shows the split-half reliability coefficients for the two parts of the STAI test.

<b>Corr. Coeff. X<sub>1</sub>: oddtraittotal Y<sub>1</sub>: even trait total</b>			
<b>Count:</b>	<b>Covariance:</b>	<b>Correlation:</b>	<b>R-squared:</b>
33	12.849	.543	.295

<b>Corr. Coeff. X<sub>1</sub>: odd state total Y<sub>1</sub>: evenstate total</b>			
<b>Count:</b>	<b>Covariance:</b>	<b>Correlation:</b>	<b>R-squared:</b>
33	14.936	.559	.312

## 9.4 Results

Table 9.4 shows the STAI trait anxiety - sten scores for both groups, experimental and control.

Table 9.4 STAI sten scores at outset

	Mean	St.Dev	Std.Error	Variance	Range
Experimental	45.5	10.047	2.512	100.933	37 (28-65)
Control	40.235	6.17	1.496	38.066	26 (25-51)

### 9.4.1 Outcome measures

The STAI was readministered to all participants after a period of three months. It was of particular interest to see if there was a reduction in the number of subjects who had at the outset displayed trait anxiety. Table 9.4.1 overleaf shows the number of subjects in each group who were state and trait anxious.

Table 9.4.1 The number of subjects in each group who were state anxious and trait anxious

	Experimental	Control	Totals
State anxious	2	5	7
Trait anxious	3	1	4
Neither	11	11	22
Totals	16	17	33

There was no significant difference between the two groups, experimental and control ( $\chi^2 = 2.257$ ,  $df=2$ ,  $p = 0.3234$ ). Thus it would appear that the cognitive

programme did not reduce trait anxiety any more than the control programme.

The design was a two-factor anova with a between groups factor and with repeated measures on the before and after factors of STAI and MSPQ scores. The dependent variable was raw percentile scores.

#### 9.4.1.1 Repeated measures anovas

The independent samples analysis revealed that there were no between group differences as a function of percentile state scores which made up the state scores ( $F = 0.132$ ,  $df=1,31$ ,  $p = 0.7184$ ). On the repeated measures factor there was no reduction in the scores over time ( $F = 0.001$ ,  $df=1,31$ ,  $p = 0.9728$ ), nor any interaction, ( $F = 0.23$ ,  $df=1,31$ ,  $p = 0.6346$ ). This can be seen from figure 9.4.1.1 and table 9.4.1.1 below. There was no significant difference in these scores before the programmes commenced.

Table 9.4.1.1 F table for 2x2 mixed anova for percentile state scores.

**Anova table for a 2-factor repeated measures Anova.**

Source:	df:	Sum of Squares:	Mean Square:	F-test:	P value:
Group (A)	1	177.884	177.884	.132	.7184
subjects w. groups	31	41645.601	1343.406		
Repeated Measure (B)	1	.061	.061	.001	.9728
AB	1	11.838	11.838	.23	.6346
B x subjects w. groups	31	1593.101	51.39		

There were no missing cells found.

Figure 9.4.1.1 The percentile state scores of both groups, experimental and control, as a function of time (before and after)

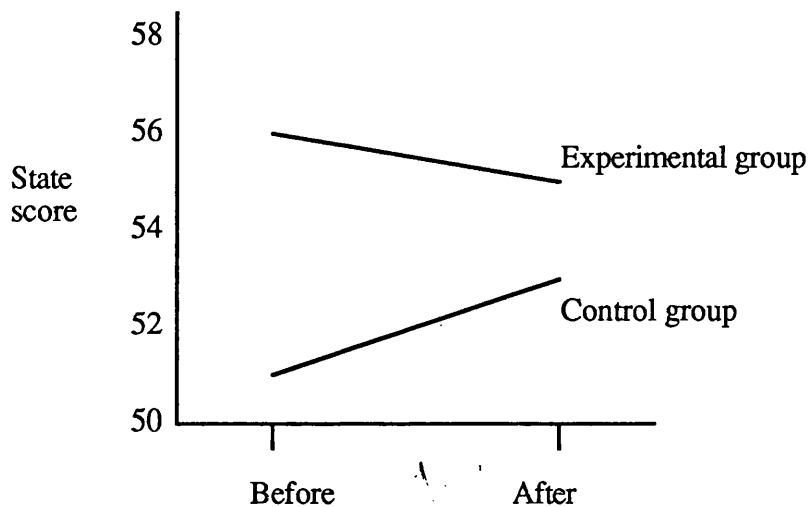


Table 9.4.1.1.1 STAI state sten scores at outset and at outcome

	Mean	St.Dev	Std.Error	Variance	Range
Exper before	38.562	8.189	2.047	67.062	30 (27-57)
Exper after	38.375	9.57	2.392	91.583	34 (26-60)
Control before	37.471	10.168	2.466	103.39	39 (23-62)
Control after	37.412	9.281	2.251	86.132	36 (24-60)

#### 9.4.1.2 Percentile trait scores

The independent samples analysis revealed that there were no between group differences as a function of percentile trait scores ( $F = 0.454$ ,  $df=1,31$ ,  $p = 0.5056$ ).

The repeated measures analysis showed that there was no reduction in the scores

over time ( $F = 0.41$ ,  $df=1,31$ ,  $p = 0.5268$ ), nor was there any interaction, ( $F = 0.18$ ,  $df=1,31$ ,  $p = 0.8936$ ). This can be seen from figure 9.4.1.2 and from table 9.4.1.2.

Figure 9.4.1.2 : percentile trait scores before and after the programmes as a function of group differences

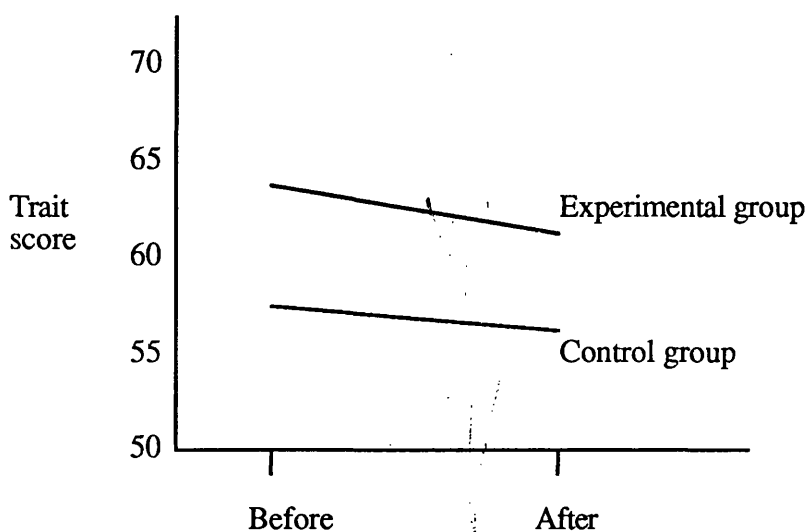


Table 9.4.1.2 F table for a 2x2 anova for percentile trait scores.

**Anova table for a 2-factor repeated measures Anova.**

Source:	df:	Sum of Squares:	Mean Square:	F-test:	P value:
Group (A)	1	604.414	604.414	.454	.5056
subjects w. groups	31	41297.404	1332.174		
Repeated Measure (B)	1	56.379	56.379	.41	.5268
AB	1	2.504	2.504	.018	.8936
B x subjects w. groups	31	4265.618	137.601		

There were no missing cells found.

#### 9.4.1.3 Reported physiological disturbances.

After the first two weeks of the computing classes, a further questionnaire was administered to the two groups, namely the MSPQ. These allows an examination of

episodes of physiological distress. The MSPQ administered again to all subjects in the last session of both groups, to monitor any changes in reported physiological distress that may have occurred as a result of the support that was given over the weeks. The MSPQ can be found in appendix 9.4.1.3. The MSPQ was administered in week three of the experiment, and then, for a second time three months later, at the end of the experiment. Table 9.4.1.3 below shows the MSPQ sten scores at the outset and at the outcome of the experiment.

Table 9.4.1.3 MSPQ sten scores at outset and at outcome

	Mean	St.Dev	Std.Error	Variance	Range
Exper before	17.5	7.501	1.875	56.267	23 (7-30)
Exper after	8.875	4.47	1.118	19.983	15 (1-16)
Control before	14	6.354	1.541	40.375	22 (4-26)
Control after	8.176	3.34	.81	11.154	11 (2-13)

A mixed effect anova was conducted. It was found that there was a significant repeated measure effect ( $F = 56.48$ ,  $df=1,31$ ,  $p = 0.0001$ ), with both groups showing a significant reduction in reported physiological disturbance. There was no significant difference between the two groups, ( $F = 1.5$ ,  $df=1,31$ ,  $p = 0.2299$ ). There was no interaction effect, ( $F = 2.147$ ,  $df=1,31$ ,  $p = 0.153$ ). The results of this anova are presented in figure 9.4.1.3 and in table 9.4.1.3.1 overleaf.

Figure 9.4.1.3 The MSPQ (physiological) scores for each group, experimental and control, before and after the programmes

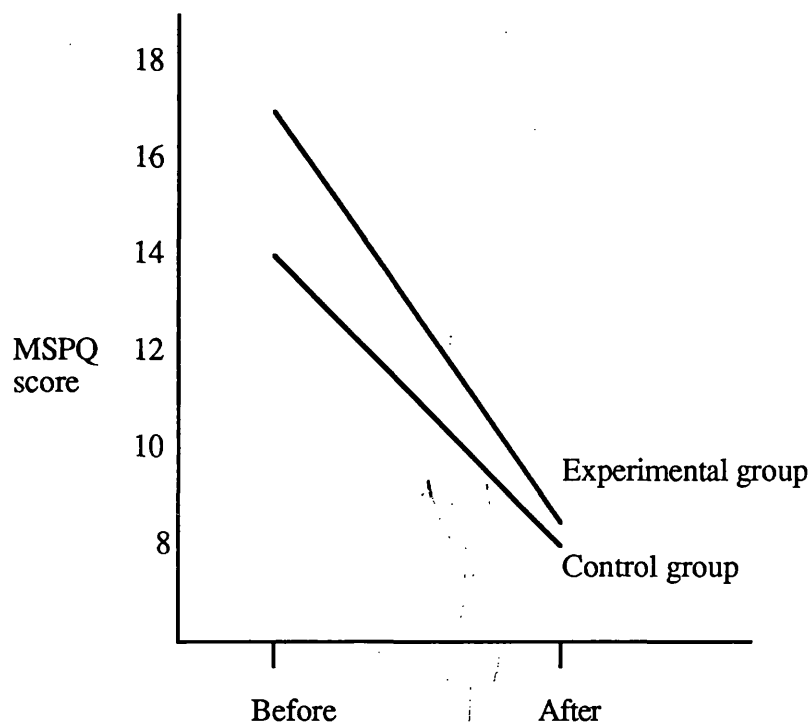


Table 9.4.1.3.1 F table for a 2x2 anova for MSPQ scores.

**Anova table for a 2-factor repeated measures Anova.**

Source:	df:	Sum of Squares:	Mean Square:	F-test:	P value:
group (A)	1	72.647	72.647	1.5	.2299
subjects w. groups	31	1501.11	48.423		
Repeated Measure (B)	1	851.045	851.045	56.48	.0001
AB	1	32.344	32.344	2.147	.153
B x subjects w. groups	31	467.11	15.068		

There were no missing cells found.

Thus, it can be seen that both the cognitive and the problem solving programme are equally successful in reducing (reported) physiological symptoms.

### 9.4.2 Attendance rates at the classes

The mean attendance of subjects at the experimental classes was 5.6 sessions out of a total possible 12 (range = 2 - 9), and the mean of the control group attendance at their classes was 4.82 ( range = 2 - 8). A t-test comparing the two groups' attendance rates at classes proved this difference to be significant ( $t = 9.5$ ,  $df=32$ ,  $p = 0.0001$ ).

### 9.4.3 How many subjects used their computer package for the purpose for which it was taught?

It was possible that a sub-sample of the population may have chosen not to use their computer package for the purpose for which it had been taught. For example, some users expressed the fact at an early stage in the programme, that they knew that they would get a friend to help them to do their project, or, sometimes in the case of statistics, some users voiced the intention to do their analyses by hand.

There was no significant difference between groups as a function of whether or not they ultimately used the package they had learned for the purpose for which it had been taught ( $\chi^2 = 0.017$ ,  $df=1$ ,  $p = 0.8953$ ), as can be seen from table 9.4.3 below.

Table 9.4.3 The number of subjects in each group who ultimately used the package they had learned for the purpose for which it had been taught

	Experimental	Control	Totals
Used	10	11	21
Did not use	6	6	12
Totals	16	17	33

#### 9.4.4 Exam pass rates

For undergraduate students a pass involved obtaining their class ticket which allows them to proceed into the next year. For postgraduates this was more difficult to assess as there were no set exams at the end of the year. Two of the postgraduate student were MSc students, who both received their MScs. Only one subject failed his course. This was a member of the experimental group.

#### 9.4.5 User satisfaction issues

##### 9.4.5.1 Did the subjects of the two groups feel that they had benefited from their respective extra help sessions?

Post-experiment interviews revealed that there was no significant difference in the subjects' feelings about whether or not they felt that they had benefited from receiving additional help, ( $\chi^2 = 0.971$ ,  $df=1$ ,  $p = 0.3245$ ). Three quarters of the members of the experimental group voiced the feeling that they had benefited. Fifty nine percent of the control group felt that they had benefited from additional classes. This can be seen in table 9.4.5.1 below.

Table 9.4.5.1 The number of subjects in each group who felt they had or had not benefited from receiving their additional help

	Experimental	Control	Totals
Yes	12	10	22
No	4	7	11
Totals	16	17	33

#### 9.4.5.2 User reports of how confident they felt about using the computer package again

There was no difference in subjects' reported confidence regarding using their particular computer package again, (chi-square = 0.674, df=1,  $p = 0.4117$ ), as is seen in table 9.4.5.2 below. A subsequent Fischer Exact test was, however significant at  $p=.00859$ .

Table 9.4.5.2 The number of subjects in each group who felt confident about using their computer package again

	Experimental	Control	Totals
Felt confident	14	13	27
Did not feel confident	2	4	6
Totals	16	17	33

#### 9.4.5.3 Would they use their particular methods of help again?

The likelihood of subjects' using the cognitive methods, or their practical problem solving methods again was not significantly different (chi-square = 3.566,  $p = 0.059$ , df = 1), as is displayed in table 9.4.5.3 overleaf. This also failed to reach significance on a Fischer Exact test ( $p=0.067$ ).

Table 9.4.5.3 The number of subjects in each group who would use their method again

	Experimental	Control	Totals
Would use again	11	16	27
Would not use again	5	1	6
Totals	16	17	33

#### 9.4.5.4 Did subjects feel that their method had helped to reduce anxiety?

There was no significant difference across groups regarding user perceptions of whether their method had actually helped to reduce anxiety, (chi-square=0.279, df=1, p = 0.5975). A Fischer Exact test also failed to reach significance. This is set out in table 9.4.5.4 below.

Table 9.4.5.4 Number of subjects in each group who felt that their method did or did not reduce anxiety

	Experimental	Control	Totals
Felt it reduced anxiety	7	9	16
Felt it did not	9	8	17
Totals	16	17	33

#### 9.4.5.5 Should anxiety management be included as part of a computer course?

When asked whether they thought that anxiety management should be included as a part of computer courses, the two groups did not differ in their responses, (chi-square = 3.64,  $p = 0.564$ ,  $df = 1$ ). This is evident in table 9.4.5.5.

Table 9.4.5.5 The number of subjects in each group who thought that anxiety management should be included as part of a computer course

	Experimental	Control	Totals
Yes	10	5	15
No	6	12	18
Totals	16	17	33

Despite only seven individuals believing that cognitive therapy reduced their anxiety, ten thought that it should be included as part of their computer course. It is also of interest to note that as many as twelve of the control group said that it should not, despite having had no experience of this type of support.

## 9.5 Discussion

The principle conclusion to be drawn from the results is that the cognitive user assistance programme is neither superior nor inferior to the alternative form of user problem solving. Neither form of assistance served to reduce user anxiety levels as measured by the STAI. There was, however, a significant reduction in the frequency of reported physiological symptoms, as measured by the MSPQ for both the experimental and the control group. This occurred independently of the type of programme of assistance they had been employing.

Borkovec and Mathews reported similar findings in 1988. They compared the efficacy of non-directive therapy, coping desensitization and cognitive therapy in the treatment of generalised anxiety disorder. Despite all three conditions showing significant improvement in 6 and 12 month follow-up measurements, no differences were found between the three conditions. The fact that therapy studies on nonphobic anxiety samples that have used simple relaxation or cognitive therapy-like methods have suffered a variety of methodological problems has been documented by Mathews in 1985. Such studies have not been able to unambiguously document clinically significant outcomes, for example, Woodward and Jones (1980).

Results such as Borkovec and Mathews' and the present results lend credence to the possibility that hope and belief in a form of assistance, regardless of type or format, may be a significant contributor to change in these groups. However, whereas Borkovec et al. saw a decrease in anxiety through the use of cognitive therapy techniques, the sole significant variable which decreased here was reported somatic disturbance. Had the experiment run on a larger scale, with more participants, and for a longer period of time, it is possible that significant reductions in state-trait anxiety would also have been manifest. It could be tentatively hypothesised that long-term follow-up may have shown longer lasting benefits to those in the cognitive (experimental) group if they indeed applied the techniques they had learned when faced with new computer packages. It would be both necessary and desirable to unpack the specific nature of the cognitions being experienced by users in any future studies of this nature in order to witness any significant reduction in state/trait

anxiety scores. If conducted on a longer-term basis, it would be easier to identify and highlight the exact cognitive distortions which are occurring, and then relate them to specific underlying assumptions. It should also be borne in mind, that the subjects in this experiment were volunteers, seeking help when interacting with computers. It is possible that these individuals were anxious about other things in general, in which case one could not reasonably expect a significant reduction in anxiety scores, if only computer anxiety is being addressed.

An analysis which was not conducted was a comparison of state anxious subjects' scores over time (before and after). Only nine individuals overall were state anxious, (5 and 4 subjects) which made such an analysis unfeasible. It may have been enlightening to discover whether these individuals in particular had a significant reduction in state anxiety over time. Those who are anxious to begin with (trait) are more likely to remain anxious, since computing will be only one of many more general anxieties.

#### 9.5.1 The possibility of a shift in anxiety focus

A feature that became clear over time during the experiment was the shift in the focus of anxiety. The content, or focus of subjects' fears appeared to change over time. Initially, the voiced fears were related to the computer per se, for example, fear of deleting all one's file, and maybe even those of surrounding workers. At later stages, these fears became more task-specific. For example, the issue was not one of how to use the computer, rather it was a question of, in the case of one spss user, which statistical analysis to use and why. This transference in focus or cause of anxiety may have been at least partly responsible for the maintenance of anxiety levels across time.

#### 9.5.2 Habituation and desensitisation - the MSPQ results explained

How can the reduction in reported physiological disturbance be explained? The clinical literature on panic disorder can possibly throw some light on this finding.

The core problem in panic disorder comes from the individual's misinterpretation of his physiological symptoms. These physiological symptoms are catastrophised, and he or she scans his body for further confirmatory evidence that other symptoms are present, and then a vicious circle of panic begins. The high MSPQ scores at the outset of the study could reasonably be attributed to the users experiencing feelings which are akin to those experienced in panic disorder. As time progresses, and they become more familiar with the system that they are learning, the severity and frequency of perceived physiological disturbance may be reduced on this count alone. As a consequence they may have resultantly fewer symptoms to misinterpret. Therefore it may be that anything that helps to keep subjects interacting with a system, rather than avoiding it, may be efficacious.

The behavioural component in this experiment was continued exposure to the anxiety provoking situation, namely the computer labs being attended. It could be argued that the MSPQ is a state measurement tool, and as such, the manifest significant reduction in both groups is a function of their continued exposure to the anxiety producing situation. The significant decrease in the MSPQ scores could be explained by habituation or desensitisation through this continued exposure. This continued exposure allowed no opportunity for avoidance, avoidance having been shown to generate and maintain anxiety (Beck, 1985). This provides an account of the trend towards significance in the experimental group, as the anxious cognitions are being addressed. Trait anxiety would generally be less likely to change over time as it is a fixed variable.

### 9.5.3 Methodological problems

There was a fluctuation in subject attendance at the two groups over the three month experimental period. Talking to people in the experimental group, both before or after they had been absent, the problem seemed to be related to the fact that they wanted more short-term, concrete solutions to their problems. As one individual in this group stated "I can handle having an element of anxiety throughout the whole thing...as long as I get through my work, and get it done, I know I can leave, and any unpleasant feelings will go too". Another person said that she felt the only way her fears would disappear would be by having concrete step-by-step instruction at

the keyboard. She felt that the methods used in the sessions were of worth at some level, but that they took too long to learn to use properly. Another user from this group was of the opinion that there was indeed a place for such help as had been provided, but that it was far from what she had expected when she had originally signed up. That some users felt disappointed by the cognitive assistance is reminiscent of Carroll's training wheels experiment. He reported that users complained that they were not receiving enough help. It was at this point that he realised that they had to be provided with more instruction than he had previously been giving them.

