Everyday Time Processing

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Submitted for the degree of Ph.D. to the Higher Degree Committee of the College of Science and Engineering, University of Glasgow

May 2013

ABSTRACT

This thesis seeks to explore everyday aspects of time. Traditionally, the psychological study of time has been defined as the processes by which a person adapts to and represents temporal properties in order to synchronise external events. On the other hand, a good understanding of time is also vital when it comes to occupational and social organisation. How should time be considered across psychology remains an open question. While time perception is an established field in cognitive psychology, previous research has often focussed on either the perception of very short time intervals (milliseconds), or psychobiological effects of celestial time cycles (e.g. sleep/wake cycle or seasonal affective disorder). However, there remain several other aspects of time that while categorically different are no less important for example, 'mental time travel' or chronesthesia is the ability to mentally project into the future or past. While these phenomena are well acknowledged, it is only in the last few decades that research has started to document other 'higher level' cognitive processes that exist beyond traditional psychophysical constructs. By combining a range of experimental and secondary data analysis methodologies, this thesis examines the relationship between everyday units of time and systematic changes in behaviour across socially derived time cycles (i.e. the calendar week and the working day). It also considers the effects of individual differences on aspects of interpersonal organisation (e.g. punctuality and watch wearing). The main findings indicate that research into psychological time can and should go beyond minutes and seconds as present-day cognitive models are inadequate when it comes to accounting for everyday time processing errors. In addition, understanding the mechanisms behind higher-level timing processes may only become apparent if the topic makes a concentrated effort to become integrated with day-to-day cognition and behaviour. The results also have several applied implications including practical recommendations for optimising appointment systems in the National Health Service. Finally, these findings are discussed in relation to the ongoing debate regarding where psychological time research should focus future efforts if it is to maintain its current momentum from a theoretical and applied perspective.

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ACKNOWLEDGEMENTS

I would like to extend the sincerest of thanks to Dr Rob Jenkins for his support, encouragement and guidance over the many years we have worked together, from undergraduate level until the present day. I consider myself very lucky and privileged to work with you, from a personal and professional point of view. I would also like to thank Professor Richard Wiseman and Katie Higgins for their assistance in collecting data reported in Studies 2.2 and 8.3.

Special mention must also go to other members of staff in the School of Psychology at Glasgow who have provided many words of wisdom - Dr David Simmons, Dr Ian Bushnell, Dr Margaret Martin, Dr Simon Kyle, Professor Mike Burton, Dr Markus Bindermann, Dr David White and Dr Steve Draper.

Friends and family also deserve a great deal of credit. There are too many names to list individuals however, my Mum and Dad deserve a special mention for their limitless support.

Final thanks, for giving of their time, to the examiners of this thesis.

This research was primarily supported by a 1+3 studentship provided by The Economic and Social Research Council (ESRC) (ES/G017271/1). Additional funding included an ESRC Internship Award in 2011 (extension of ES/G017271/1), five Charles and Barbara Tyre Trust Grants between 2007 and 2011 and a University of Glasgow Mac Robertson Scholarship in 2010.

DECLARATION

I declare that this thesis is my own work carried out under the normal terms of supervision.

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David A. Ellis

Chapter 1
General Introduction

1.1 Introducing Psychological Time

When psychology emerged from its philosophical antecedents in the late 1800s, the study of time was at the forefront of this new discipline (Nichols 1891). James (1890) featured this centrality throughout his classic work *The Principles of Psychology*. In this, *time past* was a function of attention and memory - two topics that have become the most investigated of all psychological phenomena to date. A second Chapter in James' book, and central to his perspective and theoretical discussion was *time present*. In that Chapter, he discussed what was then known about time perception.

James saw time as a central component of the human psychological experience and it remains one of the most important dimensions that controls our lives and to a large extent, our behaviour. For many people, their first act of orientation in the morning is to ask what time it is - where they are in the day and how to pitch themselves towards it.

Presently, the psychology of time encapsulates a wide variety of phenomena that make it a truly interdisciplinary topic. For example, the ability to perceive and accurately estimate the passing of time is fundamental to adapting adequately to the environment which surrounds us (Block, Zakay & Hancock 1998; Pouthas & Perbal 2004). This includes processes by which a person adapts to and represents temporal properties in order to synchronise external events. For example, while crossing a busy street, speed and time estimates are continually required (Wittmann & Paulus 2007). At the same time, a sound understanding of time is also vital when it comes to occupational and social organisation (Hoffman 2009).

Part of that organisation is centred around our built in day or circadian rhythm, which tends to last about 24 hours. While indoor lighting has been shown to affect circadian rhythms, subsequent studies have demonstrated that the range of this 24 hour cycle was no more than 24 hours plus or minus 11 minutes (Czeisler et al. 1999). Markers for measuring such a rhythm include melatonin, core body temperature and levels of cortisol (Lange, Dimitrov & Born 2010). Under normal conditions, these basic rhythms regulate various physiological events that include the cell cycle, body temperature, metabolism, feeding and the most studied of all from a psychological point of view, the sleep-wake cycle.

While time perception and circadian rhythms are perhaps an obvious starting point, psychological time also includes what are often termed higher cognitive functions. For example, time management as defined by Lakein (1973) involves determining needs, setting goals to achieve these needs, prioritising the tasks required and matching tasks to time and resources through planning, scheduling and making lists. A failure of such processes is often referred to as 'the planning fallacy' whereby people and groups underestimate how much time they will need to complete a task even with prior experience (Kahneman & Tversky 1979). This effect has been extensively studied and been observed in tax form completion, construction, marketing and furniture assembly (Buehler, Griffin & Ross 2002). More recently, Lovallo & Kahneman (2003) expanded this definition as a tendency to underestimate time, costs and risks of future actions while simultaneously overestimating the benefits of these actions. Conversely, observers who are uninvolved show the opposite effect as they overestimate the amount of time required. Explanations for this effect tend to focus on not only focalism - ignoring factors that they believe lie out the specifics of a project, but also an underestimation of time for events that are included or ignored for example sickness, vacation and meetings (Lovallo & Kahneman 2003). This takes psychological time as a construct beyond minutes and seconds.

Similarly, the study of psychological time is also concerned with what is often referred to as delay discounting, that is, a delayed reward can become discounted when compared to the value of an immediate reward (Bickel & Marsch 2001). Everyday life predictions, evaluations, and choices often pertain to events that take place at some point in the near or distant future. For example, a person may decide a short or a long time in advance whether to order a new CD-player in the short term or buy a new CD for their collection now. The short term gain of a new CD might be favoured over a new player, which would improve the listening experience of all CDs in the long run - the delayed reward may be discounted for a new CD.