A possible criticism of the study may be that any user experiencing anxiety at the start of the sessions with the computer may be able to attribute his anxiety to the fact that he or she was embarking upon something new, rather than the fact that the anxiety was intrinsically linked with the computer. The counter argument is that anxiety is often felt in new and uncertain situations. Whether the anxiety is prompted by the computer or not is academic. What is real, and what has to be dealt with is the anxiety experienced by the individual.

#### 9.5.4 Comparison with a no-intervention, baseline group and a mixed group

Had this study been possible on a larger scale, it would have been an interesting endeavour to include other comparison groups. For example, it would be feasible to draw comparisons with a no-intervention group. However, a potential difficulty with this is that subjects may feel slightly cheated by attending such a group. Additionally, it would be worthwhile to run a combined programme, offering both immediate practical, behavioural help, in addition to cognitive principles.

#### 9.5.5 Undetected differences in coping strategies

As Cohen (1984) stated, "the key question may not be *which* coping strategies an individual uses, but rather *how many* are in his repertoire, or how flexible the person is in employing different strategies". (p. 269). In some instances, the most

effective coping responses directly address the problem, and, at other times, they focus on alleviating the emotional distress aroused by the problem. Lazarus and Folkman (1984) described two functions of coping: (a) problem-focused coping - designed to manage the problem causing the distress, and (b) emotion-focused coping - designed to regulate emotion or distress. In situations that are appraised as potentially changeable, problem-focused forms of coping (information gathering, problem solving, decision making and direct action) are more likely to be used. In stressful situations that are perceived as basically unchangeable, coping strategies are more likely to involve compromise and acceptance. In such instances, emotion-focused coping can be used to alter the meaning of a situation. Hopefully, this preliminary study on cognitive-type user help will prompt further studies of a similar nature, in which Lazarus and Folkman's coping distinctions may be further explicated.

#### 9.5.6 A final word about anxiety

Pufflerova (1991) found that anxiety had a positive and facilitating influence upon performance. Those individuals who volunteered for participation in the present study were presumably anxious enough about the computing course they were about to embark upon, to put their names forward for the programme. Of this group of people, only one failed the course. This would perhaps suggest that anxiety, rather than acting as a potential handicap, may serve to ultimately facilitate interaction. Anxiety levels tend to eventually reach a plateau, after which it has a detrimental effect on performance. In the case of the subjects in this experiment, it is possible that anxiety was still in the range where it aided performance.

#### 9.5.7 The way forward for user assistance

Cognitive therapy type assistance has shown itself to be as effective as problem solving methods, and has been actively desired by some subjects. The advocated place of cognitive help within the realm of user assistance is discussed in full in the following chapter, alongside the findings from the other experimental chapters.

**CHAPTER 10**

**DISCUSSION OF THE THESIS' FINDINGS**

**AND SYNTHESIS**

## CHAPTER 10: DISCUSSION OF THE THESIS' FINDINGS

### 10.1 SUMMARY OF THIS CHAPTER

The aim of the following pages is to provide a summary of the principal findings of the thesis, and to draw conclusions based on these findings. From these conclusions come recommendations as to the way forward for HCI researchers wishing to investigate methods of measuring, and ultimately facilitating human interaction with computers. To this end, the case for and against minimalist documentation will first be argued. This is followed by the case for and against more cognitively-based user assistance, and a discussion of the measurement problem faced by HCI researchers. From this, the direction that future HCI research should take is presented.

#### 10.1.1 The goals of the thesis - a recapitulation

This thesis investigated what at a passing glance were apparently unrelated topics - minimalist documentation and emotional cues in HCI. However, these two areas were linked in an important, if not obvious way. They both develop research lines which focus on the repair of blocks, or difficulties in interaction at the interface. The emphasis on this research was on the consequences of breakdowns, and on the design of adequate repair facilities. Both minimal manuals and emotion research addressed different parts of the repair issue. The former offered behavioural repair, the latter emotional solace in the form of coping skills.

### 10.2 Minimalist documentation

#### 10.2.1 In defense of minimalist documentation

The first experiment presented in this thesis essentially formalised the last missing guideline for minimal manual design. Hitherto, there had been no guideline available which could advise documentation designers as to where they should turn

to for content information. Prior to Carroll's work, there had been the practice of dreaming up the content within the design team, which usually resulted in a comprehensive but incomprehensible volume. Carroll then led the way with specialist manuals for novice and infrequent users. By adding the 'from-scratch' method to his original guidelines for minimalist design, there is now no opportunity for unnecessary information to even get a foot in the door. The success of the minimal manual has been shown many times, but only now has it reached maturity with the addition of the 'from-scratch' design method. The 'from-scratch' method, as the advocated sixth design principle, is arguably one of the most user-centred in its approach. It allows the participation of both expert and novice computer users in different ways in different phases of the design cycle. As such, documentation designers have no reason to continue with old design practices.

On objective performance measures the minimal manual was superior to its conventional counterpart, and on subjective polls, users reported the desire to use this type of manual again, when given a choice. In the real environment user opinion carries a lot of weight, as the news spreads fast if a system and its documentation are difficult to use.

If smooth first time performance and user satisfaction are what is being striven after in the quest to bridge the gulf between the user and the system as outlined in chapter 1, then the minimal manual certainly provides this.

The thesis also illustrated that there are no significantly beneficial, nor detrimental effects exerted over first time user performance when the manual contains information presented in a pared-down format with no additional information given, nor any invitation to explore. It is posited that there is now, however, the opportunity to provide the two different types of manual to two slightly different sub-samples of the user population. The exploratory minimal manual may be the right note upon which to start in the case of the novice user who may be embarking on the first of many interaction sequences. By making the first contacts pleasurable, then his or her resistance to using more advanced aspects of the system

may be reduced.

The alternative, procedural manual may be more appropriate for what is termed the 'infrequent' user. Infrequent users need to execute certain routine procedures on an irregular basis, and for this reason they may have very little motivation to explore the system. This type of user may be more likely to adhere to the steps provided in the manual, and make fewer errors. The 'thoughtlessness' of the user action in these circumstances may be tolerable if it is appreciated that the user only has to operate in this mode for a short space of time on an infrequent basis.

In the light of the above, two points emerge. Firstly, that minimal manuals with the new 'from-scratch' guideline for design should be designed and developed in the way illustrated in this thesis. Secondly, the research on the level of explanation provided to the user has indicated the necessity of further developing the needs of novice and infrequent users separately. Draper and Oatley's idea of information flow would appear to already be built in to the original minimal manual. As such, this thesis would hold that the two theories for manual design are essentially interwoven.

### 10.2.2 The case against minimalist instruction

One of the main weaknesses in the case for minimalist documentation is that it only caters to the needs of novice or infrequent users. There is a need to develop further the design of such documentation for expert system users. The problem with this is that all novice users have a base-state of 'no knowledge', which can more easily be catered to, than can the case of a sample of experts, who have arguably diversified skills and different type of expert knowledge. The needs of certain experts may have become more specific. Minimal manuals thus address only one proportion of the population of computer users who need to refer to documentation. It is not self-evident that users weaned on minimalist instruction are better equipped to learn more advanced skills than users trained with conventional documentation. It should also be noted that technical writers very rarely have the opportunity to spend a large

period of time developing a manual (the manual designed in the first experimental chapter of this thesis took nine months to reach its seventh, and final version).

#### 10.2.2.1 System specificity

A different manual has to be designed for different packages and different systems, i.e. the assistance that the user receives from one manual is not portable.

Occasionally the transfer of universal commands will occur, however without the finer level of detail which is required, the interaction will breakdown. This non-transferability of manual content again raises the issue of the function of documentation - is it for action or for education. It also, however, brings into focus the form of transferable assistance that was also investigated and developed in the thesis which allowed users to bring their own set of coping mechanisms to the interface.

### 10.3 Cognitive user assistance

#### 10.3.1 In support of cognitive user assistance

The problem of system specificity was handled by the last experiment in the thesis (chapter 9). This experiment considered the benefits of providing a form of 'portable' user assistance that was based on cognitive therapy. The anticipated superiority of this help form was not demonstrated, which at a first glance seems straightforward enough. However, although not superior in any sense to the alternative form of user assistance, it was nonetheless not any worse, and on this count alone causes one to speculate over the worthiness of providing other types of user assistance.

Having revealed in the course of the thesis that facial expression and emotion act as communicative signals, rather than as correlates of emotion, the fact remains that emotions are occurring, and often in extreme and unpleasant forms. By providing the user with methods for coping with emotions and dysfunctional cognitions, the

research in this thesis has in effect provided a set of portable coping skills. The more specific methodological issues concerning the provision of such assistance having been discussed in chapter 9, it is now clear that the research points to an extension of these preliminary findings. By running such a programme of cognitive help on a larger scale, and by paying more attention to specific cognitions, more beneficial effects may be witnessed.

In the cases of those individuals where cognitive distortions and anxiety is the main barrier to pleasurable and beneficial interaction, then undoubtedly cognitive intervention methods have a valuable role. The student population may be more likely to produce subsamples of computer users who manifest state anxiety (Spielberger, 1966), and provide the user group who may stand to benefit most from this type of help.

### 10.3.2 The case against cognitive assistance

A large number of people favoured the inclusion of cognitive help methods for anxiety management in future computer courses, despite its unproven superiority in chapter nine. It is not, however a likely eventuality that educational institutions would be in a position to use their already limited resources to enable cognitive programmes to take place in a formal, large scale format. The added fact that no significant findings emerged from this study does not augur well for it ever being a reality. However, it is possible there exists a small sub-sample of the user population, who would surely benefit from cognitive help. It is possible that their experienced anxiety is not severe enough to warrant their consulting a clinical psychologist, yet such individuals may be receptive to using cognitive techniques. Tutorial resources within education could feasibly be reallocated for this type of cognitive instruction.

As the trend for therapy practice 'goes cognitive', it is, however important to bear in mind that some researchers continue to believe that behavioural *procedures* are

more powerful than strictly cognitive ones in affecting cognitive *processes* (Bandura, 1977). That is, they favour behavioural techniques while maintaining that it is important to alter a person's beliefs in order to effect an enduring change in behaviour. Bandura suggests that all therapeutic procedures, to the extent that they are effective, work their improvement by giving the person a sense of 'mastery' i.e. a sense of 'self-efficacy' in relation to cognitive therapy. Thus it is suggested by this thesis that if cognitive assistance were to be merged with more behavioural techniques, then this may lead to a stronger case for such assistance.

#### 10.4 Measuring up to the requirements of the researcher

The claim was made at an early stage (chapter 4) that the measurement of human-computer interaction is a two-headed monster. On the one-hand, the researcher has at his or her disposal a wealth of instruments from which to choose. In the case of this thesis, there were initially seven from which to choose. The following section illustrates the choice of combination of instruments for each study:

Experiment 1: Questionnaire, semi-structured interview, think-aloud protocol, checklist, incident diary, comparison experiment

Experiment 2: Questionnaire, semi-structured interview, comparison experiment

Experiment 3: Semi-structured interview, think-aloud protocol, focus group, checklist

Experiment 4: Questionnaire, semi-structured interview, think-aloud protocol, FACS

Experiment 5: Questionnaire, semi-structured interview, incident diary, comparison experiment

The number of instruments available puts the field in a strong research position, but there nonetheless exists a concerning lack of consensus regarding the optimal combination of these instruments. One of the features of the research conducted in

this thesis was, however, that it necessitated both the development of a new measurement instrument, and the importing and subsequent abridgement of a measurement instrument from the field of research on the emotions. Having done this, two new instruments are added to the growing corpus. The difference, however, between these two instruments and the previously mentioned ones, is that the new instruments have specific applications.

It would thus appear that vis`a vis the question of definition of measurement, the field is yet in its infancy. It is for this reason that this thesis flags the need for the investigation of:

- (a) the relative merits and demerits of each instrument as listed above, and
- (b) to what extent the instruments overlap.

Detailed investigation of the validation of the checklist instrument is already underway at Glasgow University by Edgerton, however, the field still awaits a general consensus. This resultant consensus, together with new instruments, - whether designed and developed within the field, or imported and finely-tuned to HCI research needs - will elevate the discipline to a more advanced high-profile position at the frontline of research. This will enable the field to further develop as a discipline in its own right.

## 10.5 SYNTHESIS

### 10.5.1 In anticipation of a new theory for HCI

This thesis dealt with two methods of repairing the gulf that exists between system and user when a system is not immediately self-explanatory. These two methods were user documentation and the tackling of user emotion. In Part One, Norman's theory proved to be a constructive framework for the practical approach taken by the research. The thesis would now recommend that this theory and that of Oatley and Johnson-Laird as used in Part Two be considered in a complementary manner. Both theories consider human action towards goals. Norman's notion of a 'gulf' refers to the distance between the user's mental state and the physical state of the system. The theory of the emotions takes Norman's framework one step further by detailing the nature of the user's mental state when on the edge of the user-system abyss. In this sense, there now exists a theory within a theory. Although the beauty of the theory of human emotion is that it lends structure and explanation across the gamut of human experiences, this thesis posits that within the HCI arena it be considered as an extension within Norman's theory. Thus, a more comprehensive two-tiered framework has emerged. On the meta-level, there is the acknowledged first premise that the user-system divide exists, and that it needs to be bridged. The second, embedded level provides a directive hypothesis on the nature of the user's internal state, based on a theory of human planning. It has emerged from this thesis that emotion acts in a communicative nature in HCI. The micromomentariness of facial expressions and the fact that emotions flash around at the interface, combined with a rapidly changing task would suggest that Mandler's idea that emotion is communicative in essence has a lot to offer the HCI researcher in terms of a theory of emotion for HCI. Taken together with Oatley's theory, this should serve as a platform for the further development of research in this dimension.

As Frese (1991) noted, it is necessary to enlarge the picture of software ergonomics to include organisational variables. Since minimalist documentation does not guarantee trouble-free interaction, and since it is only aimed at novice and infrequent users, it is proposed that cognitive user assistance join forces with

minimalist documentation to provide both situational and transferable user assistance. The thesis drew on the meta-level of the proposed theory by providing documentation as a means of user-system repair. The more embedded theory of the emotions provided detailed directive information on human mental states when involved in the 'sturm and drang' of bridging the gulf, and drew on the resource of human emotion in an attempt to decrease the distance of the divide.

In the light of the findings of this volume, it is posited that there are two routes that system designers should take, in the endeavour to fill the divide. On the one hand, they may provide literature as a form of accompaniment to the system. On the other, they may provide forms of coping advice to the user. These coping skills, by virtue of their being universal and thus transferable across systems, lead one to posit a two-way operational hypothesis. The documentation may bring the system closer to the user, and the user may move closer to the system through the application of coping skills that he or she has brought to the system.

#### 10.5.2 Man's eternal discontent

It is only fair, however, to acknowledge that the task of system design is not by nature an easy one, and that the efforts of designers are too often constrained, if not crippled by limited resources of time and money. Couple this with the fact that there will almost always exist an element of the user population that will never be satisfied with the nature or quality of their interactions, or both, and the task becomes excessively demanding.

It is hoped, for the above reasons, that the research which has been undertaken in this volume goes at least part of the way towards a greater understanding of the nature of human activity at the interface, and gives pointers to how both computer designers and computer users alike may help to cross the divide between human and computer.

## REFERENCES

- Abramson, L. Y. (1987) Learned helplessness in humans: critique and reformulation. *Journal of Abnormal Psychology*, 87, 49-74.
- Anastasi, A. (1988) *Psychological Testing*. New York: Macmillan.
- Argyle, M. (1967) *The Psychology of Interpersonal Communication*. Harmondsworth: Penguin.
- Bandura, A. (1977) Self-efficacy: toward a unifying theory of behavioural change. *Psychological Review*, 84, 191-215.
- Barrios, B. A. and Shigetomi, C. C. (1979) Coping-skills training for the management of anxiety: a critical review. *Behaviour Therapy*, 10,(4), 491-522.
- Beck, A. T. (1967) *Depression: Clinical, Experimental, and Theoretical Aspects*. New York: Harper and Row.
- Beck, A. T. (1976) *Cognitive Therapy and the Emotional Disorders*. New York International Universities Press.
- Beck, A. T., Rush, A. J., Shaw, B. F. and Emery, G. (1979) *Cognitive Therapy of Depression*. New York: Guilford Press.
- Beck, A. T. and Emery, G. (1979) *Cognitive Therapy of Anxiety and Phobic Disorders*. Unpublished treatment manual.
- Beck, A. T. and Emery, G. (1985) *Anxiety Disorders and Phobias: A Cognitive Perspective*. New York: Basic Books.
- Beck, A. T. and Emery, G. (1985) *Cognitive Therapy of Anxiety and Phobic Disorders*. Treatment Manual of the Center for Cognitive Therapy, 133 South 36th Street, Philadelphia 19104. In Blackburn, I. and Davidson, K. *Cognitive*

*Therapy for Depression and Anxiety. A Practitioners Guide.* Blackwell Scientific Publications.

Bellack, A. S. and Lombardo, T. W. (1984) Measurement of anxiety. In S. M. Turner (Ed.) *Behavioural Theories and Treatment of Anxiety: A Cognitive Perspective*,. New York: Basic Books.

Blackburn, I. M. (1988a) *Psychological Processes in Depression*. In Miller, E. and Cooper, P. J. (Eds.) *Adult Abnormal Psychology*, pp. 128-168. Churchill Livingstone, Edinburgh.

Booth, P. A. (1989) Analysing User-system Errors: An Approach to Improving System Design, *submitted to HCI*.

Borkovec, T. D. and Mathews, A. M. (1988) Treatment of nonphobic anxiety disorders: A comparison of nondirective, cognitive, and coping desensitisation therapy. *Journal of Consulting and Clinical Psychology*, Vol. 56, 6, 877-884.

Brown, G. and Harris, T. (1978) *Social origins of depression*. London: Tavistock.

Brynnner, J. and Stribley, K. M. (1979) *Social research: principles and procedures*. Longman.

Carroll, J. M., Mack, R. L., Grischkowsky, N. L. and Robertson, S. R. (1985) Exploring exploring a word processor. *Human-Computer Interaction vol. 1*, 283-307.

Carroll, J. M. (1987) (Ed.) *Interfacing thought - cognitive aspects of human-computer interaction*. MIT Press, Cambridge, MA.

Carroll, J. M. (1990) An Overview of Minimalist Instruction. User Interface Institute, IBM Watson Research Centre, N.Y. 23rd Hawaii International Conference on System Science (HICSS-23), 2-6 January.

Carroll, J. M. (1990b) *The Nurnberg funnel: designing minimalist instruction for practical computer skill*. Cambridge Mass: MIT press.

Carroll, J. M. , Rosson, M. B. (1985) Usability specifications as a tool in iterative development. In H. R. Hartson (Ed.) *Advances in Human-Computer Interaction* Norwood, NJ: Ablex .

Carroll, J. M., Smith-Kerker, P. L., Ford, J. R. and Mazur-Rimetz, S. A. (1986) The Minimal Manual. *IBM Research Report No. 11637*. Yorktown heights, New York: IBM.

Carroll, J. M., Smith-Kerker, P. L., Ford, J. R. and Mazur-Rimetz, S. A. (1987) The Minimal Manual. *Human-Computer Interaction, (1987-1988), Volume 3*, pp. 123-153, LEA.

Cattell, R. B. and Scheier, I. H. (1961) *The meaning and measurement of neuroticism and anxiety*. New York: Ronald Press.

Chapanis, A. (1971) In prelude to 2001: explorations in human communication. *American Psychologist, 26*, 949-961.

Clark, D. M. (1986) Cognitive Therapy for Anxiety. *Behavioural Psychotherapy, 14*, 295-301.

Clark, D. M. and Teasdale, J. D. (1982) Diurnal variation in clinical depression and accessibility of memories of positive and negative experiences. *Journal of Abnormal Psychology, 91*, 87-95.

Clark, D. M. and Teasdale, J. D. (1985) Constraints on the effect of mood on memory. *Journal of Personality and Social Psychology, 48*, 1595-1608.

Cockshott, T. (1991) Interface Agents. *Internal Report, University of Glasgow*.

Cohen, F. (1984) Coping. In J. Matarazzo, S. Weiss, J. Herd, N. Miller and S. .

Weiss (Eds.) *Behavioural Health: A handbook of health enhancement and disease prevention*. New York: John Wiley.

Cole, E. (1984) *Sources of Problem-Solving for Computer End-Users : Human Computer Interface and Social Networks in Organisations in Human Factors in Organisational Design and Management*, H.W. Hendrick and O. Brown, Jnr (Eds).

Coleman, J. C. (1949) Facial Expressions of Emotion. *Psychological Monograph*, 63 (1, Whole No. 296).

Diener, E., Larsen, R. J., Levine, S. and Emmons, R. A. (1985) Intensity and frequency: dimensions underlying positive and negative affect. *Journal of Personality and Social Psychology*, 48, 1253-1265.