Kahneman and colleagues have also explored the effect of affective forecasting on decision making, that is, the prediction of one's emotional state in the future (Lovallo & Kahneman 2003). Similarly, time discounting (or preference) involves the tendency to weigh present events over future events. The effect of this on decision making and well-being has become particularly important in recent years. For example, an individual attempting to lose weight who is disappointed with slow progress in the present may abandon their diet because they cannot see the long term outcome (Takahashi 2005; Zauberman, Kim, Malkoc & Bettman 2009). This can be further explored in terms of temporal distance effects and how this apparent distance can affect an individuals' response to future events. To address such questions, Trope & Liberman (2003) proposed that temporal distance influences individuals' responses to future events by systematically changing the way they construe those events. Specifically, that individual's form more abstract representations, or high-level construals, of distant-future events than near-future events. High-level construals consist of general features that convey the essence of information about future events, whereas low-level construals include more concrete, contextual and incidental details.

In sum, a rapid overview of psychological time reveals it to be a very difficult topic to pin down. Perhaps unsurprisingly, the measures used to measure psychological time vary considerably, but despite James (1890) discussing the issue of time in terms of past and present events, which aligns itself more closely to the likes of Trope & Liberman (2003) above, it was interval measurement studies that dominated the experimental landscape from the early 1900s onwards.

1.2 A brief history of time perception

The perception of time has a strong tradition and despite the rise of behaviouralism, there still existed some pursuit of time perception during at least the first decade and a half of the 20th century. This included studies into the effects of rhythm (Dunlap 1915) and early observations on differences between the sexes. For example, MacDougall (1904) asked men and women to estimate intervals of 15, 30 and 60 seconds. He found that women tended to overestimate all these durations by a ratio of 1 to 4 when compared to men. Such research however, was rare and the study of physiological time perception almost died out with the ascendancy of behaviourism in the United States (Hancock & Block 2012). This was largely due to the fact that time estimation is difficult to observe directly. Unlike all other forms of sensory psychophysics, time refers to an evidently intangible quality. As Hancock (2011) argued, this is what makes the psychology of time difficult to comprehend above all other dimensions of experience. This observation is not true simply for the psychology of time, but for the study of time in general (Parker, Harris & Steincck 2010).

These early methodological difficulties however, did not prevent a number of European researchers continuing to study the apparently intractable nuances of time. Among these, Fançois (1927) was perhaps the first to highlight the important link between body temperature and the perception of brief temporal intervals, an effect verified by the American Psychologist Hoagland in 1933. Hoagland, using both his own data and others, proposed that estimates of duration were directly dependent on internal body temperature, that is, time appears to move more rapidly as body temperature increases. Modern versions of this experiment have used a heating helmet that provides radiant heat from an electrical source applied along the saggital line from frontal to occipital lobes. Varying levels of heat are then applied as participants estimate short durations lasting several seconds (Hancock 1993).

However, despite a strong historical and philosophical foundation, time perception devolved from being a pinnacle of importance to the point at which Adams in 1964 concluded:

'*time perception is a venerable, tired topic in psychology that interests very few active investigators any more because no one bothered to explore the mechanisms of time perception and how it might enter into meaningful interaction with other mechanisms*'

(p. 197)

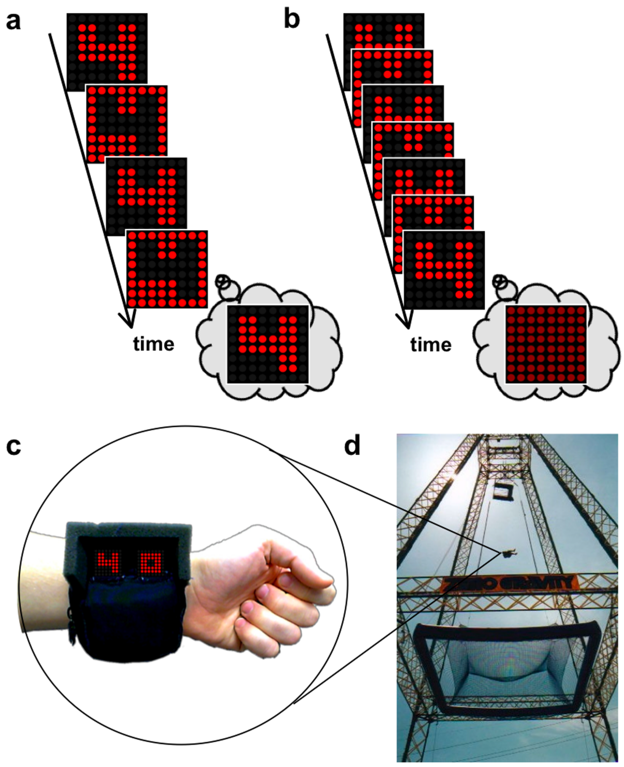
1.3 Resurrection: Abnormal time perception

Fortunately, while Adams (1964) announced the death of psychological time research, a number of studies began to initiate its resurrection. As was the case for other perceptual modalities (e.g., vision, touch), the field was significantly advanced by studying systematic errors in processing (Gregory 2010). Ornstein (1969), among others, explored the nonlinearity of temporal experience, which had become most evident under the influence of mind-altering drugs such as LSD, which causes a slowing of subjective time and leads to overestimates of duration (Fischer, Griffin & Liss 1962). This early lead was picked up by clinical psychologists interested in the relationship between other drug influences and more commonly occurring forms of mental illness (Orme 1969). Time perception became (and remains) a useful instrument for such explorations and reintroduced the perception of brief intervals of duration back into the mainstream of clinical efforts.