Draper, S.W. (1985) The Nature of Expertise in UNIX. In B. Shackel (Ed.) *Interact '84: First IFIP Conference on Human-Computer Interaction*.

Draper, S. W. (1986) Display managers as the basis for user machine communication. In D. A. Norman and S. W. Draper (Eds.) *User Centred System Design*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Draper, S. W. (1990) Metrics of interface goodness. *Internal Report, University of Glasgow*.

Draper, S. W. (1991) Practical methods for measuring the performance of Human-Computer Interfaces. *JCI Summerschool Handout, JCI Summerschool, Queen Mary and Westfield College, London*.

Draper, S. W. and Oatley, K. (1992) Action centred manuals or minimalist instruction? Alternative theories for Carroll's minimal manuals. In P. Holt and N. Williams (Eds.) *Computers and Writing: State of the Art*. Blackwells: Oxford.

Dritschel, B. H. and Teasdale, J. D. (1991) Individual differences in affect-related cognitive operations elicited by experimental stimuli. *British Journal of Clinical Psychology*, 30, 151-160.

Duncan E. (1992) Investigating Incidents of Emotion in Daily Life Using the Technique of Structured Diaries. *Unpublished PhD. thesis, University of Glasgow*.

Edgerton, E. (1992) The checklist. *Internal Report, University of Glasgow* .

Ekman, P. (1965) Differential communication of affect by head and body cues. *Journal of Personality and Social Psychology*, 2, (5), 725-735.

Ekman, P. (1976) Measuring Facial Movement. *Environmental Psychology and Nonverbal Behaviour* 1, (1), 56-75.

Ekman, P. (1978) *Facial Action Coding System*. Palo Alto: Consulting Psychologists Press.

Ekman, P. and Bressler, J. (1964) In P. Ekman, *Progress Report to National Institute of Mental Health*, Bethesda, Md.

Ekman, P. and Oster, H. (1982) Review and prospect. In P. Ekman (Ed.) *Emotion in the Human Face, 2nd ed.*, Cambridge: Cambridge University Press.

Ekman, P. and Friesen, W. V. (1978) *The Facial Action Coding System* Consulting Psychologist's Press, P. A. California .

Ekman, P. and Rose, D. (1965) In P. Ekman, *Progress Report to National Institute of Mental Health*, Bethesda, Md.

Ekman, P. (1972) Universals and cultural differences in facial expressions of emotions. *Nebraska Symposium on Motivation*. University of Nebraska Press.

- Ekman, P. (1973) Cross-Cultural studies of facial expression. In P. Ekman (Ed.), *Darwin and facial expression: A century of research in review*. New York: Academic Press.
- Ekman, P., Friesen, W. V. and Ellsworth, P. (1982) What emotion categories or dimensions can observers judge from facial behaviour. In P. Ekman (Ed.), *Emotion in the Human Face*, (2nd ed.) Cambridge: CU Press.
- Ekman, P., Friesen, W. V. and Tomkins, S. S. (1971) Facial Affect Scoring Technique (FAST): A first validity study. *Semiotica*, 3, 37-58.
- Ekman, P. and Friesen, W. V. (1971) *Unmasking the face*. Englewood Cliffs, N.J.: Prentice-Hall.
- Ericsson, K. A. and Simon, H. A. (1984) *Protocol Analysis*. MIT Press.
- Fernberger, S.W. (1928) False suggestion and the Piderit model. *American Journal of Psychology*, 40, 562-568.
- Fiske, S. T. and Tayler, S. E. (1984) *Social Cognition*. New York: Random House.
- Foa, E. B., McNally, R. and Murdock, T. B. (1989) Anxious mood and memory. *Behaviour Research and Therapy*, 27, 141-147.
- Frese, M., Brodbeck, F. C., Zapf, D. and Prümper, J. (1991) Users' errors and error handling: its relationships with task structure and social support. *SIGCHI Bulletin, April issue, Vol . 23*, no. 2.
- Frijda, N., H. (1987) Comment on Oatley and Johnson-Laird's " Towards a Cognitive Theory of Emotions ". *Cognition and Emotion*, 1, (1) 51-58.
- Frijda, N. H. (1986) *The Emotions*. Cambridge University Press.

- Frois-Wittman, J. (1930) The judgement of facial expression. *Journal of Experimental Psychology*, 13, 113-151.
- Gellhorn, E. (1964) Motion and Emotion: The role of proprioception in the physiology and pathology of the emotions. *Psychological Review*, 71, 457-472.
- Goodenough, F. L. and Tinker, M. A. (1931) The relative potency of facial expression and verbal description of stimulus in the judgement of emotion. *Journal of Comparative Psychology*, 12, 365-370.
- Greenspan, P. S. (1988) *Emotions and Reasons: An Inquiry into Emotional Justification*. London: Routledge.
- Gressard, C. P. and Loyd, B. H. (1984a) An Investigation of the Effects of Math Anxiety and Sex on Computer Attitudes. Paper presented at the *American Educational Research Association*, New Orleans.
- Gressard, C. P. and Loyd, B. H. (1984b) *The Nature And Correlates Of Computer Anxiety In College Students*. Unpublished Manuscript, University of Virginia, Charlottesville.
- Habel, C. (1992) *Granularity and Modularity in Natural Language*. Seminar given at The Department of Psychology, University of Glasgow, February 1992.
- Hanawalt, N. G. (1944) The role of the upper and lower parts of the face as the basis for judging facial expressions: II. In posed expressions and "candid camera" pictures. *Journal of General Psychology*, 31, 23-36.
- Hartson, H. R. and Smith, E. C. (1991) Rapid prototyping in human-computer interface development. *Interacting with Computers*, vol 3, no 1, 51-51.
- Hicks, J. A. and Jenkins, J. G. (1988) The measurement of preoperative anxiety. *Journal of Royal Society of Medicine*, 81, 517-519.

Hobbes, J. R. (1985) Granularity, *International Journal of Computing and Artificial Intelligence*.

Hollon, S. D. and Kendall, P. C. (1980) Cognitive self-statements in depression. Development of an automatic thoughts questionnaire. *Cognitive Therapy and Research*, 4, 383-395.

Howell, R. J. and Jorgenson, E. C. (1970) Accuracy of judging emotional behaviour in a natural setting - a replication. *Journal of Social Psychology*, 81, (2), 269-270.

Huff, C. and Cooper, J. (1987) Sex bias in educational software: the effect of designers' stereotypes on the software they design. *Journal of Applied Social Psychology*, 17, 6, 519-532.

Izard, C. E. (1972) *The Face of Emotion*. Appleton-Century-Croft: New York .

Jones, S. S., Collins, K. and Hong, H-W. (1991) An audience effect on smile production in 10-month-old infants. *Psychological Science*, 2, 45-49.

Jones, E. E., Kanouse, D. E., Kelley, H. H., Nisbett, R. E., Valins, S. and Weiner, B. (Eds.) (1972) *Attribution: Perceiving the causes of behaviour*. Morristown, N.J.: General learning Press.

Kant, I. *Sämtliche Werke*. Leipzig ( 1921-1924).

Kelley, H. H. (1967) Attribution theory in social psychology. In D. Levine (Ed.) *Nebraska Symposium on Motivation (Vol. 15)*. Lincoln: University of Nebraska Press.

Killam, H. W. (1991) Rogerian psychology and human-computer interaction. *Interacting with Computers vol 3 , no 1*, 119-128.

Kovacs, M. and Beck, A. T. (1978) Maladaptive Cognitive Structures in

Depression. *American Journal of Psychiatry*, 135, 525-35.

Kraut, R. E. and Johnston, R. E. (1979) Social and Emotional Messages of Smiling: An Ethological Approach. *Journal of Personality and Social Psychology*, vol. 37, (9), 1539-1553.

Lang, P. J. (1968) Fear reduction and fear behaviour. In J. Schlein (Ed.), *Research in Psychotherapy*. Washington: American Psychological Association.

Lanzetta, J.T. and Kleck, R. (1970) Encoding and decoding of facial affect in humans. *Journal of Personality and Social Psychology*, 16, (1), 12-19.

Larsen, R. J. and Diener, E. (1985) A multitrait-multimethod examination of affect structure: Hedonic level and emotional intensity. *Personality and Individual Differences*, 6, 631-636.

Larsen, R. J. and Diener, E. (1987) Affect intensity as an individual difference characteristic: A review. *Journal of Research in Personality*, 21, 1-39.

Larsen, R. J. and Diener, E. and Emmons, R. A. (1986) Affect intensity and reactions to daily life events. *Journal of Personality and Social Psychology*, 51, 4, 803-814.

Larsen, R. J., Diener, E. and Cropanzano, R. S. (1987) Cognitive operations associated with individual differences in affect intensity. *Journal of Personality and Social Psychology*, 53, 4, 767-774.

Lazarus, R. S. (1981) The stress and coping paradigm. In C. Eisdorfer (Ed.), *Models for clinical psychopathology*. Englewood Cliffs, NJ: Prentice Hall.

Lazarus, R. S. and Folkman, S. (1984) *Stress, appraisal and coping*. New York: Springer.

Leventhal, H. and Sharp, E. (1965) Facial expressions as indicators of distress.

In S. S. Tomkins and C. E. Izard (Eds.) *Affect, cognition and personality*. New York: Springer, 296-318.

Lewis, A. (1971) The ambiguous word 'anxiety'. *International Journal of Psychiatry*, 9, 62-79.

Mack, R. L., Lewis, C. L. and Carroll, J. M. (1983) Learning to use word-processors : Problems and Prospect. *ACM Transactions on Office Information Systems*, 1, 254-271.

Mahoney, M. (1977) Personal Science: A cognitive learning therapy. In A. Ellis and R. Grieger (Eds.) *Handbook of rational-emotive therapy*. New York: Springer.

Mandler, G. (1962) Emotion. In *New Directions in psychology: 1*. New York: Holt, Rinehart and Winston, 267-343.

Mandler, G. (1984) *Mind and Body*. New York: Norton.

Marteau, T. M. and Bekker, H. (1992) *British Journal of Clinical Psychology*, 31, 301-306.

Mathews, A. M. (1985) Anxiety states: A cognitive-behavioural approach. In B. P. Bradley and C. Thompson (Eds.), *Psychological applications in psychiatry*, (pp. 41-59), New York: Wiley.

Mayes, T., Draper, S. W., McGregor, A. M. and Oatley, K. (1988) Information Flow in a User Interface: the Effect of Experience and Context on the Recall of MacWrite Screens. In *People and Computers IV, Proceedings of the Fourth Conference of the British Computer Society, Human-Computer Interaction Specialist group. University of Manchester, 5-9 September* (Ed. D. M. Jones and R. Winder). Cambridge University Press.

McElhinney, F. (1988) *Unpublished MSc Thesis University of Glasgow*.

McGinley, M., Sanford, A. J. and Moxey, L. M. (1992) Quantification with percentages and language: influences on text memory. *Internal Report, University of Glasgow*.

McNally, R. J., Foa, E. B. and Donnell, C. D. (1989) Memory bias for anxiety information in patients with panic disorder. *Cognition and Emotion*, 3, 27-44.

Meichenbaum, D. (1988) *Stress Inoculation training*. Psychology Practitioner Guidebooks. Pergamon Press.

Miller, G. A., Galanter, E. and Pribram, K. H. (1966) *Plans and the structure of behaviour*. New York: Holt, Reinhart and Winston.

Miller, G. (1984) *Experimental design and statistics*. London: Methuen. New Essential Psychology.

Morris, D. (1987) *Body Watching*. Grafton Books.

Mowrer, O. H. (1960) *Learning Theory and Behaviour*. New York: John Wiley.

Munn, N. L. (1940) The effect of knowledge of the situation upon judgement of emotion from facial expressions. *Journal of Abnormal and Social Psychology*, 35, 324-338.

Nelson, R. E. (1977) Irrational Beliefs in Depression. *Journal of Consulting and Clinical Psychology*, 45, 1190-1191.

Norman, D. A. (1981) A psychologist views human processing: human errors and other phenomena suggest processing mechanisms. In *Proceedings of the International Joint Conference on Artificial intelligence, Vancouver*.

Norman, D. A. (1983) Some observations on mental models. In D. Gentner and L. A. Stevens (Eds.) *Mental Models*. Hillsdale, NJ: LEA.

Norman, D. A. (1983b) Design principles for human-computer interaction. *Proceedings of CHI '83: Human Factors in Computing Systems*. New York: ACM. 1-10.

Norman, D. A. (1986) Cognitive Engineering. In D. A. Norman and S. W. Draper (Eds.) *User Centred System Design. New Perspectives on Human-Computer Interaction*. Hillsdale, NJ: LEA.

Norman, D. A. (1988) *The Psychology of Everyday Things*. New York Basic Books.

Norman, D. A. and Draper, S. W. (1986) (Eds.) *User Centred System Design*. Hillsdale, NJ: LEA.

Oatley, K., Meldrum, M., C., R., Draper, S., W. (submitted) Evaluating self-instruction by minimal manual and by video for a feature of a word-processing system.

Oatley, K. and Johnson-Laird, P. N. (1987) Towards a Cognitive Theory of Emotions. *Cognition and Emotion*. 1, (1) 29-50.

Piaget, J. (1928) *Judgement and reasoning in the child*. New York: Harcourt, Brace and Co.

Plutchik, R. (1962) *The Emotions: Facts, theories, and a new model*. New York: Random House.

Pufflerova, S. (1991) The weight of influence of cognitive style, emotional and ability characteristics in the procedure of solving complex cognitive tasks. *Unpublished PhD thesis*. Slovak Academy of Sciences, Czechoslovakia.

Reason, J. and Mycielska, K. (1982) *Absent-minded? The psychology of mental lapses and everyday errors*. Prentice-Hall, Englewood Cliffs, NJ.

Sanford, A. and Ramsay, J. (1992) Aspects of Granularity. *Internal Report, University of Glasgow*.

Rolls, E. T. (1990) A theory of emotion, and its application to understanding the neural basis of emotion. *Cognition and Emotion*, 4, 161-190.

Sarason, I. (1975) Anxiety and self-preoccupation. In I. Sarason and C. Spielberger (Eds.), *Stress and Anxiety (Vol 2)*. Washington DC: Hemisphere Press.

Schachter, S. and Singer, J. (1962) Cognitive, social, and physiological determinants of emotional state. *Psychological Review*, 69, 379 - 399.

Schackel, B. (1985) (Ed.) *Human-Computer Interaction - Interact '84*. Amsterdam: North Holland.

Shapiro, D. (1974) *Neurotic Styles*. New York: Basic Books.

Scherer, K. R. (1984) On the nature of function of emotion: A component process approach. In K. R. Scherer and P. Ekman (Eds.) *Approaches to Emotion*. Hillsdale, NJ: LEA.

Scott, J., Williams, M. G, and Beck, A. T. (Eds.) (1989) *Cognitive Therapy in Clinical Practice: An Illustrative Casebook"*. London: Routledge.

Seligman, M. E. P. (1974) Depression and learned helplessness. In R. J. Friedman and M. Katz (Eds.) *The Psychology of Depression*. Washington, D. C., Winston.

Seligman, M. E. P. (1975) *Helplessness*. San Fransisco: Freeman.

- Seligman, M. E. P., Abramson, L. Y., Semmel, A. and von Bayer, C. (1979) Depressive attributional style. *Journal of Abnormal Psychology*, 88, 242-247.
- Schachter, S. (1964) The interaction of cognitive and physiological determinants of emotional state. In L. Berkowitz (Ed.) *Advances in experimental social psychology (Vol. 1)*. New York: Academic Press.
- Schachter, S. (1971) *Emotion, obesity and crime*. New York: Academic Press.
- Schachter, S. and Singer, J.E. (1962) Cognitive, social and physiological determinants of emotional state. *Psychological Review*, 69, 379-399.
- Snaith, R. P. and Turpin, G. (1990) Clinical Anxiety States, Chapter 4 in D. F. Peck and C. M. Shapiro (Eds.) *Measuring Human Problems*. John Wiley and Sons Ltd.
- Smith, T. W., Ingram, R. E. and Brehm, S. S. (1983) Social anxiety, anxious self-preoccupation, and recall of self-relevant information. *Journal of Personality and Social Psychology*, 44, 1276-1283.
- Snaith, R. P., Constantopoulos, A. A., Jardine, M. Y. and McGuffin, P. (1978) A clinical scale for the self-assessment of irritability, anxiety and depression. *British Journal of Psychiatry*, 132, 164-71.
- Song, B. K. (1988) A Comparative Study of Self-Training Materials for Novice Users of the Electronic Mailing System. *Unpublished MSc Thesis, Glasgow University*.
- Spielberger, C. D. (1979) *Preliminary manual for the State-Trait Personality Inventory (STPI)*. University of Florida: Test Forms and Psychometric Data.
- Spielberger, C. D., Gorsuch, R., Lushene, R. E. (1987a) *The State-Trait Anxiety Inventory*. NFER-Nelson, Wilson.

- Suchman, L. (1987) *Plans and Situated Action*. Cambridge University Press.
- Teasdale, J. D. (1983) Affect and accessibility. *Philosophical transactions of the Royal Society of London, (Series B)*, 303, 403-412.
- Tomkins, S. S. (1962) *Affect, imagery, consciousness (Vol. 1), The positive affects*. New York: Springer, pp. 204-242.
- Valins, S. and Nisbett, R. E. (1972) Attribution processes in the development and treatment of emotional disorders. I E. E. Jones, D. E. Kanouse, R. E. Nisbett, S. Valins and B. Wiener (Eds.) *Attribution: perceiving the causes of behaviour*. Morristown: N. J.: General Learning Press.
- Vinacke, W. E. (1949) The judgement of facial expressions by three national racial groups in Hawaii: 1. Caucasian faces. *Journal of Personality*, 17, 407-429.
- Watts, F. N. (1992) Applications of current cognitive theories of the emotions to the conceptualization of emotional disorders. *British Journal of Clinical Psychology*, 31, 153-167.
- White, J. (1991) Treatment manual for anxiety. *University of Glasgow Master of Applied Science course notes*.
- White, J. (1991) How to get round the waiting list? Using the local press and public lectures to publicize stress. *Bulletin of the Division of Clinical Psychology*, January issue.
- Wing, J. K. Cooper, J. E. and Sartorius, N. (1974) *The Measurement and Classification of Psychiatric Symptoms*. Cambridge University Press, Cambridge.
- Wolpe, J. (1982) *The Practice of Behaviour Therapy*. Pergamon General Psychology Series, Pergamon Press.

Woodward, R. and Jones, R. B. (1980) Cognitive restructuring treatment: A controlled trial with anxious patients. *Behaviour Research and Therapy*, 18, 401-407.

Wright, P. (1981) The instructions clearly state...can't people read?. *Applied Ergonomics*, 12, 131-141.

Zigmond, A. S. and Snaith, R. P. (1983) The Hospital Anxiety and Depression Scale. *Acta Psychiatrica Scandinavica*, 67, 361-370.

## APPENDICES

All the appendices are listed according to the section where they were referred to.

A  
B  
C  
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### Appendix 5.3.3

#### **Semi-Structured Interview Agenda - Experts Only**

1. How long have you been using e-mail?
  2. How often do you use it ?
  3. What is the most frequent activity you use it for?
  4. Where do you find most of the problems?
  5. What do you think of current manuals?
  6. How did you learn to use e-mail?
  7. How long would you ideally like a manual to be?
  8. What do you consider to be the main areas a new user needs to know about in order that he may get ahead with his immediate tasks ?
- 

#### **Semi-Structured Interview Agenda - Novices Only**

1. How long have you been aware of the e-mail facility?
2. How much would you like to learn? i.e. whole system, or just enough for current needs.

## Appendix 5.3.4

**Checklist of commands used for e-mail**

Please note in the boxes below :

(1) for commands you use most frequently

(2) for commands that you use sometimes

(3) for commands that you never use

In the case of those commands that you never use, please add a 4 to the outside of the bracket if you knew that the command existed, but have not had any cause to use it, or a 5 if you were not aware that the command existed.

[ ]	mail	read mail
[ ]	mail jane	mail jane
[ ]	passwd	change password
[ ]	t1	read message no 1
[ ]	r	reply
[ ]	d	delete
[ ]	write	interrupt recipient
[ ]	mail suejoe<invitation	send invitation to sue and joe
[ ]	du	disk usage
[ ]	who	who else is logged on
[ ]	ed (no file)	load line editor
[ ]	ed (fred)	edit fred file
[ ]	w	complete edit
[ ]	q	finish edit
[ ]	ctrl-D	logout

## The Visual Editor

[ ]	viF	edit F
[ ]	F	scroll forward one screen
[ ]	B	scroll back one screen
[ ]	D	scroll down half a screenful
[ ]	U	scroll up half a screenful
[ ]	G	go to last line of file
[ ]	/ <i>pat</i> ESC	scroll to next line with <i>pat</i>
[ ]	? <i>pat</i> ESC	scroll to prev line with <i>pat</i>
[ ]	n	repeat last/or?
[ ]	O	move cursor to start of this line
[ ]	\$	move cursor to end of this line
[ ]	w	move cursor to next word
[ ]	b	move cursor to previous word
[ ]	a <i>text</i> ESC	append text after cursor
[ ]	i <i>text</i> ESC	insert text before cursor
[ ]	cw <i>text</i> ESC	change this word to <i>text</i>
[ ]	rx	replace this char with x
[ ]	dd	delete this line
[ ]	dw	delete this word
[ ]	x	delete this char
[ ]	J	join this and next line
[ ]	yy	copy this line into clipboard
[ ]	p	paste lines after this line
[ ]	P	paste lines before this line
[ ]	u	undo last change
[ ]	.	repeat last change
[ ]	:rF	read F and paste after this line
[ ]	:eF	edit file F
[ ]	q	quit editing
[ ]	lpr mbox	print mail box
[ ]	more mbox	view mail box
[ ]	pre	send message back to mail spool
[ ]	R	reply to all concerned
[ ]	S (message) filename	save the message in a file

Please use the space below to note any other commands that you use. Thank you very much!

## Appendix 5.3.6

**INCIDENT DIARY**

Please complete one of these sheets every time that you get stuck, or are experiencing difficulties

1. What has happened to make you get stuck? Describe what you have just done.

---

---

2. Do you have any ideas about what may have gone wrong?

---

---

3. What are you going to do to try to get out of this situation?

---

---

4. How do you feel at the moment?

---

Appendix 5.3.8

## YOUR MINIMAL MANUAL FOR E-MAIL

### (Version 1)

You may access the mail facility from the following terminals - ADM 22, ADM 5, Apricot F2/1, a networked Mac, Sun Workstation, and VT100.

ADM 5/22. When in the Adam Smith Building, you will have the PAD prompt, so type CALL PSY (rtn)

Macintosh users - Using Netmac A, click on NCSA Telnet 1.12, go to the file menu, click open connection, click OK.

#### ALL TERMINALS

Type your login name, then your password, these will not appear on the screen. Press return. Both your login and your password must be in lower case.

\*HELP\*

Error message "login incorrect"

This refers to either your login name or your password. Don't worry! Try again!

## RECEIVING REPLYING SENDING

### Receiving mail

Whenever you log on to Mail, you will be told whether you have any new mail awaiting you. Your new mail is divided into the constituent messages so that you can deal with them in any order that you choose. Type mail (rtn). Now type 1 (rtn) to read the first message, and 2 to read the second one and so on.

### Replying

Type r (rtn).

You may now compose a reply.

At the end of the message, press (rtn) and type a full stop, then (rtn) again.

Your message has now been sent. This is confirmed by "EOT"

### Sending mail

When you send someone mail it is delivered to a (conceptual) mail box from which they can receive it when they next log on.

If you want to mail Jane, then type `mail jane (rtn)`

Do not expect a prompt at this stage. Just go ahead and type your message! As with replying to messages, make sure you type a full stop on a blank line at the end of your message to send it off.

**\*TRY IT !\***

Using the above instructions, send a message to a friend!  
Ask them to check whether they received it.

**\*HELP\***

Beware-you must `(rtn)` at the end of every line as the system will not do this automatically.

## URGENT MESSAGES AND LOGGING OUT

The write command lets you do this. Write interrupts whatever the recipient is doing, with your message.

Type `w (rtn)`

If the person you wish to contact is logged on, use the write command. `(ctrl-d)` to exit.

e.g.

```
harrier%write susam (rtn)
```

Susan will receive your message immediately, but only if she is logged on.

### Logging Out

Ctrl-D on a terminal.

Clover-D on a Mac.

**\*HELP\***

To delete a character use the delete key, or backspace on Macs.

To delete a whole line, `Ctrl-U`

**\*HINT\***

To check if Marie has accessed and read a message you sent, type -  
`finger marie`

This tells you when Marie last read her mail, and whether she has any unread mail.

## ALIASES

### Aliases

When you tell the mail system to send a message it refers to a system file "/usr/lib/aliases" which contains a list of what are known as aliases. Marie is aliased to

**marie@kite.psy.glasgow.ac.uk**

The Sun server holds everyone's mail spool file eg /usr/spool/mail/marie where mail messages are stored until read and saved by you or else deleted.

It would be a waste of time having to type judith@kite.psy.glasgow.ac.uk for each message, so a shorthand/alias is used. This is expanded by sendmail when it refers to the aliases file.

To see the list of aliases type -

```
cd..(rtn)
ls (rtn)
```

Go ahead and use some of the aliases!

**\*HIELP\***

Error message "too many arguments" means that you should have typed cd then one space and two dots together.

## FILES AND DIRECTORIES

### Files

If you are reading a message and want to save it in a file, type

**& s judith (rtn)**. This saves the message in a file called judith

More **judith (rtn)** or **cat judith (rtn)** will let you view this file.

All subsequent messages that you save in the file judith will be appended.

Type **mail -f mbox/judith (rtn)** and the mail program will display the messages separately, i.e. with headers etc.

**ls (rtn)** to view your files

**rm judith (rtn)** removes judith

**mv judith judy (rtn)** changes the file name

**cat judith isobel>HCI (rtn)** creates the file HCI from judith and Isobel

mail keith <HCI (rtn) sends the HCI file to Keith

To view the contents of your mailbox-

harrier% more mbox (rtn)

Q (rtn) to quit.

## DIRECTORIES

Type pwd (rtn) to view your working directory

mkdir judith (rtn) creates a directory called judith

ls (rtn) lets you check it was formed

rmdir (rtn) removes the directory

### **\*HINT\***

Here's a tip - keep your Directories listed in capitals, files in lower case, so you can distinguish them easily.

**HAPPY MAILING!**

## Appendix 5.3.8.1

**E-MAIL TASK SHEET**

Subject no. \_\_\_\_\_ Sex \_\_\_\_\_ MM/CM

Please do the following tasks in the order in which they appear below.

Do not worry if you cannot do any of the tasks, just try to do your best.

1. Log on to e-mail
2. Access your own mail and read your messages
3. Send a short message to the experimenter, who's mail address you will be given
4. Use the 'write' command to contact the experimenter
5. Create a file and a directory
6. Check that the file and directory were successfully created
7. Log off from e-mail

## Appendix 5.3.8.1

**EMAIL TASK SHEET**

Subject no\_\_\_\_ Sex\_\_\_\_ MM /CM

Please do the following tasks in the order that they appear below.

Do not worry if you cannot do any of the tasks, just try to do your best.

1. Log on to e-mail
2. Access your own mail
3. Send a short message to the experimenter, who's mail address you will be given
4. Use the 'write' command to contact the experimenter
5. Create a file and a directory to store your mail
6. Check that the file and directory were successfully created
7. Log off from e-mail

## Appendix 5.3.9

**Semi-Structured Interview Agenda - Novices Only**

1. How much do you know about e-mail?
2. What do you think of current manuals?
3. How long would you ideally like your e-mail manual to be?
7. What would you like to see in a new manual?
8. What do you see yourself using e-mail for?

BLANK.

Appendix 5.3.9.1

## A MINIMAL MANUAL FOR E-MAIL

(Version 2)

**Before you do anything...read the note below!**

(rtn) means press the return key which is at the  
right hand side of your keyboard

## LOGGING ON TO E-MAIL

### **1. THE TERMINALS YOU MAY USE**

You may access the mail facility from the following terminals - ADM 22, ADM 5, Apricot F2/1, a networked Mac, Sun Workstation, and VT100.

### **2. HOW TO LOG ON**

ADM 5/22 When in the Adam Smith Building, you will have the PAD prompt, so type CALL PSY (rtn).

3. **MACINTOSH USERS** - Using Netmac A, click on NCSA Telnet 1.12, go to the file menu, click open connection, click OK.

**NO MATTER WHAT TYPE OF TERMINAL YOU ARE USING GO AHEAD AND TRY THE FOLLOWING .....**

Type your login name, then your password, these will not appear on the screen. Press return. Both your login and your password must be in lower case.

### **\*FIRST AID\***

1 Error message "login incorrect"

This refers to either your login name or your password. Don't worry! Try again!

## RECEIVING REPLYING SENDING

### **1. RECEIVING MAIL**

Whenever you log on to e-mail, you will be told whether you have any new mail awaiting you. Your new mail is divided into the constituent messages so that you can deal with them in any order that you choose.

Type mail (rtn). Now type 1 (rtn) to read the first message, and 2 to read the second one and so on.

### **2. REPLYING**

If you have just read a message, you may now reply by merely typing r (rtn).

You may now compose a reply - it's that easy!.

At the end of the message, press (rtn) and type a full stop, then (rtn) again.

Your message has now been sent. This is confirmed by "EOT".

### **3. SENDING MAIL**

When you send someone mail it is delivered to a (conceptual) mail box from which they can access it when they next log on.

If you want to mail Jane, then type mail jane (rtn)

When you see the word "subject:" just type in a title for your message, and do a carriage return. Do not expect a prompt at this stage. Just start typing your message! As with replying to messages, type a full stop on a blank line at the end of your message to send it off.

### **\*TRY IT !\***

Using the above instructions, send a message to a friend!

Ask them to check whether they received it.

### **\*HELP\***

Beware-you must (rtn) at the end of every line as the system will not do this automatically.

## URGENT MESSAGES AND LOGGING OUT

### 1. URGENT MESSAGES

Write is the command that lets you do this. Write interrupts whatever the recipient is doing, with your message.

Type `w (rtn)`.

If the person you wish to contact is logged on, use the write command. (ctrl-d) to exit.

e.g.

```
harrier%write susan (rtn)
```

Susan will receive your message immediately, but only if she is logged on.

### 2. LOGGING OUT

Ctrl-D on a terminal.

Clover-D on a Mac.

#### **\*HELP\***

1 To delete a character use the delete key, or backspace on Macs.

2 To delete a whole line, Ctrl-U

#### **\*HINT\***

To check if someone has accessed and read a message you sent, type -  
`finger marie`

This tells you when Marie last read her mail, and whether she has any unread mail.

## ALIASES

### *ALIASES*

When you tell the mail system to send a message it refers to a system file "/usr/lib/aliases" which contains a list of what are known as aliases. marie is aliased to

marie@kite.psy.glasgow.ac.uk

The Sun server holds everyone's mail spool file eg /usr/spool/mail/marie where mail messages are stored until read and saved by you or else deleted.

It would be a waste of time having to type judith@kite.psy.glasgow.ac.uk for each message, so a shorthand/alias is used. This is expanded by sendmail when it refers to the aliases file.

To see the list of aliases type -

cd..(rtn)

ls (rtn)

**\*HELP\***

Error message "too many arguments" means that you should have typed cd then one space and two dots together.

## FILES AND DIRECTORIES

### *1. FILES*

If you are reading a message and want to save it in a file, type & s judith (rtn). This saves the message in a file called judith More judith (rtn) or cat judith (rtn) will let you view this file.

All subsequent messages that you save in the file `judith` will be appended  
 Type `mail -f mbox/judith (rtn)` and the mail program will display the messages  
 separately, ie headers etc.

`ls (rtn)` to view your files

`rm judith (rtn)` removes `judith`

`mv judith judy (rtn)` changes the file name

`cat judith isobel>HCI (rtn)` creates the file `HCI` from `judith` and `Isobel`

`mail keith <HCI (rtn)` sends the `HCI` file to `Keith`

To view the contents of your mailbox-

`harrier% more mbox (rtn)`

`Q (rtn)` to quit.

## 2. *DIRECTORIES*

Directories are like folders, they can contain files and other directories. There is a single root directory owned by the system. This is a hierarchical system. Each user has a home directory which is the starting position for that person logging on, and a working directory. Initially your working directory is your home directory.

Type `pwd (rtn)` to view your working directory

`mkdir judith (rtn)` creates a directory called `judith`

`ls (rtn)` lets you check it was formed

`rmdir (rtn)` removes the directory

**\*HINT\***

Good idea to keep Dirs in capitals, files in lower case, so you can distinguish them easily.

**Happy mailing!!!**

Appendix 5.3.9.1 continued

## YOUR MINIMAL MANUAL FOR E-MAIL

(Version 3)

**Before you do anything...read the note below!**

### KEY

---

**CLICK ON** means - click on the item  
with the mouse

**(CR)** means - press the carriage return  
key

**(Ctrl-D)** means hold down the control  
key and type D simultaneously

**(Ctrl-U)** means hold down the control  
key and type U simultaneously

---

## LOGGING ON TO E-MAIL

---

### ***1. THE TERMINALS YOU MAY USE***

You may access the mail facility from the following terminals - ADM 22, ADM 5, Apricot F2/1, a networked Mac, Sun Workstation, and VT100.

### ***2. HOW TO LOG ON***

ADM 5/22 When in the Adam Smith Building, you will have the PAD prompt, so type CALL PSY (rtn).

3. ***MACINTOSH USERS*** - Using Netmac A, click on NCSA Telnet 1.12, go to the file menu, click open connection, click OK.

***NO MATTER WHAT TYPE OF TERMINAL YOU ARE USING GO AHEAD AND TRY THE FOLLOWING .....***

Type your login name, then your password, these will not appear on the screen. Press return. Both your login and your password must be in lower case.

---

### ***\*FIRST AID\****

1 Error message "login incorrect"

This refers to either your login name or your password. Don't worry! Try again!

2 If you see the following message, " command not found/command unknown" do not panic! Maybe you mistyped, or missed out a space...try again!

---

## RECEIVING REPLYING SENDING

---

### **1. RECEIVING MAIL**

Whenever you log on to e-mail, you will be told whether you have any new mail awaiting you. Your new mail is divided into the constituent messages so that you can deal with them in any order that you choose.

Type mail (rtn). Now type 1 (rtn) to read the first message, and 2 to read the second one and so on.

---

### **2. REPLYING**

Type r (rtn).

You may now compose a reply.

At the end of the message, press (rtn) and type a full stop, then (rtn) again.

Your message has now been sent. This is confirmed by "EOT".

### **3. SENDING MAIL**

When you send someone mail it is delivered to a (conceptual) mail box from which they can receive it when they next log on.

If you want to mail Jane, then type mail jane (rtn)

Go ahead and state what the title of your message is!

Do not expect a prompt at this stage. Just start typing your message! As with replying to messages, type a full stop on a blank line at the end of your message to send it off.

---

### **\*TRY IT !\***

Using the above instructions, send a message to a friend!

Ask them to check whether they received it.

---

### **\*FIRST AID\***

Beware-you must (rtn) at the end of every line as the system will not do this automatically.

---

## URGENT MESSAGES AND LOGGING OUT

---

### 1. URGENT MESSAGES

Write is the command that lets you do this. Write interrupts whatever the recipient is doing, with your message.

Type `w (rtn)`.

If the person you wish to contact is logged on, use the write command.

e.g.

```
harrier%write susan (rtn)
```

Susan will receive your message immediately, but only if she is logged on.

---

### 2. LOGGING OUT

Ctrl-D on a terminal.

Clover-D on a Mac.

---

### **\*FIRST AID\***

1 To delete a character use the delete key, or backspace on Macs.

2 To delete a whole line, Ctrl-U

---

### **\*HINT\***

To check if someone has accessed and read a message you sent, type -

```
finger marie
```

This tells you when Marie last read her mail, and whether she has any unread mail.

---

## ALIASES

---

### *ALIASES*

When you tell the mail system to send a message it refers to a system file `"/usr/lib/aliases"` which contains a list of what are known as aliases. `marie` is aliased to

```
marie@kite.psy.glasgow.ac.uk
```

The Sun server holds everyone's mail spool file eg `/usr/spool/mail/marie` where mail messages are stored until read and saved by you or else deleted. It would be a waste of time having to type `judith@kite.psy.glasgow.ac.uk` for each message, so a shorthand/alias is used. This is expanded by `sendmail` when it refers to the aliases file.

To see the list of aliases type -

```
cd..(rtn)
```

```
ls (rtn)
```

---

### **\*FIRST AID\***

Error message "too many arguments" means that you should have typed `cd` then one space and two dots together.

---

## FILES AND DIRECTORIES

---

### *1. FILES*

If you are reading a message and want to save it in a file, type `& s judith (rtn)`. This saves the message in a file called `judith`. More `judith (rtn)` or `cat judith (rtn)` will let you view this file.

All subsequent messages that you save in the file `judith` will be appended

Type `mail -f mbox/judith (rtn)` and the mail program will display the messages separately, i.e. with headers etc.

`ls (rtn)` to view your files

`rm judith (rtn)` removes judith

`mv judith judy (rtn)` changes the file name

`cat judith isobel>HCI (rtn)` creates the file HCI from judith and Isobel

`mail keith <HCI (rtn)` sends the HCI file to Keith

To view the contents of your mailbox-

`harrier% more mbox (rtn)`

`Q (rtn)` to quit.

---

## DIRECTORIES

---

Directories are like folders, they can contain files and other directories. There is a single root directory owned by the system. This is a hierarchical system. Each user has a home directory which is the starting position for that person logging on, and a working directory. Initially your working directory is your home directory.

Type `pwd (rtn)` to view your working directory

`mkdir judith (rtn)` creates a directory called judith

`ls (rtn)` lets you check it was formed

`rmdir (rtn)` removes the directory

---

### **\*HINT\***

Good idea to keep Dirs in capitals, files in lower case, so you can distinguish them easily.

Appendix 5.3.9.1 continued

## A MINIMAL MANUAL FOR E-MAIL

### (VERSION 4)

This manual is intended to provide you with enough basic information of the important areas of e-mail to allow you to get ahead with your own work as quickly and as easily as possible

#### KEY

---

**CLICK ON** means - click on the item  
with the mouse

**(CR)** means - press the carriage  
return key

**(Ctrl-D)** means hold down the control  
key and type D simultaneously

**(Ctrl-U)** means hold down the control  
key and type U simultaneously

---

## LOGGING ON...THE FIRST STEP

---

### Sun Workstation users....

*login*   *type*   *your*   *login*   *name*  
*password*   *type*   *your*   *password*

Don't worry, your password will not appear on the screen when you type it. If you are using suntools, then click the right mouse button to open file. The screen menus will guide you through mail. To exit suntools click the right mouse button outside the window and select "exit suntools".

---

### Macintosh users.....

Using Netmac A, double click on NCSA Telnet 1.12, go to file menu. Click OK. Login as above.

---

### ADM 5/22 users.....

Type your login name. Next type in your password. This will not appear on the screen. Press (cr). Your login and password must both adhere to the system case requirements, i.e. always lower, or always upper case.

---

---

### \*HELP\*

1 Error message "login incorrect"

This may refer to either your login name or your password. Don't worry! Try again.

---

## RECEIVING REPLYING SENDING

---

### 1. RECEIVING MAIL

Type *mail* (cr)

Now type *1*(cr) to read the first message. Type *2*(cr) to read the second one, etc.

### 2. REPLYING

Do you want to reply straight away? If so, then .....

Type *r* (cr).

You may now compose a reply.

At the end of your message, press (cr) and type a full stop, then (cr) again.

Your message has now been sent. This is confirmed by "EOT"

### 3. SENDING MAIL

If you want to send someone a message, then type *mail*

e.g. if you want to mail Jane, then type *mail jane* (cr)

When asked for a subject name, just give a short title to your message.

---

### **\*TRY IT !\***

Using the above instructions, send a message to a friend.  
Ask them to check whether they received it.

---

### **\*HELP\***

A word of caution-you must (cr) at the end of every line as the system will not do this automatically.

A full stop at the beginning of a line on its own sends the message off, i.e. (cr)

---

## URGENT MESSAGES AND LOGGING OUT

---

### 1. URGENT MESSAGES

There is a command that lets you interrupt whatever the recipient is doing, with your message.

Type *W* (cr).

If the person you wish to contact is logged on e.g. susan, then use the write command. (ctrl-d) to exit.

e.g.

harrier% *write susan* (cr)

---

### 2. LOGGING OUT

Ctrl-D on a terminal.

Clover-D on a Mac.

---

#### \*HELP\*

- 1 To delete a character use the delete key, or backspace on Macs.
  - 2 To delete a line, Ctrl-U
- 

#### \*HINT\*

To check if someone e.g. Marie has accessed and read a message you sent, type

*finger marie*

This tells you when Marie last read her mail, and whether she has any unread mail.

---

## ALIASES

It would be a waste of time having to type `judith@kite.psy.glasgow.ac.uk` for each message you wanted to send to this person, so a shorthand/alias is used.

Keith is aliased to `keith@kite.psy.glasgow.ac.uk`

To see the list of aliases type -

***ls-a*** (cr)

---

**\*HELP\***

Error message "Too many arguments".  
Maybe you misspelled or got your spacing wrong...try again!

---

## FILES

Your incoming mail is stored in a standard file the system mailbox for that user. When you read messages your system mailbox is the default place that they get sent to. This is called your mbox and is in what is called your home directory.

You can save messages in files quite easily. Have a go at the following -

---

### 1. SAVING A MESSAGE IN A FILE

If you are reading a message and want to save it in a file called `judith`, type

**& s *judith*** (cr). This saves the message in a file called `judith`

***More judith*** (cr) or ***cat judith*** (cr) will let you view this file.

All subsequent messages that you save in the file `judith` will be appended.