This trend has continued into the 21st century. For example, social interaction often requires the interpretation of fleeting signals, such as facial microexpressions and speech, and can also demand fine motor coordination (Burr & Morrone 2006). Accurate time perception is thus fundamental to social fluency, and states of mind characterised by disturbed time perception (e.g. schizophrenia [Davalos Kisley & Ross 2003] and some hallucinogenic states [Wittman et al., 2007]) can severely disrupt normal social interaction. For example, patients suffering from depression or autism are more likely to perceive a slowing of time (Watt 1991; Wittman & van Wassenhove 2009). Falter, Noreika, Wearden & Bailey (2012) however, used a temporal generalisation task, also known as a prior entry effect. Prior entry refers to the phenomenon whereby attended stimuli are perceived earlier than unattended stimuli (Shore 2001). In a typical study, attention is oriented to the left or right of fixation, and observers are required to indicate which of two subsequent stimuli, one presented on the left and one on the right, was presented first. In most studies, the interval between the two stimuli is varied, and the point of subjective simultaneity (PSS) is determined for each type of cue. The PSS represents the interval for which the observer perceives the stimuli as simultaneous and is computed as the interval at which 'left first' and 'right first' responses are reported equally. Combining PSS measures with a standard gaze cuing paradigm can provide novel insights into the attentional effects of social signals. For example, if the direction of another person’s gaze can affect the apparent order of events, this could have major implications for understanding both gaze signals and time perception, and their intersection in social communication. For example, Wearden & Bailey (2012) revealed that the sensitivity of temporal discrimination was reduced in autistic participants suggesting that temporal intervals are fundamentally processed the same way in typical and autistic individuals, but with a reduced sensitivity for temporal distinction in those who suffer from autism. Moreover, response criteria in the autistic group was related to symptom strength in the communication domain. Being critical, one might argue that the stimuli used as part of this experiment, visual squares and audio beeps are not particularly representative of social interaction.

However, studies such as these remain an important cornerstone in the literature because they emphasise the importance of understanding errors in order to understand the normal functioning of a system. However, even in normal mental states, time perception is surprisingly labile. For example, during threatening events such as car accidents and robberies, many people report that events seem to pass in slow motion - as if time has slowed down. Stetson, Fiesta & Eagleman (2007) explored whether this is a function of increased time resolution during the event, or an illusion of remembering an event which was emotionally salient. In this experiment, participants experienced free fall for 31 meters before landing in a safety net. While people overestimated the duration of their fall, no improvement was observed in temporal resolution suggesting that subjective time is not a single entity that speeds up or down, but is made up of separate subcomponents. Specifically, that time-slowing is a function of recollection and not perception (figure 1.1).

Fig. 1.1. Taken from Stetson et al. (2007) showing how temporal resolution was measured during a frightening event. When digits on a watch are alternated slowly they were easy to identify (a). Digits were then presented at a rate where patterns fused into a uniform field (b). If temporal processing improves during a frightening event, participants would be able to read a random sequence of numbers presented at a high speed (c).



1.4 Current models of time perception

Models of time perception typically concern the role of attention and it is attention alone that has driven the development of recent models. In the late 1950s and early 1960s attention iself experienced a renaissance in the early dawn of the cognitive revolution (Broadbent 1958). While presenting different tasks, the constant challenge remained over how to control the amount of attention a person paid to each respective task? This concern itself emphasises the issue of individual differences and the problems that such interindividual and intraindividual variation posed, and still poses, to the whole area of time perception (Doob 1971; Tien & Burnes 2002).

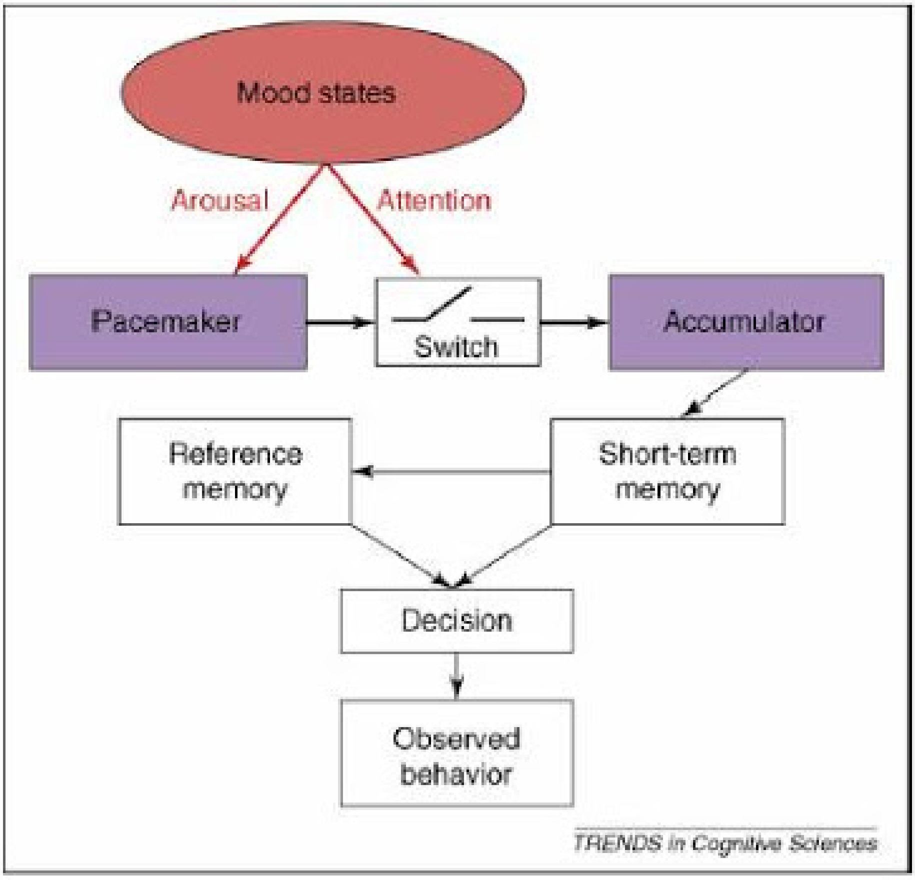
However, modern behavioural researchers introduced the scalar expectancy theory (SET) of time perception in the 1980s, based largely on studies of animals such as rats and pigeons (for a review, see Church 2003). However, SET theorists largely ignored the role of attention in their formal models. The issue of attention was raised more pertinently in a revision of SET that explicitly included attention, the attentional gate model (AGM; see, for example, Zakay & Block 1997). The AGM was proposed partly from what has become to be known as the prospective–retrospective comparison. This comparison has been explored most extensively by Block and Zakay (Block 1974; Block & Zakay 1997; Zakay 1993). In prospective conditions, a person is aware that he or she will be asked about the duration of an interval and therefore is expected to pay explicit attention to encoding that duration. In contrast, during retrospective judgments, the person has not been forewarned about the need to estimate the length of any particular duration and so, presumably, pays less attention to the passage of time. In this way, one can seek to generate an explicit contrast of the effects of differing levels of attention, without the necessity to make the inference as to which filling activities demand more or less attention. This however, does not circumvent the persistent and thorny issue of individual differences, but the results of these comparisons show important and large effects as to whether a person does or does not know whether he or she will be asked to judge the accuracy of a duration for which there are a number of potential explanations. These typically emphasise the influence of memory and attention (Block & Zakay 1997; Zakay & Block 2004).