Type ***mail -f mbox/judith*** (cr) and the mail program will display the messages separately, i.e. with headers etc.

***ls*** (cr) lets you have a look at all of your files

***rm judith*** (cr) removes the file called `judith`

*mv judith judy* (cr) changes the file name from judith to judy

*cat judith isobel>HCI* (cr) creates the file HCI from judith  
and Isobel

*mail keith <HCI* (cr) sends the HCI file to Keith

To view the contents of your mailbox-

harrier% *more mbox* (cr)

*Q* (cr) to quit.

---

**\*TRY IT !\***

Use the above command to view your mail box and familiarise yourself with the concept. Take as much time as you like, and don't be afraid of not getting it right first time.

---

**\*HELP\***

"*s judith*" will only work with the "&" prompt.

---

## DIRECTORIES

Directories are like folders - they can contain files and other directories. You have a home directory which is the starting position for you when you log on.

---

Type *pwd* (cr) to view your working directory

*mkdir judith* (cr) creates a directory called judith

*ls* (cr) lets you check it was formed

*rmdir* (cr) removes the directory

---

**\*HINT\***

Here's a good idea - keep your directories in capitals, and your files in lower case, so you can distinguish them at a glance.

Appendix 5.3.9.1 continued

## A MINIMAL MANUAL FOR EMAIL

### (VERSION 6)

Electronic mail (e-mail) is a quick and efficient way of contacting people at home or abroad (as long as they have access to e-mail too). This manual is intended to provide you with enough basic information of the important areas of e-mail to allow you to get ahead with your own work as quickly and as easily as possible

### READ THIS KEY NOW

-----  
**CLICK ON** means - click on the item  
with the mouse

**(CR)** means - press the carriage  
return key

**(Ctrl-D)** means hold down the control  
key and type D simultaneously

**(Ctrl-U)** means hold down the control  
key and type U simultaneously  
-----

## LOGGING ON...THE FIRST STEP

Do you have your login name? Have you arranged how to set your password with the computer manager? OK, you are ready to start!

---

### Sun Workstation users....

*login type your login name*  
*password type your password*

Don't worry, your password will not appear on the screen when you type it. If you are using suntools, then click the right mouse button to open file. The screen menus will guide you through mail. To exit suntools click the right mouse button outside the window and select "exit suntools".

---

### Macintosh users.....

Using Netmac A, double click on NCSA Telnet 1.12, go to file menu. Click OK. Login as above.

---

### ADM 5/22 users.....

Type your login name. Next type in your password. This will not appear on the screen. Press (cr). Your login and password must both adhere to the system case requirements, i.e. always lower, or always upper case.

---

---

### \*HELP\*

1 Error message "login incorrect"

This may refer to either your login name or your password. Don't worry! Try again.

---

## RECEIVING REPLYING SENDING

---

### 1. RECEIVING MAIL

Type *mail* (cr)

Now type *1*(cr) to read the first message. Type *2*(cr) to read the second one, etc.

### 2. REPLYING

Do you want to reply straight away? If so, then .....

Type *r* (cr).

You may now compose a reply.

At the end of your message, press (cr) and type a full stop, then (cr) again. Your message has now been sent. This is confirmed by "EOT"

If you want to reply to more than one person at a time, then (have a look at the header to check if the message you have just read is from a group) then type *R* then proceed with your message in the usual manner.

### 3. SENDING MAIL

If you want to send someone a message, then type *mail* (cr)

e.g. if you want to mail Jane, then type *mail jane* (cr)

If you want to mail a lot of people at once, then type

*mail jane, susan, steve* (cr)

When you see the word "subject:" on your screen, this is the invitation to state what your message will be about. When you have done a carriage return, you may start to type your message.

---

### \*TRY IT !\*

Using the above instructions, send a message to a friend.  
Ask them to check whether they received it.

---

### \*HELP\*

A word of caution-you must (cr) at the end of every line as the system will not do this automatically.

## URGENT MESSAGES AND LOGGING OUT

---

### 1. URGENT MESSAGES

There is a command that lets you interrupt whatever the recipient is doing, with your message.

Type **W** (cr).

If the person you wish to contact is logged on e.g. susan, then use the write command. (ctrl-d) to exit.

e.g.

harrier% **write susan** (cr)

Alternatively, if you would like to chat with someone, but do not want to interrupt them, then instead of write use **talk**

---

### **\*TRY IT OUT!\***

Use talk in the way you have been shown how to use write, and see how you get on!

---

### 2. LOGGING OUT

Ctrl-D on a terminal.

Clover-D on a Mac. - it's that simple!

---

### **\*HELP\***

- 1 To delete a character use the delete key, or backspace on Macs.
  - 2 To delete a line, Ctrl-U
- 

### **\*HINT\***

To check if someone e.g. Marie has accessed and read a message you sent, type

**finger marie**

This tells you when Marie last read her mail, and whether she has any unread mail.

---

## ALIASES

It would be a waste of time having to type `judith@kite.psy.glasgow.ac.uk` for each message you wanted to send to this person, so a shorthand/alias is used.

Keith is aliased to `keith@kite.psy.glasgow.ac.uk`

To see the list of aliases type -

***ls-a*** (cr)

**\*HELP\***

Error message "Too many arguments".  
Maybe you misspelled or got your spacing wrong...try again!

## FILES

Your incoming mail is stored in a standard file the system mailbox for that user. When you read messages your system mailbox is the default place that they get sent to. This is called your mbox and is in what is called your home directory.

You can save messages in files quite easily. Have a go at the following -

### 1. SAVING A MESSAGE IN A FILE

If you are reading a message and want to save it in a file called `judith`, type

**& s *judith*** (cr). This saves the message in a file called `judith`

**More *judith*** (cr) or **cat *judith*** (cr) will let you view this file.

All subsequent messages that you save in the file `judith` will be appended.

Type **mail -f *mbox/judith*** (cr) and the mail program will display the messages separately, i.e. with headers etc.  
If you are in the middle of reading a message and want to escape, then do `ctrl-U`.

**ls** (cr) lets you have a look at all of your files

*rm judith* (cr) removes the file called judith  
*mv judith judy* (cr) changes the file name from judith to judy  
*cat judith isobel>HCI* (cr) creates the file HCI from judith  
 and Isobel

*mail keith <HCI* (cr) sends the HCI file to Keith

To view the contents of your mailbox-

harrier% *more mbox* (cr)

*Q* (cr) to quit.

---

**\*TRY IT !\***

Use the above command to view your mail box and familiarise yourself with the concept. Take as much time as you like, and don't be afraid of not getting it right first time.

---

**\*HELP\***

"*s judith*" will only work with the "&" prompt.

---

## DIRECTORIES

Directories are like folders - they can contain files and other directories. You have a home directory which is the starting position for you when you log on.

---

Type *pwd* (cr) to view your working directory

*mkdir judith* (cr) creates a directory called judith

*ls* (cr) lets you check it was formed

*rmdir* (cr) removes the directory

---

**\*HINT\***

Here's a good idea - keep your directories in capitals, and your files in lower case, so you can distinguish them at a glance.

## Appendix 5.3.10

**Pilot Stage Rating Scale Questionnaire**      Manual Version no \_\_\_\_\_

Subject no \_\_\_\_\_      Male/Female

Please rate the following aspects of the manual you received, on a scale of 0-10, with 0 representing extremely negative, 10 representing extremely positive.

How easy did you find the language to understand ?

0    1    2    3    4    5    6    7    8    9    10

How helpful was the manual ?

0    1    2    3    4    5    6    7    8    9    10

How helpful did you find the Hints section?

0    1    2    3    4    5    6    7    8    9    10

How easy did you find the manual to use?

0    1    2    3    4    5    6    7    8    9    10

How convenient did you find the manual's length?

0    1    2    3    4    5    6    7    8    9    10

How convenient did you find the manual's layout?

0    1    2    3    4    5    6    7    8    9    10

How well did the manual compare with other forms of documentation?

0    1    2    3    4    5    6    7    8    9    10

How readily would you use this manual form to learn about advanced features of e-mail?

0    1    2    3    4    5    6    7    8    9    10

**Appendix 5.3.12**

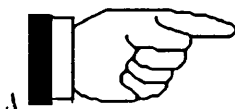
**Pages 254-261**

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X  
Y  
Z

## YOUR MINIMAL MANUAL FOR EMAIL



(Version 7)



### IMPORTANT!

READ THIS KEY BEFORE YOU START!

CLICK ON means - click on the item with the mouse

(return) means - press the carriage return key

(Ctrl-Z) means hold down the control key and type Z simultaneously

(Ctrl-U) means hold down the control key  
and type U simultaneously

Electronic mail (e-mail) is a quick and efficient method of communication. You can use it to send and receive messages to and from other users on the computer immediately, or arrange for delivery when they next log in, and to store these messages in files for future reference. This manual will help you to learn how to use e-mail both quickly and easily. It gives you enough information to allow you to get started and to let you use the system in a straightforward way.

## LOGGING ON



### THIS SECTION IS IMPORTANT. READ IT!

First you should receive your username and password from your computer manager. Your username identifies you and your files. It gives access to your account, which gives you a share of all the resources of the computer. You have complete control over your account, and your work will be protected from other users who use the same system as you.

You will be working on two different levels in UNIX so you will use two prompts. One level uses the > prompt; the other level uses the & prompt. When at the & prompt, type Ctrl-Z to get the > prompt when you need to. If you keep typing it, you will eventually log yourself out.

#### Sun Workstation

login *type your login name* (return)

password *type your password* (return)

#### \*TRY IT

!\* 

Go ahead and login !

#### \*HELP

\* 

! Error message "login incorrect"

This refers to either your login name or your password. Don't worry! Try again.

## ACCESSING REPLYING SENDING



### 1. ACCESSING MAIL

Type *mail* (return)

If you have any mail, type *1* (return) to read your first message. Type *2* (return) to read the second one, etc.

### 2. HOW TO REPLY TO MESSAGES

Type *r* (return). You should be at the & level to do this.

You may now compose a reply!

At the end of the message, press (return) and type a full stop, then (return) again.

Your message has now been sent. This is confirmed by "EOT"

### 3. HOW TO SEND PEOPLE MESSAGES

After you have logged on, type *mail* (return)

eg. if you want to mail Jane, then type *mail jane* (return), or mail gkwy12..etc.

Now type in the name of your message, after the subject prompt. Press return, and start to write your message on the next line. Sign off/end your message using the procedure given in the section above.

To broadcast the same message to several individuals,

type *mail susan, david* (return)

**\*TRY IT !\***



Using the above instructions, send a message to a friend.

Ask them to check whether they received it.

**\*HELP\***



Beware, you must press return at the end of each line. The computer will not do it automatically.

## URGENT MESSAGES AND LOGGING OUT

### 1. HOW TO SEND URGENT MESSAGES

There is a command called Write which interrupts whatever your recipient is doing, with your message.

Obtain the `>` prompt as explained earlier.

Type `w` (return).

If the person you wish to contact is logged on eg susan, then just go ahead and use the write command.

Use Ctrl-Z to exit this mode, now use the write command in the way you used the mail command before.

eg.

harrier%*write susan* (return)

### 2. HOW TO LOG OUT

Type Ctrl-Z then press return - it's that simple.

It is essential that you log off after you have finished what you are doing, so that noone can misuse your account, and computer resources are not wasted.

**\*HELP\***



1 To delete a character use the delete key

2 To delete a line, Ctrl-U

**\*HINT\***



To check if someone eg gkwy12.. has accessed and read a message you sent,

make sure you have the `>` prompt, then type -

*finger marie*

This tells you when Marie last read her mail, and whether she has any unread mail.

Go ahead and try it!

## ALIASES



### 1. ALIASES

It would be a waste of time having to type `judith@kite.psy.glasgow.ac.uk` for each message, so a shorthand/alias is used. This is expanded by `sendmail` when it refers to the aliases file.

Keith is aliased to `keith@kite.psy.glasgow.ac.uk`

To see the list of aliases first get the `>` prompt, then type-

Now you are ready to see your list of files -

`ls ..` (return)

## FILES



A file is a collection of information. We need to create, read, transmit and manipulate information, such as experimental results or email messages. Each of your files has a name. The only character you cannot use in a file name is / (the slash character), you may also have some problems with \* and ?. You cannot have two files with the same name.

### 1. SAVING A MESSAGE IN A FILE

Type *mail -f /jyour login name* (return) and the mail program will display your messages separately, ie with headers etc.

If you are reading a message and want to save it in a file, type

*& s judith* (return). This saves the message in a file called judith.

Make sure you have the '&' prompt at this stage.

You must have a message to save in the first place if you want to do this last step.

*More judith* (return) or *cat judith* (return) will let you view this file.

All subsequent messages that you save in the file judith will be appended.

Type *ctrl-Z* now

Obtain the > prompt

*ls* (return) to view your files

If a file is longer than one page, then Ctrl-S will halt the scrolling on the screen, and Ctrl-Q will let it carry on again. Alternatively, you can use the command, more, which lets you view a page at a time, and to bring up the next page, simply press the spacebar. When using more, type q to exit.

***rm judith*** (return) removes the file called judith

***mv judith judy*** (return) changes the file name to judy

***cat judith isobel>HCI*** (return) creates the file HCI from judith and Isobel

***mail keith <HCI*** (return) sends the HCI file to Keith

To view the contents of your mailbox-

harrier% ***more mbox*** (return)

***Q*** (return) to quit.

**\*TRY IT !\***



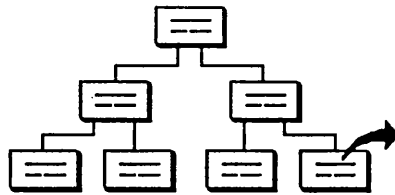
Use the above command to view your mail box and familiarise yourself with the concept. Open up a file for your mail

**\*HELP\***



"s judith" will only work with the "&" prompt.

## DIRECTORIES



All of your files are grouped together into a hierarchical directory structure, and within this directory your files may be grouped into further subdirectories. Unix uses the directory to locate all your files; it is useful to group your files into directories by topic. If you want to refer to a file in directory other than the one that you are in at the present time, then you need to select its pathname ie where it is in the directory hierarchy. A forward slash (/) indicates the root directory, which is at the head of the hierarchy. It also separates the names of directories in the pathname.

The topmost directory is the root directory. (Think of an upside down tree). To find out the full pathname of your working directory use the `pwd` command.

Type `pwd` (return) to view your working directory

`mkdir judith` (return) creates a directory called judith

`ls` (return) lets you check it was formed

`rmdir` (return) removes the directory

You can change the names of directories in the same way as for files.

**\*HINT\***



Good idea to keep Dirs in capitals, files in lower case, so you can distinguish them easily.

## Appendix 5.3.12.1

**Post criterion test semi-structured interview agenda**

Subject no\_\_\_\_\_Sex\_\_\_\_\_ MM/CM

1. How satisfied were you with your manual?
  
2. Would you like to use this form of manual again to learn more advanced features of e-mail if given a choice?
  
3. What were the main problems if any with your manual?

**Appendix 5.5.1**  
**Scheffe post-hoc tests**

pp. 263-286

**One Factor ANOVA X<sub>1</sub>: version Y<sub>1</sub>: lang**

Analysis of Variance Table


Source:	DF:	Sum Squares:	Mean Square:	F-test:
Between groups	6	19.968	3.328	1.604
Within groups	93	192.942	2.075	p = .1547
Total	99	212.91		

Model II estimate of between component variance = .209

1  



**One Factor ANOVA X<sub>1</sub>: version Y<sub>1</sub>: lang**

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
one	10	6.9	1.37	.433
two	12	7	1.954	.564
three	13	7.846	.987	.274
four	7	7	1.291	.488
five	32	7.969	1.402	.248

2  


**One Factor ANOVA X<sub>1</sub>: version Y<sub>1</sub>: lang**

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
six	12	7.833	1.03	.297
seven	14	7.143	1.748	.467

3  


**One Factor ANOVA X<sub>1</sub>: version Y<sub>1</sub>: lang**

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnnett t:
one vs. two	-.1	1.225	.004	.162
one vs. three	-.946	1.203	.406	1.562
one vs. four	-.1	1.41	.003	.141
one vs. five	-1.069	1.036*	.699	2.048
one vs. six	-.933	1.225	.382	1.513

\* Significant at 95%

4

**One Factor ANOVA X<sub>1</sub>: version Y<sub>1</sub>: lang**

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnnett t:
one vs. seven	-.243	1.184	.028	.407
two vs. three	-.846	1.145	.359	1.467
two vs. four	0	1.36	0	0
two vs. five	-.969	.968*	.658	1.987
two vs. six	-.833	1.168	.335	1.417

\* Significant at 95%

5

**One Factor ANOVA X<sub>1</sub>: version Y<sub>1</sub>: lang**

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnnett t:
two vs. seven	-.143	1.125	.011	.252
three vs. four	.846	1.341	.262	1.253
three vs. five	-.123	.941	.011	.259
three vs. six	.013	1.145	8.239E-5	.022
three vs. seven	.703	1.102	.268	1.268

6

One Factor ANOVA  $X_1$ : version  $Y_1$ : lang

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnnett t:
four vs. five	-.969	1.194	.433	1.612
four vs. six	-.833	1.36	.247	1.216
four vs. seven	-.143	1.324	.008	.214
five vs. six	.135	.968	.013	.278
five vs. seven	.826	.917	.534	1.789

7

One Factor ANOVA  $X_1$ : version  $Y_1$ : lang

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnnett t:
six vs. seven	.69	1.125	.247	1.219

8

One Factor ANOVA X<sub>1</sub>: version Y<sub>2</sub>: help

Analysis of Variance Table

Source:	DF:	Sum Squares:	Mean Square:	F-test:
Between groups	6	48.371	8.062	2.824
Within groups	93	265.469	2.855	p = .0143
Total	99	313.84		

Model II estimate of between component variance = .868

9

One Factor ANOVA X<sub>1</sub>: version Y<sub>2</sub>: help

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
one	10	7	1.491	.471
two	12	6	2.174	.628
three	13	6	1.633	.453
four	7	7	1.155	.436
five	32	5.219	1.475	.261

10

One Factor ANOVA X<sub>1</sub>: version Y<sub>2</sub>: help

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
six	12	7	1.954	.564
seven	14	6	1.84	.492

11

**One Factor ANOVA X<sub>1</sub>: version Y<sub>2</sub>: help**

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
one vs. two	1	1.437	.318	1.382
one vs. three	1	1.411	.33	1.407
one vs. four	0	1.654	0	0
one vs. five	1.781	1.216*	1.411	2.91
one vs. six	0	1.437	0	0

\* Significant at 95%

12

**One Factor ANOVA X<sub>1</sub>: version Y<sub>2</sub>: help**

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
one vs. seven	1	1.389	.341	1.43
two vs. three	0	1.343	0	0
two vs. four	-1	1.596	.258	1.245
two vs. five	.781	1.136	.311	1.366
two vs. six	-1	1.37	.35	1.45

13

**One Factor ANOVA X<sub>1</sub>: version Y<sub>2</sub>: help**

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
two vs. seven	0	1.32	0	0
three vs. four	-1	1.573	.266	1.263
three vs. five	.781	1.104	.329	1.406
three vs. six	-1	1.343	.364	1.479
three vs. seven	0	1.292	0	0

14

**One Factor ANOVA X<sub>1</sub>: version Y<sub>2</sub>: help**

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
four vs. five	1.781	1.4*	1.064	2.527
four vs. six	0	1.596	0	0
four vs. seven	1	1.553	.272	1.279
five vs. six	-1.781	1.136*	1.617	3.115
five vs. seven	-.781	1.075	.347	1.443

\* Significant at 95%

15

**One Factor ANOVA X<sub>1</sub>: version Y<sub>2</sub>: help**

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
six vs. seven	1	1.327	.377	1.505

16

One Factor ANOVA  $X_1$ : version  $Y_3$ : hints

Analysis of Variance Table

Source:	DF:	Sum Squares:	Mean Square:	F-test:
Between groups	6	42.334	7.056	2.461
Within groups	93	266.626	2.867	$p = .0297$
Total	99	308.96		

Model II estimate of between component variance = .698

17

One Factor ANOVA  $X_1$ : version  $Y_3$ : hints

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
one	10	6	2.404	.76
two	12	6	2.174	.628
three	13	6.308	1.548	.429
four	7	5.143	1.345	.508
five	32	7	1.136	.201

18

One Factor ANOVA  $X_1$ : version  $Y_3$ : hints

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
six	12	7.5	1.883	.544
seven	14	6	1.84	.492

19

**One Factor ANOVA X<sub>1</sub>: version Y<sub>3</sub>: hints**

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
one vs. two	0	1.44	0	0
one vs. three	-.308	1.414	.031	.432
one vs. four	.857	1.657	.176	1.027
one vs. five	-1	1.218	.443	1.63
one vs. six	-1.5	1.44*	.713	2.069

\* Significant at 95%

20

**One Factor ANOVA X<sub>1</sub>: version Y<sub>3</sub>: hints**

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
one vs. seven	0	1.392	0	0
two vs. three	-.308	1.346	.034	.454
two vs. four	.857	1.599	.189	1.064
two vs. five	-1	1.138	.507	1.745
two vs. six	-1.5	1.373*	.785	2.17

\* Significant at 95%

21

**One Factor ANOVA X<sub>1</sub>: version Y<sub>3</sub>: hints**

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
two vs. seven	0	1.323	0	0
three vs. four	1.165	1.576	.359	1.467
three vs. five	-.692	1.106	.258	1.243
three vs. six	-1.192	1.346	.516	1.759
three vs. seven	.308	1.295	.037	.472

22

**One Factor ANOVA X<sub>1</sub>: version Y<sub>3</sub>: hints**

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnnett t:
four vs. five	-1.857	1.403*	1.152	2.629
four vs. six	-2.357	1.599*	1.428	2.927
four vs. seven	-.857	1.557	.199	1.094
five vs. six	-.5	1.138	.127	.872
five vs. seven	1	1.078	.566	1.843

\* Significant at 95%

23

**One Factor ANOVA X<sub>1</sub>: version Y<sub>3</sub>: hints**

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnnett t:
six vs. seven	1.5	1.323*	.845	2.252

\* Significant at 95%

24

One Factor ANOVA  $X_1$ : version  $Y_4$ : ease

Analysis of Variance Table

Source:	DF:	Sum Squares:	Mean Square:	F-test:
Between groups	6	55.486	9.248	2.981
Within groups	93	288.554	3.103	$p = .0104$
Total	99	344.04		

Model II estimate of between component variance = 1.024

25

One Factor ANOVA  $X_1$ : version  $Y_4$ : ease

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
one	10	4	1.054	.333
two	12	6.25	2.301	.664
three	13	4	2.273	.63
four	7	5.286	1.38	.522
five	32	5.188	1.615	.286

26

One Factor ANOVA  $X_1$ : version  $Y_4$ : ease

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
six	12	5	1.414	.408
seven	14	6	1.84	.492

27

**One Factor ANOVA X<sub>1</sub>: version Y<sub>4</sub>: ease**

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnnett t:
one vs. two	-2.25	1.498*	1.483	2.983
one vs. three	0	1.471	0	0
one vs. four	-1.286	1.724	.366	1.481
one vs. five	-1.188	1.267	.577	1.861
one vs. six	-1	1.498	.293	1.326

\* Significant at 95%

28

**One Factor ANOVA X<sub>1</sub>: version Y<sub>4</sub>: ease**

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnnett t:
one vs. seven	-2	1.448*	1.253	2.742
two vs. three	2.25	1.4*	1.697	3.191
two vs. four	.964	1.664	.221	1.151
two vs. five	1.062	1.184	.529	1.782
two vs. six	1.25	1.428	.504	1.738

\* Significant at 95%

29

**One Factor ANOVA X<sub>1</sub>: version Y<sub>4</sub>: ease**

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnnett t:
two vs. seven	.25	1.376	.022	.361
three vs. four	-1.286	1.64	.404	1.557
three vs. five	-1.188	1.151*	.7	2.05
three vs. six	-1	1.4	.335	1.418
three vs. seven	-2	1.347*	1.448	2.948

\* Significant at 95%

30

One Factor ANOVA X<sub>1</sub>: version Y<sub>4</sub>: ease

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnnett t:
four vs. five	.098	1.46	.003	.134
four vs. six	.286	1.664	.019	.341
four vs. seven	-.714	1.619	.128	.876
five vs. six	.188	1.184	.016	.314
five vs. seven	-.812	1.121	.345	1.44

31

One Factor ANOVA X<sub>1</sub>: version Y<sub>4</sub>: ease

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnnett t:
six vs. seven	-1	1.376	.347	1.443

32

One Factor ANOVA X<sub>1</sub>: version Y<sub>5</sub>: length

Analysis of Variance Table

Source:	DF:	Sum Squares:	Mean Square:	F-test:
Between groups	6	117.857	19.643	8.975
Within groups	93	203.533	2.189	p = .0001
Total	99	321.39		

Model II estimate of between component variance = 2.909

33

One Factor ANOVA X<sub>1</sub>: version Y<sub>5</sub>: length

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
one	10	4.9	1.101	.348
two	12	4.417	2.466	.712
three	13	6.154	1.951	.541
four	7	6.143	1.345	.508
five	32	5.125	1.185	.209

34

One Factor ANOVA X<sub>1</sub>: version Y<sub>5</sub>: length

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
six	12	7.833	1.03	.297
seven	14	7	1.038	.277

35

**One Factor ANOVA X<sub>1</sub>: version Y<sub>5</sub>: length**

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
one vs. two	.483	1.258	.097	.763
one vs. three	-1.254	1.236*	.677	2.015
one vs. four	-1.243	1.448	.484	1.705
one vs. five	-.225	1.064	.029	.42
one vs. six	-2.933	1.258*	3.574*	4.631

\* Significant at 95%

36

**One Factor ANOVA X<sub>1</sub>: version Y<sub>5</sub>: length**

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
one vs. seven	-2.1	1.216*	1.959	3.428
two vs. three	-1.737	1.176*	1.434	2.933
two vs. four	-1.726	1.397*	1.003	2.453
two vs. five	-.708	.995	.333	1.414
two vs. six	-3.417	1.199*	5.334*	5.657

\* Significant at 95%

37

**One Factor ANOVA X<sub>1</sub>: version Y<sub>5</sub>: length**

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
two vs. seven	-2.583	1.156*	3.284*	4.439
three vs. four	.011	1.377	4.184E-5	.016
three vs. five	1.029	.966*	.745	2.115
three vs. six	-1.679	1.176*	1.34	2.836
three vs. seven	-.846	1.132	.368	1.485

\* Significant at 95%

38

One Factor ANOVA X<sub>1</sub>: version Y<sub>5</sub>: length

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
four vs. five	1.018	1.226	.453	1.649
four vs. six	-1.69	1.397*	.962	2.403
four vs. seven	-.857	1.36	.261	1.252
five vs. six	-2.708	.995*	4.875*	5.408
five vs. seven	-1.875	.941*	2.607*	3.955

\* Significant at 95%

39

One Factor ANOVA X<sub>1</sub>: version Y<sub>5</sub>: length

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
six vs. seven	.833	1.156	.342	1.432

40

One Factor ANOVA X<sub>1</sub>: version Y<sub>6</sub>: layout

Analysis of Variance Table

Source:	DF:	Sum Squares:	Mean Square:	F-test:
Between groups	6	105.647	17.608	6.435
Within groups	93	254.463	2.736	p = .0001
Total	99	360.11		

Model II estimate of between component variance = 2.479

41

One Factor ANOVA X<sub>1</sub>: version Y<sub>6</sub>: layout

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
one	10	6	1.826	.577
two	12	5	1.414	.408
three	13	6.077	2.1	.582
four	7	6.143	1.345	.508
five	32	8.031	1.356	.24

42

One Factor ANOVA X<sub>1</sub>: version Y<sub>6</sub>: layout

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
six	12	7	1.954	.564
seven	14	7.143	1.748	.467

43

**One Factor ANOVA X<sub>1</sub>: version Y<sub>6</sub>: layout**

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
one vs. two	1	1.407	.332	1.412
one vs. three	-.077	1.382	.002	.111
one vs. four	-.143	1.619	.005	.175
one vs. five	-2.031	1.19*	1.915	3.39
one vs. six	-1	1.407	.332	1.412

\* Significant at 95%

44

**One Factor ANOVA X<sub>1</sub>: version Y<sub>6</sub>: layout**

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
one vs. seven	-1.143	1.36	.464	1.669
two vs. three	-1.077	1.315	.441	1.626
two vs. four	-1.143	1.562	.352	1.453
two vs. five	-3.031	1.112*	4.885*	5.414
two vs. six	-2	1.341*	1.462	2.962

\* Significant at 95%

45

**One Factor ANOVA X<sub>1</sub>: version Y<sub>6</sub>: layout**

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
two vs. seven	-2.143	1.292*	1.807	3.293
three vs. four	-.066	1.54	.001	.085
three vs. five	-1.954	1.08*	2.151	3.592
three vs. six	-.923	1.315	.324	1.394
three vs. seven	-1.066	1.265	.467	1.673

\* Significant at 95%

46

One Factor ANOVA X<sub>1</sub>: version Y<sub>6</sub>: layout

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnnett t:
four vs. five	-1.888	1.371*	1.248	2.736
four vs. six	-.857	1.562	.198	1.09
four vs. seven	-1	1.521	.284	1.306
five vs. six	1.031	1.112	.565	1.842
five vs. seven	.888	1.053	.468	1.676

\* Significant at 95%

47

One Factor ANOVA X<sub>1</sub>: version Y<sub>6</sub>: layout

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnnett t:
six vs. seven	-.143	1.292	.008	.22

48

One Factor ANOVA X<sub>1</sub>: version Y<sub>7</sub>: compare

Analysis of Variance Table

Source:	DF:	Sum Squares:	Mean Square:	F-test:
Between groups	6	26.458	4.41	1.988
Within groups	93	206.292	2.218	p = .0752
Total	99	232.75		

Model II estimate of between component variance = .365

49

One Factor ANOVA X<sub>1</sub>: version Y<sub>7</sub>: compare

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
one	10	7	1.491	.471
two	12	7.833	1.03	.297
three	13	6.154	1.951	.541
four	7	8	.816	.309
five	32	7.344	1.066	.188

50

One Factor ANOVA X<sub>1</sub>: version Y<sub>7</sub>: compare

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
six	12	7	1.954	.564
seven	14	6.857	1.916	.512

51

**One Factor ANOVA X<sub>1</sub>: version Y<sub>7</sub>: compare**

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
one vs. two	-.833	1.266	.285	1.307
one vs. three	.846	1.244	.304	1.351
one vs. four	-1	1.458	.309	1.362
one vs. five	-.344	1.072	.068	.637
one vs. six	0	1.266	0	0

52

**One Factor ANOVA X<sub>1</sub>: version Y<sub>7</sub>: compare**

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
one vs. seven	.143	1.225	.009	.232
two vs. three	1.679	1.184*	1.322	2.817
two vs. four	-.167	1.407	.009	.235
two vs. five	.49	1.001	.157	.971
two vs. six	.833	1.208	.313	1.371

\* Significant at 95%

53

**One Factor ANOVA X<sub>1</sub>: version Y<sub>7</sub>: compare**

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
two vs. seven	.976	1.164	.463	1.666
three vs. four	-1.846	1.387*	1.165	2.644
three vs. five	-1.19	.973*	.983	2.429
three vs. six	-.846	1.184	.336	1.419
three vs. seven	-.703	1.139	.251	1.226

\* Significant at 95%

54

One Factor ANOVA X<sub>1</sub>: version Y<sub>7</sub>: compare

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
four vs. five	.656	1.234	.186	1.056
four vs. six	1	1.407	.332	1.412
four vs. seven	1.143	1.369	.458	1.658
five vs. six	.344	1.001	.077	.682
five vs. seven	.487	.948	.173	1.02

55

One Factor ANOVA X<sub>1</sub>: version Y<sub>7</sub>: compare

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
six vs. seven	.143	1.164	.01	.244

56

One Factor ANOVA X<sub>1</sub>: version Y<sub>g</sub>: use again

Analysis of Variance Table

Source:	DF:	Sum Squares:	Mean Square:	F-test:
Between groups	6	32.574	5.429	1.976
Within groups	93	255.536	2.748	p = .0769
Total	99	288.11		

Model II estimate of between component variance = .447

57

One Factor ANOVA X<sub>1</sub>: version Y<sub>g</sub>: use again

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
one	10	6.2	1.687	.533
two	12	6.833	1.697	.49
three	13	6.308	2.25	.624
four	7	7	1.291	.488
five	32	7.375	1.008	.178

58

One Factor ANOVA X<sub>1</sub>: version Y<sub>g</sub>: use again

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
six	12	6	2.174	.628
seven	14	6	1.84	.492

59

**One Factor ANOVA X<sub>1</sub>: version Y<sub>g</sub>: use again**

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
one vs. two	-.633	1.41	.133	.892
one vs. three	-.108	1.385	.004	.154
one vs. four	-.8	1.622	.16	.979
one vs. five	-1.175	1.193	.638	1.957
one vs. six	.2	1.41	.013	.282

60

**One Factor ANOVA X<sub>1</sub>: version Y<sub>g</sub>: use again**

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
one vs. seven	.2	1.363	.014	.291
two vs. three	.526	1.318	.105	.792
two vs. four	-.167	1.566	.007	.211
two vs. five	-.542	1.114	.155	.965
two vs. six	.833	1.344	.253	1.231

61

**One Factor ANOVA X<sub>1</sub>: version Y<sub>g</sub>: use again**

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
two vs. seven	.833	1.295	.272	1.278
three vs. four	-.692	1.543	.132	.891
three vs. five	-1.067	1.083	.639	1.958
three vs. six	.308	1.318	.036	.464
three vs. seven	.308	1.268	.039	.482

62

One Factor ANOVA X<sub>1</sub>: version Y<sub>g</sub>: use again

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnnett t:
four vs. five	-.375	1.374	.049	.542
four vs. six	1	1.566	.268	1.268
four vs. seven	1	1.524	.283	1.303
five vs. six	1.375	1.114*	1.001	2.451
five vs. seven	1.375	1.055*	1.117	2.589

\* Significant at 95%

63

One Factor ANOVA X<sub>1</sub>: version Y<sub>g</sub>: use again

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnnett t:
six vs. seven	0	1.295	0	0

64

Appendix 6.3.1

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## YOUR MINIMAL MANUAL FOR EMAIL



(Version 7A)



### IMPORTANT!

READ THIS KEY BEFORE YOU START!

CLICK ON means - click on the item with the mouse

(return) means - press the carriage return key

(Ctrl-Z) means hold down the control key and type Z simultaneously

(Ctrl-U) means hold down the control key  
and type U simultaneously

## LOGGING ON



**THIS SECTION IS IMPORTANT. READ IT!**

You will be working on two different levels in UNIX so you will use two prompts  
One level uses the > prompt; the other level uses the & prompt. When at the &  
prompt, type Ctrl-Z to get the > prompt when you need to.

### Sun Workstation

login *type your login name* (return)

password *type your password* (return)

### **\*HELP**



\*

1 Error message "login incorrect"

This refers to either your login name or your password. Don't worry! Try again.

## ACCESSING REPLYING SENDING



### 1. ACCESSING MAIL

Type *mail* (return)

If you have any mail, type *1*(return) to read your first message. Type *2* (return) to read the second one, etc.

### 2. HOW TO REPLY TO MESSAGES

Type *r* (return).

At the end of the message, press (return) and type a full stop, then (return) again.

Your message has now been sent. This is confirmed by "EOT"

### 3. HOW TO SEND PEOPLE MESSAGES

After you have logged on, type *mail* (return)

eg. if you want to mail Jane, then type *mail jane* (return), or mail gkwy12..etc.

Now type in the name of your message, after the subject prompt. Press return,  
and start to write your message on the next line.

To broadcast the same message to several individuals,

type *mail susan, david* (return)

\*HELP\*



Beware, you must press return at the end of each line. The computer will not do it automatically.

A full stop at the beginning of a line on its own sends the message off, ie (return)

## URGENT MESSAGES AND LOGGING OUT

### 1. HOW TO SEND URGENT MESSAGES

Write interrupts whatever the recipient is doing, with your message.

Obtain the > prompt as explained earlier

Type *w* (return).

If the person you wish to contact is logged on eg susan, use the write command.

Use Ctrl-Z to exit this mode, now use the write command in the way you used the mail command before.

eg.

harrier%*write susan* (return)

### 2. HOW TO LOG OUT

Type Ctrl-Z then press return

I

\*HELP\*



1 To delete a character use the delete key

2 To delete a line, Ctrl-U

## ALIASES



### 1. ALIASES

Keith is aliased to `keith@kite.psy.glasgow.ac.uk`

To see the list of aliases first get the `>` prompt, then type-

`ls ..` (return)

## FILES



A file is a collection of information.

### 1. SAVING A MESSAGE IN A FILE

**& s *judith*** (return). This saves the message in a file called *judith*.

Make sure you have the '&' prompt at this stage.

You must have a message to save in the first place if you want to do this last step.

***More judith*** (return) or ***cat judith*** (return) will let you view this file.

All subsequent messages that you save in the file *judith* will be appended.

Type ***ctrl-Z*** now

Obtain the **>** prompt

***ls*** (return) to view your files

***rm judith*** (return) removes the file called *judith*

***mv judith judy*** (return) changes the file name to *judy*

*cat judith isobel*>*HCI* (return) creates the file HCI from judith and Isobel

*mail keith* <*HCI* (return) sends the HCI file to Keith

To view the contents of your mailbox-

harrier% *more mbox* (return)

*Q* (return) to quit.

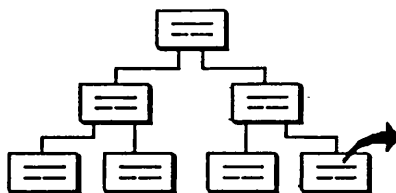
\*



**\*HELP\***

"s judith" will only work with the "&" prompt.

## DIRECTORIES



Type *pwd* (return) to view your working directory

*mkdir judith* (return) creates a directory called judith

*ls* (return) lets you check it was formed

*rmdir* (return) removes the directory.

You can change the names of directories in the same way as for files.

**\*HINT\***



Good idea to keep Dirs in capitals, files in lower case, so you can distinguish them easily.

## Appendix 6.3.6

**Previous experience questionnaire**

Sex: M/F (please circle)

Age:

Faculty:

Please indicate your choice of answer by underlining it

1. How extensive would you say your experience with computers is:

none at all

some

a lot

(a lot means a thorough knowledge of a wide cross-section of systems  
and packages)

2. Please indicate the type of experience (hands-on) you have had with computers  
by underlining those boxes which apply.

Programming e.g. Pascal, Fortran, Basic

Spreadsheets e.g. Lotus 1-2-3, Excel, Wingz

Mainframe e.g. SPSSx

Word-processing e.g. MacWrite, WORD

3. Please state which terminals you have worked on:

Sun Workstation    IBM        ADM        Macintosh

Apricot            Other (please state)

4. Is this a normal day for you? Yes/No (Please circle one)

If not, could you briefly say why?

---

Thank you

## Appendix 7.4.2

### Focus group / semi-structured interview agenda

1. General discussion about the ranges of experiences people have with computers.
2. Discussion of a frightening experience.
3. How do such situations make people feel?
4. Social reflection: do you prefer to work socially or in isolation?
5. Help-seeking - where do they look for help when having problems?
6. Are there other situations in life that cause comparable levels of fear and anxiety?
7. General discussion of the accompanying physiological effects when things go wrong.
8. Is there any purpose of emotions in these situations?
9. To whom do they attribute blame. Self or other?
12. What happens, and how do you feel when things do work out well?

## Appendix 7.5.2 The unfactorised checklist of cognitions and emotions

**Checklist of Cognition and Emotion**

Please rate your strength of agreement with each of the following statements by circling a number. 0 means you don't feel it at all; 10 means it is as strong as you have ever felt.