Many additional examples in support of these models are often related to low-level processes. For example, Tse and colleagues (2004) showed that, when several stimuli are shown in succession, a low-probability 'oddball' stimulus in the series is reported as lasting subjectively longer than the high probability stimuli. This occurs even when they are presented for the same duration and has been found to be true in both vision and audition. The dynamics of the distortion (taking several hundred millisecond to reach its peak effect) support the view that attentional shifts underlie distortions in perceived duration. These findings have lent considerable support to the latest generation of cognitive models of time perception (Tse, Intriligator, Rivest & Cavanagh 2004; Zakay & Block 1997), which propose that a simple 'counter' model can account for both how time is represented cognitively and explain its subsequent distortion. These proposed that, instead of a perfect accurate internal clock, the brain simply has access to the approximate constant rate of information processed (figure 1.2). The subjective duration of time is therefore controlled by the number of temporal units accumulated over a certain time span. When individuals are asked to judge an interval, for example, 30 seconds during a time estimation task, an overestimation would correspond to an increased accumulation of temporal units over that period. In comparison, because of an increased accumulation of units over time, an individual would produce a shorter production of the same duration during a time-production task (figure 1.2).

While such an illusion is clearly defined, the idea of a counter is in debate (Buonomano & Karmarkar 2002; Mauk & Buonomano 2004). Firstly, in contrast to a counter model that integrates events, the '*state dependent networks*' model proposes that the ubiquity of time varying neuronal properties allows networks to inherently encode temporal information (Buonomano & Merzenich 1995). That is, the way the network evolves through time allows it to code for time itself. Secondly, as outlined previously, research into time faces a number of challenges and current cognitive models have very little to say beyond psychophysical experiments that do not translate to behaviour or cognition outside the lab. .

Despite an active history, current models of time are based on purely psychophysical experiments alone. It is clear that the different skills used by people to estimate the passing of time will influence their behaviour in various facets of their lives, but current models offer comparatively little when considering the importance of time outside the lab. For example, many goods and services have a temporal component which will often correlate with an evaluation of how good they believe that service to be (Frederick, Loewenstein & O'Donoghue 2002). Take, for example, purchasing a book through a website. The delivery time in days taken for an item to arrive is a crucial ex ante variable which affects a decision to order from that company again. These social constructs like days and weeks are often what people generally use to organise and manage their lives, not minutes and seconds (Zerubavel 1985).

Fig. 1.2. Taken from Wittman & Paulus (2007). Model of time perception based on pacemaker/accumulator model.



1.5 Beyond minutes and seconds

Recent research concerning psychological aspects of time however, has started to focus on both the way people manage time in an everyday context and how time can be incorporated into other well-established areas of cognition. Research is now starting to consider how time in a psychological sense '*might enter into meaningful interaction with other mechanisms*' (Berntsen & Jacobsen 2008). Such studies however, are not ignorant of previous duration research despite using very different measurement techniques.

Specifically, work has started to examine 'higher level' cognitive functions that build upon more basic time perception processes. Because keeping to any schedule is likely to involve accurate time estimation, Francis-Smyth & Robertson (1999) considered the relationship between time management practices and estimates of task duration. In their experiment, participants were asked to spell-check a page. Before starting, they were also asked to consider how long they thought it would take (a retrospective judgement). After completing this task, participants were also required to give prospective estimates of time while watching several videos and complete Time Management Behavior Scale (TMBS) and Time Structure Questionnaires (TSQ).

As expected, participants were less accurate when it came to judging the duration of a future task, but this showed a great deal of variation. While previous research had examined relationships between errors in expected estimates and self-report of time management behaviours through the TSQ (Burt & Kemp, 1994), Francis-Smyth & Robertson (1999) extended this work by incorporating prospective estimation durations and other measures of time management behaviours. While Burt & Kemp (1994) found that those who scored highly on structured routine were poorer at estimating expected durations, Francis-Smyth & Robertson (1999) failed to replicate their findings . They did find however, find that those who perceive themselves as in control of their time, or as practising time management behaviours estimated expected durations more accurately than those who did not. Regarding prospective estimates, participants who perceived themselves to be good at setting goals and priorities, good at planning and scheduling and to have a structured routine were shown to be poor at estimating time in passing. Whilst carrying out a task they estimated time as passing more quickly than it actually does. However, this can be explained from an attentional model perspective proposing that, through an over-zealous monitoring of time and attention to the cognitive timer, participants actually put down more STUs than are appropriate in the given time, experience time as owing more rapidly and hence underestimate a target interval. It may be the case that people who perceive themselves as good at time management depend very heavily on the external cues of a watch to monitor time in passing, and this underestimation is a cautious reaction to its removal. Francis-Smyth & Robertson (1999) also point out that being early or on time does not have the same consequences as being late.

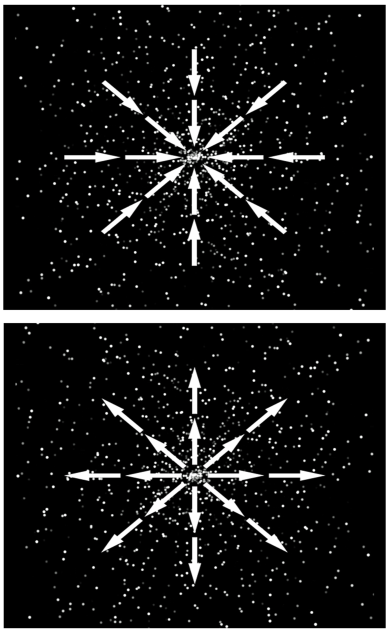
A more recent time construct that goes even further beyond minutes and seconds is termed chronesthesia (Tulving 2002). This ability to travel subjectively through time sets humans apart from other species (Suddendorf & Corballis 2007). Unlike durations of several seconds, mental time travel enables people to tailor their behaviour to satisfy the challenges of daily life (Schacter, Addis, & Buckner 2007; Tulving 2002). To date, work on chronesthesia has elucidated the neural basis of retrospection and prospection (Addis, Wong, & Schacter 2007; Schacter et al. 2007) and documented how the process of mental time travel is affected by both aging (Addis, Wong, & Schacter 2008) and mental illness (D'Argembeau, Raffard & Van der Linden 2008).

For example, Casasanto & Boroditsky (2008) considered how the metaphorical relationship between space and time observed in language also exists in more basic representations of distance and duration that are never directly experienced through the senses. In one experiment, participants viewed 162 growing lines, one at a time. Post-presentation, participants were asked to either produce the lines displacement or duration. The results of this particular experiment showed that spatial displacement affected estimates of duration, but duration did not affect estimates of spatial displacement. In sum, participants were unable to ignore irrelevant spatial information when making judgements about duration suggesting that our mental representations of things we can never see or touch may be built, in part, out of representations of physical experiences in perception.

Miles, Nind & Macrae (2010) went on to consider how 'mental time travel' might tie into these other behaviours. Participants were fitted with a movement sensor and instructed to stand on the spot. After being blindfolded, they were asked to imagine (a) everyday life circumstances 4 years into the future or (b) 4 years in the past. The results showed that 'mental time travel' has an additional and measurable behavioural correlate, that is, the direction of movement through space as retrospective thought was backwards whereas movement and prospective thought led to an increase in forwards movement.

This relationship also appears in visual modalities. Miles, Karpinska, Lumsden & Macrae (2010) used visual optic flow patterns (figure 1.3). While observing an apparent forward or backward motion, participants had to click on stimuli that appeared at random.

Fig. 1.3. Vection displays of optic flows (taken from Miles, Karpinska, Lumsden & Macrae 2010).



Afterwards, participants were asked if they had experienced task-unrelated thoughts (day-dreams) and if so had to to estimate the proportion of these day dreams that were related to past compared to future events. Remarkably, participants in the forward direction condition reported a higher proportion of future-related daydreams compared to their counterparts in the backward condition.

Christian, Miles & Macrae (2012) took this idea further by considering how we think and talk about time in terms of space for example, 'looking ahead to the future'; 'looking back at our past'. Importantly, this faculty for 'mental time travel' is dependent on an underlying cognitive representation of time beyond minutes and seconds (Szpunar 2010). Using a simple line segmentation task, participants marked the location of their own, their best friends or a strangers birthday in the past, present and future. Participants indicating their own birthday's tended to leave a larger gap between their previous and next birthday's, as compared with participants who marked the birthdays of a best friend. This relationship suggests that the more richly we encode past and future events in our minds, the more physical space we allocate to our mental representation of those periods. This along with additional findings are consistent with construal level theory in that more space is allocated to events that feature self-relevant and episodically rich mental representations (Miles, Karpinska & Macrae 2010).

A second experiment was designed to conceptually replicate the relationship between episodic content and the scaling of spatiotemporal mappings in experiment one. In this instance, participants were required to estimate the duration of a hypothetical journey to specific events (i.e. birthdays) in the past and future. In this case, participants also experienced patterns of optic flow designed to simulate self-motion while they 'travelled' to target events. This experiment treated time as a continuous construct rather than discrete units and taken together, the results provided additional evidence that variations in self-relevant episodic content are reflected in the manner in which participants use space as a proxy of thinking about time. These results may also help explain differences observed in the planning fallacy - the tendency to underestimate how long things will take and may even extend to other aspects of time management such as punctuality.

Mental time travel has also become a key component of cognitive neuroscience (Viard, Chetelat, Lebreton, Desgranges, Landeau, Sayette, Eustache & Piolino 2011). Recent investigations have focused on identifying malfunctions in future thinking in those suffering from mental disorders such as schizophrenia (D'Argembeau, Raffard, Van der Linden 2008). What remains unclear however is where mental time travel begins and future episodic memory ends. Are these part of the same system or separate? Kwan et al. (2012) explored these differences in a patient who suffered from episodic amnesia and who was unable to imagine future experiences. However, they were able to discount the value of future rewards. The authors argue that because this patient is neither able to imagine personal uses for the rewards or provide a rational for selecting larger future rewards in comparison to present small awards, a dissociation exists between imagining the future and and making decisions that involve the future. However, strong evidence confirms that the majority of people do use mental time travel on a regular basis Kwan et al. (2012).

The real world importance of looking forwards has also been quantified based on how Internet users worldwide seek more information about years in the future than years in the past. Preis, Moat, Stanley & Bishop (2012), analysed *Google* logs and found a strong correlation between 45 country's GDP and the propositions of its citizens to look forward (r = .78). These results suggest that there is a relationship between economic success of a country and the information-seeking behaviour of its inhabitants online. The authors conclude that such a future orientation index may be fruitfully applied to further spatial and temporal divisions and compared with other social and financial indicators in large data sets.

A future challenge for this research is to try and understand the mechanisms behind this phenomena in the general population, however, the examples presented here open up the link between time as a real-world concept that can link and compliment theoretical and applied aspects of cognition and behaviour. In particular, the idea that time can go beyond traditional units is a worthwhile endeavour that may encourage a move away from traditional boundaries that have plagued previous research, that is, expanding beyond traditional units of time that have little baring on daily temporal experiences.

This 'mental time travel' ability in addition to building on other higher-level processes regarding decision making is relevant across this thesis as participants are required to compare the present day against others, arrive at an event on time, and adapt to changes based on time cues provided. However, as discussed previously mental time travel may not be essential for making future decisions, it remains useful in typical participants (Kwan et al. 2012). The notion of mental time travel also takes us out of the millisecond scale with which psychophysical studies are concerned, and into the everyday time scale of days, weeks and associated behavioural outcomes.

1.6 Current Research Challenges

Despite fairly rapid progress across the 20th Century, research concerning psychological time has encountered a number of problems that can be termed sociocultural, methodological and conceptual. It has also often failed to adequately deal with individual differences, particularly in light of recent work, which has attempted to examine 'higher level' cognitive functions that build upon more basic time perception processes.

1.6.1 Sociocultural

While previous studies illustrate how psychological time is difficult to observe and study, for many people time itself has become less straightforward. The pervasive sense of stress, rush and pressure in contemporary societies has become a subject of policy debates and routine complaint. Despite living longer than ever before, people complain of suffering from endemic shortages of time (Hoffman 2009). For some, in the inversion of the old motto, time has become a more valuable and a less attainable commodity than money. At odds with this real-life dilemma, current research offers little insight into how people can better manage their time. For example, while studies focusing on punctuality have identified some correlates with personality, no guidance exists on how this can be improved in order to have an applied, real-world impact (Back, Schmukle & Egloff 2006). This is further compounded by recent technological developments that often give us more free time to do 'fun' activities by helping us manage time more efficiently (Schmidt & Cohen 2013).

These aspects of time are important because individuals whose normal social interaction or daily functioning is disrupted by problems characterised by disrupted time perception or management (e.g. schizophrenia (Davalos, Kisley & Ross 2003; Wittmann & van Wassenhove 2009) may benefit from intervention strategies that manipulate the temporal delay of rewards or that cognitively restructure the perception of inter-temporal choices (Wittman & Paulus 2007; Ungemach Stewart & Reimers 2011). In addition, interventions might be able to alter the timing system directly, which would in turn profoundly affect the way individuals processed delayed rewards and aid in restructuring behaviour towards health-promoting actions. Government nudge strategies rely on an individual acting or thinking about a message given at a specific point time, but whether this is an effective strategy is likely to be influenced by where an individual places themselves in time - as many people are often overheard to quip '*I don't have time for this?*'.