I feel confused 0 1 2 3 4 5 6 7 8 9 10

I can't wait to leave this situation 0 1 2 3 4 5 6 7 8 9 10

I know it is silly that this task affects me in this way 0 1 2 3 4 5 6 7 8 9 10

I always feel like this in this sort of situation 0 1 2 3 4 5 6 7 8 9 10

I do not know why I am affected in this way 0 1 2 3 4 5 6 7 8 9 10

I feel that I could do this task if it were not on the computer e.g. paper analog 0 1 2 3 4 5 6 7 8 9 10

I feel that I could never do this task 0 1 2 3 4 5 6 7 8 9 10

This task is making me nervous 0 1 2 3 4 5 6 7 8 9 10

This task is affecting me adversely 0 1 2 3 4 5 6 7 8 9 10

I feel that this situation is not a true reflection of my abilities 0 1 2 3 4 5 6 7 8 9 10

I feel sick	0	1	2	3	4	5	6	7	8	9	10
I would rather be somewhere else	0	1	2	3	4	5	6	7	8	9	10
I feel more nervous than usual	0	1	2	3	4	5	6	7	8	9	10
I feel more anxious than usual	0	1	2	3	4	5	6	7	8	9	10
I feel like I am falling apart	0	1	2	3	4	5	6	7	8	9	10
I feel that everything is alright	0	1	2	3	4	5	6	7	8	9	10
I feel that nothing bad will happen	0	1	2	3	4	5	6	7	8	9	10
I feel that everything is getting on top of me	0	1	2	3	4	5	6	7	8	9	10
I feel stupid	0	1	2	3	4	5	6	7	8	9	10
I have got butterflies	0	1	2	3	4	5	6	7	8	9	10
I am useless at this type of thing	0	1	2	3	4	5	6	7	8	9	10
I feel that I am a failure	0	1	2	3	4	5	6	7	8	9	10
I feel tense	0	1	2	3	4	5	6	7	8	9	10
I never was the type of person who could do this sort of task	0	1	2	3	4	5	6	7	8	9	10
I feel like I am going to pieces	0	1	2	3	4	5	6	7	8	9	10
I cannot concentrate on this task	0	1	2	3	4	5	6	7	8	9	10

I could do this task if I had unlimited time	0	1	2	3	4	5	6	7	8	9	10
I can feel my heart beating fast	0	1	2	3	4	5	6	7	8	9	10
I feel uncomfortable	0	1	2	3	4	5	6	7	8	9	10
I am breathing heavily	0	1	2	3	4	5	6	7	8	9	10
I am hopeless at this type of thing	0	1	2	3	4	5	6	7	8	9	10
I feel upset	0	1	2	3	4	5	6	7	8	9	10
I have got palpitations	0	1	2	3	4	5	6	7	8	9	10
I feel harrassed	0	1	2	3	4	5	6	7	8	9	10
It must be me	0	1	2	3	4	5	6	7	8	9	10
I don't have enough knowledge	0	1	2	3	4	5	6	7	8	9	10
I feel angry	0	1	2	3	4	5	6	7	8	9	10
Other people will think I am incapable	0	1	2	3	4	5	6	7	8	9	10
I feel too silly to ask someone else what to do	0	1	2	3	4	5	6	7	8	9	10
I feel frustrated	0	1	2	3	4	5	6	7	8	9	10
I am scared of looking silly	0	1	2	3	4	5	6	7	8	9	10
My mouth is dry	0	1	2	3	4	5	6	7	8	9	10

- I am sweating more than usual 0 1 2 3 4 5 6 7 8 9 10
- My mind is blank 0 1 2 3 4 5 6 7 8 9 10
- The task is impossible 0 1 2 3 4 5 6 7 8 9 10
- I am having a bad day 0 1 2 3 4 5 6 7 8 9 10
- If the task were something else  
then I could do it 0 1 2 3 4 5 6 7 8 9 10
- I feel involved in the task 0 1 2 3 4 5 6 7 8 9 10
- I know I could never do this task 0 1 2 3 4 5 6 7 8 9 10
- I worry about what others will think  
of me 0 1 2 3 4 5 6 7 8 9 10
- I cannot think clearly 0 1 2 3 4 5 6 7 8 9 10
- I feel unhappy 0 1 2 3 4 5 6 7 8 9 10
- I feel panicky 0 1 2 3 4 5 6 7 8 9 10

**Appendix 7.5.2.1**

**Unrotated and Rotated factor matrices**

**pp. 302-313**

**Unrotated Factor Matrix**

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
item 1	-.339	.387	.323	.257	.067	.123	.487	-.003
item2	.018	.426	-.051	.048	.015	-.727	-.174	-.03
item3	-.29	-.047	.339	.158	.091	-.21	.238	.471
item4	.23	.207	-.057	.383	.338	.114	.136	-.129
item5	.186	.428	.261	.064	.245	.334	-.03	.003
item6	.052	-.161	-.238	.093	.057	.135	-.046	.166
item7	-.188	-.038	.26	.443	.314	.035	-.238	.208
item8	.28	-.11	-.533	-.005	-.026	-.299	.28	-.001
item9	-.63	-.081	.074	-.259	.125	.161	.121	.253
item10	.189	.066	.04	.445	.158	.546	-.308	.187
item11	.113	-.046	.192	.504	-.043	-.359	.379	-.145
item12	-.722	.02	-.1	-.468	-.077	-.052	.297	.174
item13	.298	-.573	-.044	-.012	.262	-.215	-.265	.018
item14	.472	-.089	-.075	-.009	.038	.215	-.013	.125
item15	-.143	.138	.134	-.131	.498	-.087	-.362	.547
item16	.341	-.505	.107	-.308	-.311	.116	.317	.238

**Unrotated Factor Matrix**

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
item17	-.037	.618	.203	.181	-.406	-.049	.017	.166
item18	.184	.201	-.221	.07	.521	.429	.428	.021
item19	.321	-.09	.217	-.307	.179	-.056	.174	.16
item20	-.309	-.411	.515	.071	-.081	-.127	-.124	.042
item21	-.211	.458	-.607	.23	-.146	-.002	-.148	.071
item22	.02	-.134	.245	.105	.006	.595	-.144	.354
item23	.453	.476	-.158	.214	-.209	-.168	.24	.257
item24	-.528	-.21	-.42	.021	-.132	.107	.068	.126
item25	-.122	-.443	.301	-.396	.061	.186	-.124	-.159
item26	.439	.116	-.229	-.067	-.376	-.013	-.023	.168
item27	-.374	.649	.083	.357	.133	.243	-.12	.166
item28	-.227	.157	.228	-.042	-.543	.113	-.22	.229
item29	.245	.294	.033	-.058	-.301	-.199	.246	.21
item30	.275	-.007	.466	.14	-.091	-.179	-.161	.368
item31	-.038	-.316	-.407	.35	-.264	.031	.241	.502
item32	-.095	.274	.352	-.19	.448	-.446	-.219	.126

**Unrotated Factor Matrix**

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
item33	-.015	-.109	.399	.528	.276	-.038	.39	-.302
item34	.582	-.03	.054	-.485	.009	.062	-.199	.031
item35	.589	-.028	-.254	-.355	.103	.385	-.069	.104
item36	-.372	.054	-.395	-.166	.147	-.314	-.085	.136
item37	-.435	-.461	.243	.289	.055	-.326	.165	-.005
item38	.017	.177	.375	.081	-.468	.303	.308	-.196
item39	-.362	-.042	.055	.233	-.328	.175	-.342	-.234
item40	-.454	.075	-.321	.13	.041	.345	-.057	.092
item41	.209	.324	.248	-.383	-.014	-.123	-.048	.44
item42	.007	-.351	-.295	.401	.191	.307	-.09	.252
item43	.225	.084	.555	-.237	.187	.009	.315	.404
item44	-.228	-.435	.014	.152	.104	-.052	.301	.408
item45	-.208	.158	.357	-.404	.108	.126	.063	-.402
item46	.639	.495	.102	.051	-.15	-.086	-.021	.067
item47	.614	-.059	.006	.181	.569	.048	-.075	-.151
item48	.183	-.295	.218	.185	-.506	.08	-.412	-.143

**Unrotated Factor Matrix**

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
item49	-.046	.137	.027	.331	-.174	-.119	-.49	.06
item50	-.292	.066	-.129	-.054	.282	-.315	-.436	.109
item51	-.347	.259	.575	-.239	-.073	.348	-.105	-.178
item52	.423	-.352	.368	.474	-.005	-.282	-.093	-.153
item53	.229	-.405	.296	.18	-.357	.013	-.092	.35

**Unrotated Factor Matrix**

	Factor 9	Factor 10	Factor 11	Factor 12	Factor 13	Factor 14	Factor 15	Factor 16
item 1	-.024	.154	-.124	.08	.065	-.191	-.235	-.014
item2	.11	-.036	.015	.061	-.274	-.249	.076	-.092
item3	.171	-.077	-.118	.165	-.456	-.09	-.065	.22
item4	.183	-.007	-.428	.1	.37	-.189	.222	-.194
item5	-.135	.144	-.067	.358	-.292	-.038	-.124	.156
item6	.636	-.188	.057	.338	-.07	.165	-.095	.144
item7	-.301	.033	.179	.234	.093	-.143	.28	-.177
item8	-.001	-.216	-.088	.362	.254	.019	.015	-.039
item9	.268	.085	.11	-.347	.072	-.049	.024	-.149
item10	.069	-.182	.052	-.417	.071	.01	.041	.132
item11	.079	-.13	.142	-.127	.041	-.06	.271	.323
item12	-.115	.051	.065	.007	.114	.021	.03	.095
item13	-.227	.03	-.238	.051	.138	-.242	-.038	.296
item14	.341	-.256	.543	.062	.053	-.284	-.23	.007
item15	-.105	-.093	-.188	-.021	-.001	.195	-.092	.014
item16	.22	-.044	-.006	-.12	.089	-.209	.169	.107

**Unrotated Factor Matrix**

	Factor 9	Factor 10	Factor 11	Factor 12	Factor 13	Factor 14	Factor 15	Factor 16
item17	.109	.03	-.222	-.286	.198	.148	-.039	.092
item18	-.143	-.174	.183	-.118	.042	.037	-.049	-.189
item19	.567	.072	-.357	-.233	-.102	-2.93E-5	.025	-.152
item20	-.269	-.233	-.232	.187	-.016	-.159	.019	-.224
item21	.053	-.044	.033	.114	.002	.244	-.034	-.035
item22	.086	.204	-.092	.085	-.177	-.019	.354	-.058
item23	-.306	-.153	.132	.191	.164	.047	-.067	-.076
item24	-.253	-.117	-.213	.139	-.12	-.078	.177	.24
item25	-.032	.009	.067	.261	.248	.058	-.102	.064
item26	.308	.477	-.113	.103	-.139	.094	-.188	-.293
item27	.022	-.017	.032	-.061	-.084	-.219	.134	.034
item28	-.167	-.256	.152	-.097	.339	.062	.157	-.004
item29	-.023	.404	.05	.063	.214	-.307	.207	.194
item30	-.188	.022	.337	.022	-.018	.197	-.307	.207
item31	.1	.06	.271	.107	-.035	-.118	.026	-.098
item32	.109	-.254	-.009	.088	.304	.178	.092	-.122

**Unrotated Factor Matrix**

	Factor 9	Factor 10	Factor 11	Factor 12	Factor 13	Factor 14	Factor 15	Factor 16
item33	.105	.223	.195	-.057	.081	.082	-.007	-.022
item34	.114	-.044	.055	.131	.034	.001	.342	-.115
item35	-.149	.201	-.029	.043	.057	-.087	-.007	.194
item36	-.032	.281	-.056	-.152	.157	.158	.013	.339
item37	.375	.113	.142	-.051	-.068	.169	.116	-.035
item38	-.172	.143	.023	.208	.038	.419	.028	-.007
item39	.223	.375	-.065	.25	.279	-.008	.108	-.074
item40	.209	-.034	-.007	.265	.213	-.333	-.198	.106
item41	-.104	.362	.258	-.155	.17	-.177	.042	.005
item42	-.077	.317	-.235	-.022	-.002	.306	.071	.165
iyem43	-.096	-.047	-.299	.184	.115	.031	-.114	.01
item44	.053	.058	-.128	.017	.386	.107	-.308	-.15
item45	.34	.018	.152	.201	.13	.142	.098	.296
item46	.205	-.082	-.27	.098	-.045	.114	.093	.125
item47	-.016	.125	.207	-.054	.127	.15	.022	.07
item48	-.159	.016	-.192	-.21	.003	-.168	-.318	-.098

**Unrotated Factor Matrix**

	Factor 9	Factor 10	Factor 11	Factor 12	Factor 13	Factor 14	Factor 15	Factor 16
item49	.513	-.243	-.102	-.003	.243	-.048	-.119	.166
item50	.079	.483	.306	.185	-.018	-.001	.008	-.152
item51	.167	-.051	.08	.127	-.052	-.149	-.115	.05
item52	-.037	.309	-.017	.004	.064	-.116	-.118	.086
item53	.015	-.204	.156	.155	-.103	.235	.243	-.075

Unrotated Factor Matrix

	Factor 17
item 1	.102
item2	-.066
item3	-.252
item4	-.131
item5	.047
item6	-.249
item7	-.08
item8	.051
item9	.022
item10	-.1
item11	.296
item12	.008
item13	-.124
item14	.065
item15	.12
item16	-.021

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Unrotated Factor Matrix

	Factor 17
item17	-.003
item18	-.033
item19	.081
item20	.099
item21	.371
item22	.082
item23	-.112
item24	.125
item25	-.004
item26	-.06
item27	.028
item28	-.299
item29	-.005
item30	.18
item31	-.098
item32	.156

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Unrotated Factor Matrix

	Factor 17
item33	.178
item34	.243
item35	.245
item36	-.215
item37	.166
item38	-.067
item39	-.093
item40	.268
item41	.088
item42	.094
item43	.004
item44	-.009
item45	.057
item46	.012
item47	-.274
item48	.201

Unrotated Factor Matrix

	Factor 17
item49	.056
item50	-.003
item51	-.176
item52	-.057
item53	.068

Appendix 7.5.2.1.1

**Orthogonal Transformation Solution-Varimax**

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
item 1	-.111	.076	.307	.253	-.051	-.145	-.122	-.022
item2	.056	-.321	.006	-.408	.177	.096	.35	.181
item3	-.121	-.064	-.039	.092	-.001	-.125	-.021	.127
item4	.28	-.104	-.022	.05	.119	.145	-.114	.099
item5	.232	.156	.107	-.352	-.13	.007	-.029	.106
item6	.043	.14	.056	.08	.294	.253	.078	-.066
item7	.127	-.091	-.08	.047	-.068	-.141	.314	.275
item8	-.082	-.169	-.109	.106	-.051	.785	-.065	-.031
item9	-.474	.132	.168	.387	-.086	-.55	.158	.141
item10	.28	-.247	.009	-.049	.242	-.467	-.315	.089
item11	.066	-.131	-.028	-.117	.085	.129	-.225	-.037
item12	-.723	.259	.126	.296	-.218	-.086	.074	.067
item13	.189	-.026	-.895	.075	.024	.151	-.027	.05
item14	.208	.011	-.042	-.021	.031	.045	-.06	-.081
item15	-.048	-.117	-.116	.081	.029	-.132	.107	.812
item16	-.086	.131	-.234	.163	-.095	.024	-.344	-.269

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**Orthogonal Transformation Solution-Varimax**

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
item17	.06	-.153	.491	-.007	.479	-.159	-.31	.093
item18	.124	-.149	.202	.102	-.577	-.026	-.248	.13
item19	.153	.052	-.031	.049	-.011	-.126	-.108	.197
item20	-.147	.122	-.232	.191	.041	-.09	-.012	.162
item21	-.348	-.37	.442	-.154	.291	.32	.197	.077
item22	-.037	.06	.084	-.097	-.027	-.286	.042	-.007
item23	.276	-.383	.317	-.039	-.057	.476	-.248	.054
item24	-.738	-.131	-.171	.011	-.024	.141	-.043	-.137
item25	-.036	.665	-.264	.229	-.071	.002	.048	.03
item26	.281	-.234	.26	.029	.149	.239	.255	-.348
item27	-.181	-.182	.349	-.233	.196	-.399	.059	.198
item28	-.112	.111	.295	.1	.323	-.212	-.239	.017
item29	.006	-.053	.024	-.075	.05	.149	.008	-.175
item30	.366	-.032	.006	.083	.109	.002	-.051	.273
item31	-.201	-.446	.066	.359	-.007	.198	.146	-.345
item32	.093	.207	.057	-4.47E-4	.108	.044	.156	.873

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**Orthogonal Transformation Solution-Varimax**

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
item33	.354	.122	.11	.222	-.141	-.106	.066	-.077
item34	.141	.197	-.068	-.404	-.122	.204	.012	.209
item35	.076	.028	-.273	-.216	-.223	.19	-.149	-.028
item36	-.259	-.049	-.193	.161	.071	.003	.239	.109
item37	-.125	.095	.023	.328	.095	-.117	.33	-.001
item38	.19	.357	.562	.035	-.064	.117	-.262	-.314
item39	-.045	.302	.132	.116	.513	-.074	.4	-.338
item40	-.549	.061	-.007	.183	.307	.032	.144	-.058
item41	.076	.004	.05	-.013	-.12	-.207	.138	.28
item42	.026	-.259	-.186	.223	.025	.078	.071	-.053
item43	.17	.214	-.01	.219	-.204	.091	-.348	.437
item44	-.092	-.071	-.091	.861	.002	.11	-.014	.115
item45	-.073	.845	.152	-.182	.033	-.076	.015	.086
item46	.407	-.105	.214	-.431	.27	.298	-.31	.141
item47	.768	.016	-.249	-.062	-.243	.05	.027	.123
item48	.163	-.156	-.219	.047	.424	-.18	-.143	-.304

**Orthogonal Transformation Solution-Varimax**

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
item49	.053	-.038	.013	-.032	.876	-.029	.016	.156
item50	-.006	.003	-.061	.019	.046	-.072	.878	.2
item51	-.051	.619	.226	-.098	.125	-.458	-.044	-.012
item52	.641	-.072	-.399	.111	.175	.036	.088	-.205
item53	.134	-.043	.094	.018	.098	.141	-.092	.013

Appendix 7.5.2.1.1

**Orthogonal Transformation Solution-Varimax**

	Factor 9	Factor 10	Factor 11	Factor 12	Factor 13	Factor 14	Factor 15	Factor 16
item 1	.062	.19	-.115	.66	.166	.161	.259	-.102
item2	-.047	.148	-.099	.028	.261	.054	.074	-.583
item3	-.058	.023	-.051	.138	.914	-.127	.142	.005
item4	-.028	.034	-.012	.213	-.057	.829	.1	.115
item5	.061	.085	.037	.623	.173	-.042	-.15	.247
item6	-.164	-.307	.437	-.125	.432	.103	-.108	.204
item7	.583	.04	.006	.054	.146	.199	.151	.251
item8	-.036	-.002	.147	-.128	-.068	.197	.002	-.149
item9	-.154	-.003	.062	-.107	.065	.073	.027	.004
item10	.219	-.145	.307	.009	-.096	.118	-.026	.462
item11	.075	.122	.021	-.038	.071	-.008	.886	-.084
item12	.089	.14	-.196	-.047	.102	-.09	-.073	-.168
item13	.035	-.008	-.056	-.115	-.001	-.01	-.045	.091
item14	-.068	.065	.915	-.045	-.047	-.104	-.023	-.032
item15	-.013	-.037	-.077	.119	.133	-.137	-.233	.193
item16	-.38	.339	.264	-.451	.1	-.033	.038	.144

**Orthogonal Transformation Solution-Varimax**

	Factor 9	Factor 10	Factor 11	Factor 12	Factor 13	Factor 14	Factor 15	Factor 16
item17	-.01	.354	-.276	.119	-.001	-.011	.005	-.082
item18	.089	-.145	.376	.249	-.145	.302	-.02	.115
item19	-.847	.097	.063	-.112	.137	.18	.017	.03
item20	.166	-.144	-.262	-.062	.154	-.06	.09	-.055
item21	.118	-.152	.035	.194	-.252	-.042	-.042	.089
item22	-.057	.111	.078	-.02	.147	.103	-.08	.754
item23	.297	.388	.118	.084	.03	-.019	-.125	-.154
item24	.236	-.179	-.191	.009	.102	.007	-.02	.218
item25	.027	-.092	.027	-.111	-.11	-.134	-.128	.079
item26	-.503	.266	.015	-.005	-.001	-.075	-.351	.111
item27	.335	.106	.051	.429	.145	.254	.052	.097
item28	.494	.259	-.077	-.395	.028	-.081	-.258	-.056
item29	-.026	.827	-.041	.04	.043	.059	.091	-.045
item30	.145	.253	.122	.055	.094	-.693	.134	.077
item31	.128	.112	.356	-.219	.284	-.032	.068	.246
item32	-.006	.044	-.051	-.064	-.004	.09	.11	-.279

Appendix 7.5.2.1.1

Orthogonal Transformation Solution-Varimax

	Factor 9	Factor 10	Factor 11	Factor 12	Factor 13	Factor 14	Factor 15	Factor 16
item33	.03	-.078	-.014	.256	-.02	.087	.766	.057
item34	-.344	.254	.242	-.334	-.271	.013	-.187	.15
item35	-.236	.281	.264	.109	-.387	-.096	-.32	.396
item36	.087	.082	-.31	-.087	.065	-.034	-.085	-.067
item37	-.142	-.229	-.093	-.22	.26	-.089	.673	.026
item38	.16	.117	-.315	.07	.005	-.164	.043	.18
item39	.195	.002	-.214	.006	-.101	.211	-.023	.204
item40	.14	-.084	.347	.425	-.084	.19	-.047	.156
item41	-.088	.781	.091	-.01	-.091	-.215	-.15	-.048
item42	.017	-.201	-.15	.053	-.038	-.001	.069	.768
item43	-.217	.363	-.083	.201	.291	-.022	-.093	.076
item44	-.057	-.02	.008	-.01	.117	.012	.094	.128
item45	-.104	-.002	.026	.067	-.009	.022	.157	-.097
item46	-.274	.287	-.004	.076	.086	.079	-.085	.032
item47	.068	-.057	.22	-.019	-.101	.162	.069	.161
item48	-.046	-.058	-.118	.007	-.337	-.329	-.104	.014

Orthogonal Transformation Solution-Varimax

	Factor 9	Factor 10	Factor 11	Factor 12	Factor 13	Factor 14	Factor 15	Factor 16
item49	.009	-.104	.192	-.026	.037	.061	.059	-.041
item50	.1	.075	-.028	.029	.007	-.077	-.067	-.031
item51	.093	.021	.039	.243	.197	.006	-.171	-.127
item52	.004	.123	-.108	.043	.035	-.108	.378	.043
item53	.061	.026	.114	-.494	.222	-.303	.129	.354

Orthogonal Transformation Solution-Varimax

	Factor 17
item 1	.097
item2	-.019
item3	.079
item4	.017
item5	.072
item6	-.237
item7	.318
item8	-.1
item9	-.118
item10	-.122
item11	.006
item12	-.206
item13	.039
item14	.031
item15	-.054
item16	.171

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Orthogonal Transformation Solution-Varimax

	Factor 17
item17	-.128
item18	-.22
item19	.038
item20	.744
item21	-.287
item22	.293
item23	-.031
item24	-.052
item25	.204
item26	-.015
item27	-.069
item28	.135
item29	-.093
item30	.159
item31	-.003
item32	.04

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Orthogonal Transformation Solution-Varimax

	Factor 17
item33	.074
item34	.191
item35	-.127
item36	-.668
item37	.091
item38	.168
item39	.111
item40	-.048
item41	-.05
item42	-.205
item43	.266
item44	.06
item45	-.169
item46	-.038
item47	-.303
item48	.511

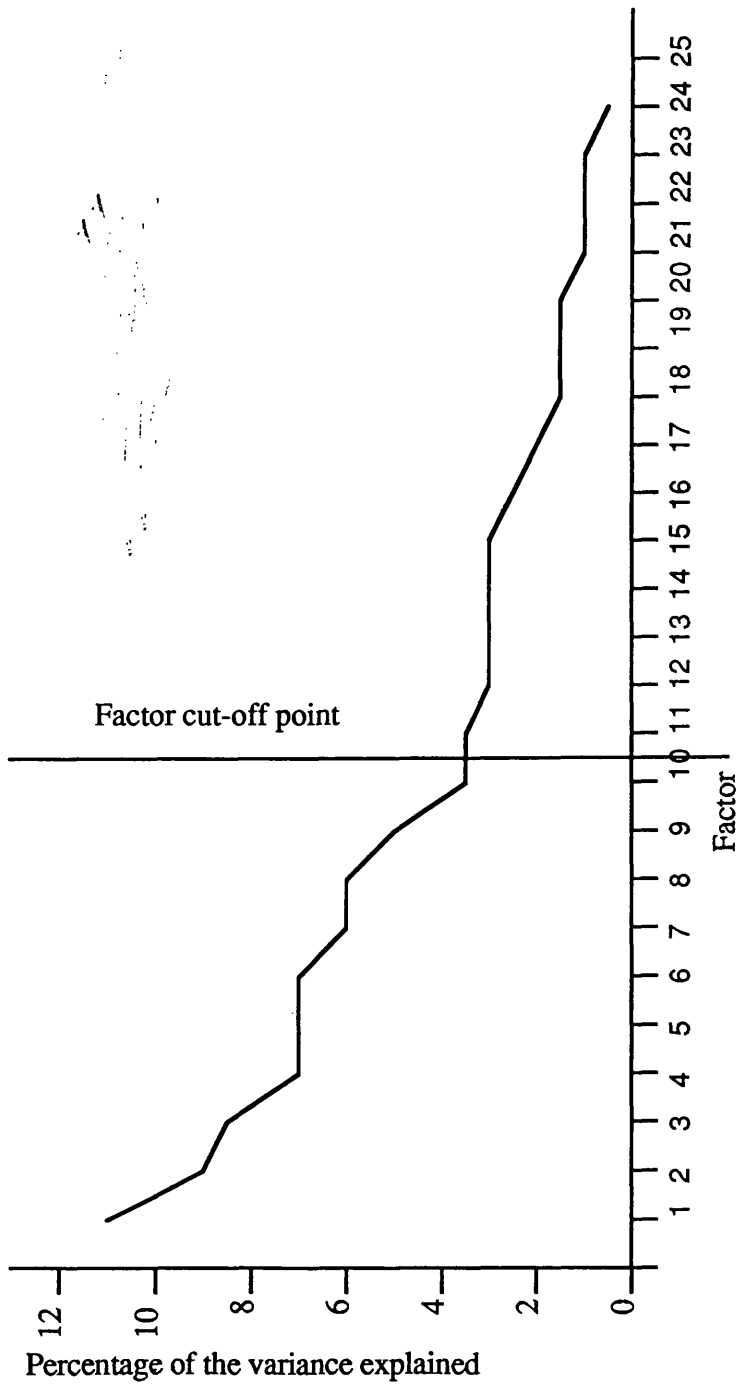
83

Orthogonal Transformation Solution-Varimax

	Factor 17
item49	-.027
item50	-.174
item51	.198
item52	.24
item53	.457

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Appendix 7.5.2.3



## Appendix 7.5.4.1 The final feature checklist of cognitions and emotions

**Feature Checklist of cognitions and emotions**

Please rate your strength of agreement with each of the following statements by circling a number. 0 means you don't feel it at all; 10 means it is as strong as you have ever felt.

I'm having a bad day and feel down      0 1 2 3 4 5 6 7 8 9 10

I'm confused, but I feel this is within  
my capabilities      0 1 2 3 4 5 6 7 8 9 10

This is a bad social reflection, but I am  
no more nervous than usual      0 1 2 3 4 5 6 7 8 9 10

My mind is blank      0 1 2 3 4 5 6 7 8 9 10

I feel good and involved in the task      0 1 2 3 4 5 6 7 8 9 10

I can't think clearly      0 1 2 3 4 5 6 7 8 9 10

I worry I will look stupid      0 1 2 3 4 5 6 7 8 9 10

I feel upset      0 1 2 3 4 5 6 7 8 9 10

My heart rate is faster than usual      0 1 2 3 4 5 6 7 8 9 10

This is a bad social reflection and  
it is making me uncomfortable      0 1 2 3 4 5 6 7 8 9 10

Appendix 7.5.5 and 7.5.5.1

Rotated and Unrotated Matrices for  
Principal Components Analysis

pp. 316-321

**Eigenvectors**

	Vector 1	Vector 2	Vector 3	Vector 4
Column 49	.017	-.115	.075	.176
Column 50	.098	-.052	.108	.146
Column 51	.143	-.166	-.266	-.014
Column 52	-.141	.131	-.061	.311
Column 53	-.056	.162	-.13	.171

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**Unrotated Factor Matrix**

	Factor 1	Factor 2	Factor 3	Factor 4
Column 1	-.3	.396	.26	-.142
Column 2	.087	.427	-.309	.473
Column 3	-.304	-.022	.26	.221
Column 4	.272	.179	-.083	-.256
Column 5	.252	.413	.319	-.147
Column 6	.05	-.176	-.215	-.037
Column 7	-.174	.023	.195	.099
Column 8	.29	-.237	-.512	-.126
Column 9	-.659	-.082	.197	-.209
Column 10	.206	.059	.126	-.238
Column 11	.063	.113	-.292	.419
Column 12	-.732	-.045	.127	-.21
Column 13	.222	-.579	-.005	.162
Column 14	.477	-.207	.015	-.087
Column 15	-.104	.146	.288	-.107
Column 16	.253	-.598	.284	-.02

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## Unrotated Factor Matrix

	Factor 1	Factor 2	Factor 3	Factor 4
Column 17	.031	.651	.112	.201
Column 18	.251	.044	-.004	-.763
Column 19	.296	-.138	.318	.024
Column 20	-.433	-.285	.462	.294
Column 21	-.101	.396	-.631	-.095
Column 22	.011	-.124	.442	-.184
Column 23	.53	.35	-.188	-.005
Column 24	-.528	-.204	-.316	-.277
Column 25	-.224	-.37	.419	-.028
Column 26	.506	.026	-.21	.257
Column 27	-.265	.681	.024	-.177
Column 28	-.243	.233	.225	.159
Column 29	.306	.227	.015	.195
Column 30	.236	.014	.385	.453
Column 31	-.023	-.44	-.407	.051
Column 32	-.085	.349	.268	.151

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## Unrotated Factor Matrix

	Factor 1	Factor 2	Factor 3	Factor 4
Column 33	.104	-.062	-.048	.318
Column 34	.589	.022	.203	-.077
Column 35	.61	-.171	.073	-.41
Column 36	-.324	.073	-.383	-.02
Column 37	-.508	-.347	.015	.432
Column 38	-.01	.241	.309	.061
Column 39	-.366	.108	-.09	.312
Column 40	-.397	.067	-.258	-.299
Column 41	.299	.261	.403	.132
Column 42	.146	-.277	.252	-.607
Column 43	.226	.032	.67	-.069
Column 44	-.273	-.461	.045	-.018
Column 45	-.241	.266	.345	-.069
Column 46	.688	.486	.059	.116
Column 47	.617	-.114	.031	-.109
Column 48	.106	-.265	.067	.44

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**Unrotated Factor Matrix**

	Factor 1	Factor 2	Factor 3	Factor 4
Column 49	-.043	.248	-.157	.351
Column 50	-.243	.113	-.225	.291
Column 51	-.356	.36	.556	-.028
Column 52	.35	-.284	.128	.62
Column 53	.139	-.352	.271	.34

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**Community Summary**

	SMC	Final Estimate		SMC	Final Estimate
Column 1	1	.334	Column 17	1	.478
Column 2	1	.509	Column 18	1	.647
Column 3	1	.21	Column 19	1	.208
Column 4	1	.178	Column 20	1	.569
Column 5	1	.357	Column 21	1	.574
Column 6	1	.081	Column 22	1	.245
Column 7	1	.079	Column 23	1	.439
Column 8	1	.418	Column 24	1	.497
Column 9	1	.524	Column 25	1	.363
Column 10	1	.118	Column 26	1	.367
Column 11	1	.277	Column 27	1	.566
Column 12	1	.598	Column 28	1	.189
Column 13	1	.411	Column 29	1	.183
Column 14	1	.279	Column 30	1	.409
Column 15	1	.127	Column 31	1	.363
Column 16	1	.503	Column 32	1	.224

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## Community Summary

	SMC	Final Estimate
Column 33	1	.118
Column 34	1	.394
Column 35	1	.575
Column 36	1	.257
Column 37	1	.565
Column 38	1	.157
Column 39	1	.251
Column 40	1	.317
Column 41	1	.337
Column 42	1	.531
Column 43	1	.505
Column 44	1	.289
Column 45	1	.252
Column 46	1	.726
Column 47	1	.407
Column 48	1	.28

	SMC	Final Estimate
Column 49	1	.211
Column 50	1	.207
Column 51	1	.566
Column 52	1	.604
Column 53	1	.332

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## Orthogonal Transformation Solution-Varimax

	Factor 1	Factor 2	Factor 3	Factor 4
Column 1	-.094	.505	-.265	.013
Column 2	.344	.064	-.014	-.622
Column 3	-.318	.26	.153	-.133
Column 4	.338	-.025	-.175	.18
Column 5	.366	.429	-.027	.197
Column 6	-.008	-.283	-.026	.003
Column 7	-.171	.203	.076	-.045
Column 8	.219	-.6	-.102	.025
Column 9	-.629	.23	-.262	.088
Column 10	.182	.065	-.034	.282
Column 11	.159	-.125	.096	-.477
Column 12	-.657	.221	-.343	.023
Column 13	-.113	-.419	.454	.126
Column 14	.292	-.241	.239	.28
Column 15	-.064	.32	-.037	.137
Column 16	-.148	-.242	.501	.414

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**Orthogonal Transformation Solution-Varimax**

	Factor 1	Factor 2	Factor 3	Factor 4
Column 17	.336	.508	-.106	-.309
Column 18	.243	-.083	-.402	.647
Column 19	.118	.073	.35	.258
Column 20	-.599	.271	.366	-.048
Column 21	.237	-.182	-.587	-.374
Column 22	-.135	.224	.16	.389
Column 23	.659	-.034	-.043	-.043
Column 24	-.484	-.255	-.444	-.016
Column 25	-.455	.114	.266	.269
Column 26	.473	-.237	.25	-.157
Column 27	.125	.508	-.518	-.151
Column 28	-.128	.381	.005	-.166
Column 29	.367	.099	.147	-.13
Column 30	.127	.262	.559	-.111
Column 31	-.17	-.57	.028	-.088
Column 32	.056	.449	.03	-.133

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**Orthogonal Transformation Solution-Varimax**

	Factor 1	Factor 2	Factor 3	Factor 4
Column 33	.06	-.078	.247	-.218
Column 34	.468	.018	.275	.316
Column 35	.415	-.228	.1	.584
Column 36	-.162	-.155	-.361	-.277
Column 37	-.612	-.066	.236	-.362
Column 38	.057	.385	.073	.013
Column 39	-.239	.111	-.043	-.424
Column 40	-.246	-.069	-.502	-.023
Column 41	.307	.398	.277	.083
Column 42	-.059	-.071	-.075	.719
Column 43	.082	.447	.356	.414
Column 44	-.473	-.203	.114	.107
Column 45	-.128	.473	-.095	.054
Column 46	.813	.203	.153	-.022
Column 47	.454	-.204	.245	.315
Column 48	-.066	-.119	.474	-.193

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**Orthogonal Transformation Solution-Varimax**

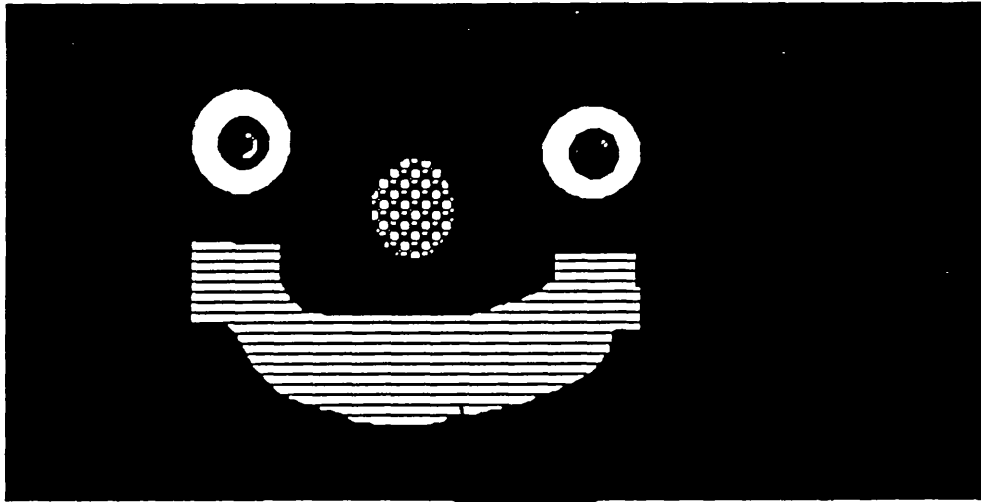
	Factor 1	Factor 2	Factor 3	Factor 4
Column 49	.116	.08	.013	-.437
Column 50	-.108	-.014	-.075	-.435
Column 51	-.217	.716	-.056	.055
Column 52	.116	-.133	.722	-.227
Column 53	-.119	-.042	.562	.016

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**Oblique Solution Primary Pattern Matrix-Orthotran/Varimax**

	Factor 1	Factor 2	Factor 3	Factor 4
Column 1	-.183	.519	-.268	.012
Column 2	.302	.007	.021	-.596
Column 3	-.356	.305	.121	-.156
Column 4	.355	-.067	-.132	.211
Column 5	.356	.399	.038	.244
Column 6	.018	-.289	-.037	-.006
Column 7	-.197	.23	.061	-.056
Column 8	.283	-.642	-.094	.029
Column 9	-.712	.305	-.342	.031
Column 10	.206	.051	-.004	.304
Column 11	.152	-.156	.106	-.469
Column 12	-.756	.294	-.431	-.039
Column 13	-.011	-.397	.44	.115
Column 14	.386	-.266	.281	.31
Column 15	-.094	.337	-.034	.14
Column 16	-.036	-.202	.494	.409

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## Appendix 8.3.1.2 Facial coding sheet

Subject no: \_\_\_\_\_ Sex : \_\_\_\_\_ Start point on video: \_\_\_\_\_

End point on video: \_\_\_\_\_

## Time points at which occurred on video

## 1. Forehead

*Frown**Brow raised*

## 2. Eyes

*Eyes widen**Eyes narrow**Peer*

## 3. Mouth

*Mouth open**Lip pout**Pucker**Pursed lips**Lip chew**Lip lick*

## 5. Chin

---

*Chin frown*

---

## 6. Head

---

*Head shake*

---

---

*Head tilt*

---

## 7. Face

---

*Face screw*

---

## 8. Smile

---

*Regular smile*

---

---

*Socially induced smile*

---

## 9. Laugh

---

*Regular laugh*

---

---

*Socially induced laugh*

---

9.2.5.1.1

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DATE	SITUATION Describe: 1. Actual event leading to unpleasant emotion, or 2. Stream of thoughts, daydream, or recollection, leading to unpleasant emotion.	EMOTION(S) 1. Specify sad/ anxious/ angry, etc. 2. Rate degree of emotion, 1-100.	AUTOMATIC THOUGHT(S) 1. Write automatic thought(s) that preceded emotion(s). 2. Rate belief in automatic thought(s), 0-100%.

9.2.5.1.1

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<b>RATIONAL RESPONSE</b> 1. Write rational response to automatic thought(s). 2. Rate belief in rational response, 0-100%.	<b>OUTCOME</b> 1. Re-rate belief in automatic thought(s), 0-100%. 2. Specify and rate subsequent emotions, 0-100.	<b>FURTHER ACTION</b>

# HAD Scale

Date:

As you are aware that emotions play an important part in most illnesses. If your doctor knows about these feelings he will be able to help you more. This questionnaire is designed to help your doctor to know how you feel. Read each item and place a firm tick in the box opposite the one which comes closest to how you have been feeling in the past week. Do not take too long over your replies: your immediate reaction to each item will probably be more accurate than a long thought-out answer.

*Tick only one box in each section*

**Feel tense or 'wound up':**

- Most of the time .....
- A lot of the time .....
- From time to time, Occasionally .....
- Not at all .....

<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>

**I feel as if I am slowed down:**

- Nearly all the time .....
- Very often .....
- Sometimes .....
- Not at all .....

<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>

**I don't enjoy the things I used to enjoy:**

- Definitely as much .....
- Not quite so much .....
- Only a little .....
- Hardly at all .....

<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>

**I get a sort of frightened feeling like 'butterflies' in the stomach:**

- Not at all .....
- Occasionally .....
- Quite often .....
- Very often .....

<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>

**I get a sort of frightened feeling as if something awful is about to happen:**

- Very definitely and quite badly .....
- Sometimes, but not too badly .....
- Only a little, but it doesn't worry me .....
- Not at all .....

<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>

**I have lost interest in my appearance:**

- Definitely .....
- I don't take so much care as I should.....
- I may not take quite as much care .....
- I take just as much care as ever .....

<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>

**I don't laugh and see the funny side of things:**

- As much as I always could .....
- Not quite so much now .....
- Definitely not so much now .....
- Not at all .....

<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>

**I feel restless as if I have to be on the move:**

- Very much indeed .....
- Quite a lot .....
- Not very much .....
- Not at all .....

<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>

**Worrying thoughts go through my mind:**

- A great deal of the time .....
- A lot of the time .....
- From time to time but not too often .....
- Only occasionally .....

<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>

**I look forward with enjoyment to things:**

- As much as ever I did .....
- Rather less than I used to .....
- Definitely less than I used to .....
- Hardly at all .....

<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>

**I feel cheerful:**

- Not at all .....
- Not often .....
- Sometimes .....
- Most of the time .....

<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>

**I get sudden feelings of panic:**

- Very often indeed .....
- Quite often .....
- Not very often .....
- Not at all .....

<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>

**I can sit at ease and feel relaxed:**

- Definitely .....
- Usually .....
- Not often .....
- Not at all .....

<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>

**I can enjoy a good book or radio or TV programme:**

- Often .....
- Sometimes .....
- Not often .....
- Very seldom .....

<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>

RALE: 9.3.1.3 329  
 DATE: \_\_\_\_\_

M.S.P.Q.

Please describe how you have felt during the PAST WEEK by making a check mark ✓ in the appropriate box. Please answer all questions. Do not think too long before answering.

	Not at all	A Little Slightly	A great deal. Quite a bit	Extremely, could not have been worse
Heart Rate Increasing				
Heart Beating Louder				
Heart Missing Beats				
Feeling Hot All Over				
Feeling hot in a particular part of body				
Blushing				
Sweating all over				
Sweating in a particular part of body				
Pulse in neck				
Pounding in head				
Dizziness				
Blurring of vision				
Feeling faint				
Everything appearing unreal				
Nausea				
Butterflies in stomach				
Pain or ache in stomach				
Stomach churning				
Desire to pass water				
Desire to defecate (open bowels)				
Diarrhoea				
Mouth becoming dry				
Difficulty swallowing				
Muscles in neck aching				
Difficulty in breathing				
Breathing becomes faster				
Breathing becomes shallow				
Hands shaking				
Legs feel weak				
Muscles twitching or jumping				
Tense feeling across forehead				
Tense feeling in jaw muscles				
Flatulence (wind)				