1.6.2 Methodological

When assembling the ongoing literature regarding time perception, it is clear that there is almost no principled fashion in which the content "filling" an interval was ordered. A typical investigation uses a series of convenient activities - counting, crossing off the letter 'w' on a page of text, listening to text, doing nothing at all, actively trying to estimate the interval and so on - in which there is virtually no theoretical foundation for the chosen activity or activities.

The traditional and historically dominant techniques are verbal estimation, duration production, and duration reproduction (Bindra & Waksberg 1956; Clausen 1950; Guay & Salmoni 1988), but each has some drawbacks (Siegman 1962). For example, reproduction necessarily emphasises memory for explorations of time in passing, but this same method has some limited exploratory capacities. In contrast, verbal estimation and production require the person to reference standard temporal units (e.g., seconds, minutes), and thus the pure perception of duration is contaminated by linguistic and semantic tags that are disassociated from the units of time we use everyday (Zakay 1990).

That of course may not be seen as weakness because time by its very nature is often tied to broad linguistic tags, but while this provides methodological convenience and respectability in the field, such a perspective can mask certain important qualitative dimensions of differing human temporal experiences (Hancock 2011). However, psychophysical experiments are likely to be limited in the conclusions they can draw regarding how humans manage and deal with time on a daily basis.

In their recent review, Hancock and Block (2012) point out that reading the introductions to many papers makes for paradoxical reading. Many authors mention the importance of a theoretical backbone, and then go onto select their own idiosyncratic selection of the task. This principled failure to establish a theoretical taxonomy as to what denotes a task (which remans a contemporary challenge) has inhibited progress. In addition, this supports Adam's (1964) earlier observation that time perception has failed to integrate itself with other cognitive processes.

In terms of higher-cognitive functions, these methodological shortcomings are perhaps less prominent, but the complex nature of different time representations often make comparisons difficult because of the variability when measuring past and present, which also remains a conceptual issue.

1.6.3 Conceptual

The concept of time from a psychological viewpoint remains complex and this is also reflected in the complexity of the current literature. '*How should the concept of time be defined and studied within psychology*?' (Zimbardo & Boyd 1999) remains open to debate both to its credit and weakness. What is known however, is that people's use of time is eminently social and cultural in its variations, as well as being strongly influenced by biological and environmental conditions (Zimbardo & Boyd 1999). Human beings experience time through the changes which are repetitive and progressive like the alternations of day and night; or irreversible progressions such as biological change that comes with aging. Hudson (2001) argues that cognitive development and social interactions provide a context on which time concepts are introduced to a child and time is not an entity like concrete objects, to be discovered by the child. The idea of psychological time is therefore considered to be a '*developmental process that takes place at different stages of life*' (Shmotikin & Eyal 2003, p261). However, once developed, it is generally considered to be a stable characteristic reflecting individual differences with a flexible and modifiable construct (Zimbardo & Boyd 1999). Despite this well acknowledged importance, cognitive models of time have little to offer when it comes to these timing processes that impact the decisions people make on a daily basis. Everyday units of time are often cyclic for example, the diurnal cycle of night and day, and the annual cycle of the four seasons. These alone are likely to be the constructs that help inform decisions and not intervals lasting several several seconds.

1.6.4 Individual differences

Individual attitudes to time can vary considerably, but the simple act of estimating any duration also remains a highly variable trait. This can be easily demonstrated by asking a group of people to close their eyes and raise their hands after the passing of 17 seconds. The diversity of accuracy in estimating this duration will be high (Hancock & Block 2012). Several studies have identified variables that moderate accuracy on time estimation tasks. The results however, largely depend on task type, design and methodology employed (for reviews see; Block and Zakay 1997; Block, Hancock & Zakay 2000; Zakay 1993). As a result, understanding individual differences that may affect these judgments becomes difficult when combining multiple studies that often use comparatively small samples and a variety of stimuli.

Specifically, the issue of gender effects has been described as '*far from settled*' (Block, Hancock & Zakay 2000; p1333). Researchers have previously explored gender differences in small samples with results ranging from no gender effect to a significant female advantage in both retrospective and prospective duration judgments (Block et al 2000). However, Block and colleagues concluded that females '*demonstrate improved episodic memory in a retrospective paradigm'* (p1341). The prevailing theoretical account explaining this difference is based on the frequency of an 'internal clock', which is modulated by general cortical arousal mediated by differences in basal metabolic rate and/or body temperature (Coull, Vidal, Nazarian & Macar 2004; Gibbon & Malapani 2002). Observed sex differences are therefore explained as a different average frequency of this 'internal clock' between males and females.

The effect of age and sex has also warranted a recent meta-analysis, but again it remains difficult to answer definitively due to a variety of different methodologies. Block, Zakay & Hancock (1998) found that older participants produced larger verbal estimates, but Espinosa-Fernández, Miro, Cano & Buela-Casal (2003) found the opposite effect in duration production tasks. In contrast, Hancock & Raush (2010), failed to find any effect of age on a similar set of reproduction tasks.

Personality has also been linked with duration judgements in men and women because differences may originate in experiments if personality traits previously known to affect time estimation are not controlled (e.g. extraversion (Zakay, Lomranz & Kaziniz 1984) and emotional stability (Kirkcaldy 1984)). Typical experiments from Rammsayer & Rammstedt require participants to reproduce target intervals of 1, 2 and 5 seconds. Their accuracy was then compared with a personality inventory - usually The Big Five. Previous research has hinted at a possible link with overestimation in a small sample of males (N=34) who were also highly extraverted (Rammsayer 1997). However in (2000) he found no linear relationship between personality scores and timing performance in men or women.

Research focusing on higher-cognitive timing functions often explores negative outcomes associated with disrupted delay discounting or mental time travel. For example, Petry (2000) tested active and abstinent alcoholics as well as controls by giving them various scenarios involving monetary rewards for example, five pounds now or twenty pounds in a month. Petry found that alcoholics or other substance abusers tend to prefer immediate rather than delayed rewards. Lower levels of delay discounting has also been linked with higher intelligence and additional processes that may take place in the anterior prefrontal cortex (Shamosh et al. 2008).

Zimbardo & Boyd (2008) have also developed a time orientation scale that attempts to measure an individuals' propensity to think ahead or backwards. Increased levels of future time orientation have been associated with a decreased likelihood of engaging in HIV transmission risk behaviours as well as smoking, alcohol and substance abuse (Boyd & Zimbardo 2005; Keough, Zimbardo & Boyd 1999; Petry, Bickel & Arnett 1998 Petry 2003; Wills, Sandy, & Yaeger 2001). It has also been associated with improved health outcomes in systemic lupus erythematosus (Sundaramurthy, Bush, Neuwelt & Ward 2003) and with higher socio-economic status (Guthrie, Butler & Ward 2009). General explanations tend to relate these to a cognitive structure that people access when making decisions about short-term and long-term actions and goals. Surprisingly and despite the well established theoretical relationship between personality (Zimbardo & Boyd 1999), no one has yet examined how these measures could be combined with time scales we use on a daily basis. Taken together, a range of measures could be termed as an individual's 'time personality'.

In sum, the existing literature on individual differences surrounding time estimates of a few seconds is mixed. Making conclusions across studies has been hampered by methodological shortcomings, particularly in relation to sample size composition (e.g. N<40), variability in task demands and the use of atypical samples. At the same time, higher-cognitive research has an overreliance on atypical popualtions and gives less consideration to variation in typical participants.

Despite a lack of research that directly addresses individual differences along with well documented sociocultural, methodological and conceptual shortcomings, it is difficult to deny the impact of cognitive models from the time perception literature. However, due to the issues outlined above, these models remain limited in scope when it comes to 'higher level' cognitive functions that embody aspects of time which James (1890) felt were fundamentally more important than millisecond duration judgements. In turn, I would argue that time across an everyday context would benefit from additional study.

1.7 The importance of time in an everyday context

The study of time can be multifaceted, but I would argue that its importance has been diminished over the last few decades because of an over-reliance on paradigms that lack theoretical coherence and applied impact. As a result, they offer little in the way of applied solutions to old problems. For example, how can the study of time be integrated into other areas of psychological research? This thesis is therefore an attempt to advance the study of time by going beyond traditional psychophysical experiments. (Fraser, Haber, & Muller 1971; Hancock & Warm 1989). Because research has chosen to stick with paradigms that remain limited outside the lab, time research itself has become stuck in the past. For example, a Web of Science search reveals that one of the most cited articles in *The American Journal of Psychology* concerns time estimation (Hicks, Miller, & Kinsbourne 1976). Given this ongoing discussion, Hancock & Block (2012) point towards a paradox and importance of that cited work. First, the paradox:

How is it that the oldest continuously published journal in all of psychology has one of the highest citation rates for an article in an area that I have just described as behind the times? The answer derives from the fact that the work of Hicks et al. was central to the ongoing theme of time perception and the content of specific intervals that has persisted throughout the 20th century. Thus, their work struck a chord at the juncture when time perception was beginning to emerge onto the psychological scene. In particular, they asked how prospective and retrospective judgments of time varied as a function of the amount of information processed (e.g., Smith 1969). Briefly, they found no systematic effects in the retrospective paradigm, in which the person was not aware of the necessity to estimate the duration of the interval. However, in contrast, they found that in the prospective paradigm, judged time was an inverse linear function of response uncertainty. This linked attention to the information content intrinsic to a particular interval in conditions where someone expected to be asked to estimate the duration experienced. Thus, Hicks et al. identified the crux of an ongoing major issue and reported results that illuminated both the empirical pattern of outcomes and the theoretical reasons why such a pattern may be produced. Although the whole area of time perception has moved on since the 1970s, this finding has proved so important and influential that it remains a central building block in a number of theories on time perception. However, in addition to this paradox, I would also argue that there is harsh irony as subsequent research has completely misunderstood why James (1890) considered time to be a core part of psychological science.

In the four decades since Hicks et al. (1976) reported their findings, the psychological study of time perception has progressed on numerous, but often repetitive fronts (e.g., Friedman 1990). What is perhaps most challenging is the generation of new techniques through which to explore the sense of time because these already appear to be heading in a similar direction. For example, investigations using neuropsychological and pharamacological approaches to study time perception in animals and humans have yielded the specific hypothesis that fronto-striatal circuits, which are modulated by the dopamine system, are crucial for temporal processing in the seconds range (Coull, Vidal, Nazarian & Macar 2004). Individuals with structural damage to the frontal lobes (Kagerer, Contreras-Vidal & Stelmach 2002) or traumatic brain injury predominantly affecting frontal areas (Pouthas & Perbal 2004) show impaired estimation of temporal intervals lasting several seconds.

A further challenge involves sustaining the renewed interest in time while ensuring that it does not again fall into obscurity. One solution is for psychology to adopt a sense of multidimensionality in the way time is represented in the cognitive literature. In turn this will allow new models of time to make a larger contribution from both a theoretical and applied perspective. Progress has already been made recently in this respect as research has slowly started to return to what James at the turn of the century considered so important, that is, the existence of past, present and future thinking and how these can modulate planning and decision making.

One solution is to ensure that future research makes a strong theoretical link back to traditional perception, and this is happening. For example, Wittmann and Paulus (2007) have made attempts to link impulsivity, decision making and time perception, but admit that it is only in recent years that this has been addressed systematically. However, this typically focuses on decisions that are made in an experimental, rather than our everyday relationship with time. For example, do people arrive at appointments late because they think it will take less time to get to a place than it actually does or are they enjoying that moment in time too much and leave late?

As outlined previously, people often bias the present when making decisions (hyperbolic discounting). Zauberman, Kim, Malkoc & Bettman (2009) directly compared prospective duration with hyperbolic discounting. In one experiment, participants were presented with a scenario asking them to imagine receiving a gift certificate worth $75. They were then told that the gift certificate was valid today and were asked to indicate how much they would have to be paid in order to wait for 1 month, 1 year or 3 years before using the gift certificate. On the next page, participants were given a 180mm line with end-points labeled ‘Very Short’ on the left end and ‘Very Long’ on the right end. They were asked to imagine a day 3 months, 1 year or 3 years in the future and to mark on the line indicating “how long do you consider the duration between today and a day, 3 months, 1 year or 3 years later?”. The distance from the left end of the scale to each participant’s mark was measured with a ruler and used as an indicator of subjective time horizon.

These experiments demonstrated that consumers’ subjective perception of changes in time duration were not adequately sensitive to objective changes in time horizon as no significant differences were observed between the 1 month, 1 year or 3 year conditions. However, subjective estimates of future time horizon changed less than the corresponding change in objective time, and internal discount rates calculated using subjective estimates of time horizon (a fixed point in the future) did not decrease over time.

These results have important implications for intertemporal preferences, suggesting that we may observe declining rates of discounting with increased time intervals not because people's internal discount functions are approximated by hyperbolas, but because discount rates are calculated using objective time horizon. By showing that simply examining how people perceive time and taking into account the relative insensitivity in those perceptions outside the lab, this finding provides a provocative new look at the underlying drivers of hyperbolic discounting. These results are also psychologically distinct from previous explanations, since it separates discounting the outcome itself from the perception of the time interval relevant to that decision. However, the authors admit that not all hyperbolic discounting can be fully accounted for by a sensitivity to this type of prospective duration. For example, making decisions over several days or over several weeks may be better explained in terms of emotional or visceral effects on the value of the outcomes (Loewenstein 1996; Metcalfe and Mischel 1999).

While such work again moves away from the perception of time and further towards time as an everyday construct, it is particularly relevant in light of this thesis. The notion of considering days and weeks as units of time is mentioned, but unaccounted for in much of the literature. This is surprising given that days and weeks are so well grounded in history and highly likely to interact with the constructs outlined previously (Zerubavel 1985). This issue underlies a substantial body of the research reported as part of this thesis.

1.8 General methodological approach and overview

The ability to perceive and understand time plays an important role in all aspects of human life. From knowing when to arrive at a job interview to understanding the timing of events, such as a motor act followed by a sensory consequence, is critical for moving, speaking, determining causality, and decoding the barrage of temporal patterns that reach our sensory receptors (Eagleman, Tse, Buonomano, Janssen, Nobre & Holcombe 2005).

Despite its importance for cognition, behaviour and perception, the last few decades have witnessed limited investigations in time as it relates to people on a day-to-day basis. And it is only in the last few years that a concentrated effort has been applied to old problems, specifically, how does our relationship with and awareness of time affect other aspects of cognition and behaviour. Time is multifaceted and any psychological study cannot simply be limited to subjective duration, although this was a core motivation for this research. Constructs need to go beyond minutes and seconds, and consider time in terms of everyday units and devices that people readily identify with. These include for example, the working day, the calendar week, and associated time management related constructs.

The main goal of this thesis is therefore to examine aspects of time across an everyday context. While time perception is an established field in cognitive psychology, previous research has examined either the perception of very short time scales (milliseconds), or psychobiological effects of celestial cycles (e.g. sleep/wake cycle, menstrual cycle, seasonal affective disorder). There are however, several other aspects of time that are categorically different, because they do not rely on subjective experience, but are no less important (Zakay and Block 2004). These have largely been ignored or glossed over in the current literature. This includes systematic changes in behaviour across socially derived time cycles as well as the effects of regular exposure to time cues. For example, because the weekly cycle is socially constructed rather that being celestially defined, it can not have become biologically ingrained. Nevertheless, systematic changes have been observed across the week and working day in a range of cognitive tasks (Weith & Zacks 2012**)**.

Given the importance of time for both social and occupational organisation it is surprising that much of the literature has had a tendency to split into two separate camps. These can broadly be defined as psychophysical or occupational in nature. Psychophysical studies tend to focus on the cognitive processes by which a person adapts to and represents temporal properties in order to synchronise external events. For example, when crossing a busy street, speed and time estimates are continually required (Wittmann & Paulus 2007). However, it is surprising that very few attempts have been made to link time with occupational and social organisation, particularly as there is the potential for far-reaching and demonstrable impact. This thesis refers to both strands of research throughout and attempts to show where they can be explored together from an applied and theoretical perspective. It also aims to highlight some mechanisms that may lie behind 'mental time travel' by considering everyday units of time. It involves a substantial amount of interdisciplinary research which often integrates converging evidence from laboratory based behavioural experiments and large scale secondary data analysis.

Correlational designs rely on the truthfulness of the responders answers. Researchers have debated extensively about the truthfulness of people's self-reports and while no clear-cut conclusion has emerged, it is important to remember that correlations cannot be used to make clear-cut statements about the causes of relationships between variables (Judd, Smith & Kidder 1991). Therefore it is important to compliment such an approach with additional methodologies.

Experimental designs are at the cornerstone of cognitive and social psychology because they can help identify the causes of a phenomenon. For example, an independent groups design employed in later Chapters involves each group of participants being randomly assigned to a different treatment. However, this random assignment can lead to a potential confounder due to individual differences among participants in each group (Zechmeister, Zechmeister & Shaughnessy 2001). In addition, results from both experimental and correlational designs do not always translate or replicate outside the lab, but this thesis also employs additional online tools that encapsulate experimental and correlational methods.

Psychologists have long relied on student samples and more generally those from a small sector of humanity (Henrich, Heine & Norenzayan 2012). Recent evidence has suggested that collecting data via the Internet can reduce biases found in traditional samples (Gosling, Vazire, Srivastava & John 2004). Buhrmester and colleagues considered the quality of data from Amazon Mechanical Turk. Turk includes a participant compensation system, a large participant pool; and a straightforward system to aid study design, recruitment and data collection. Large-scale data analysis has shown that participants recruited through Turk are significantly more demographically diverse than university students and the data is at least as reliable as that obtained through traditional methods (Buhrmester, Kwang and Gosling 2011; Paolacci, Chandler & Imeirotis 2010).

While very precise experiments can now be conducted online, it is unsurprisingly not a perfect way to collect data because the experimenter cannot always guarantee that the person sitting behind their computer is either (a) answering honestly and/or (b) really human and not an automated bot.

Two large online data collections took place during the course of this thesis. The first is reported exclusively in Chapter 2 and the second is referred to in Chapters 3,6, 7 and 8. Two large online surveys are referred to throughout (see Appendix A) involving samples of 1130 and 634 respectively. Participants in this instance were recruited via several email campaigns and through social media. Throughout this thesis, I control for these two issues by removing responses that have either completed online responses in a time that is unusually short (suggesting bot automation) or long (suggesting a lack of attention paid to task).

Finally, while secondary data sources can initially be difficult to locate, these are are worthwhile endeavors because they allow for experimental findings to be extrapolated beyond the laboratory. Many large organisations have dedicated members of staff who deal specifically with research data requests. Data reported in later Chapters for example, has often involved the collaboration with government data scientists. Such exchanges also cover ethical and related data-protection issues. Cherry-picking is unlikely because a solid case has to be made for any data to be released. Handing over an entire government data set for example, would prove unmanageable and unethical. It also gives hints regarding future research. These two aspects alone mean that resources available from governments or third parties who store such data represent a fantastic opportunity for psychologists working in a variety of specialities.

These correlational, experimental, online and secondary data analysis methods often overlap considerably, but online and secondary data analysis methodologies are clearly marked as confirmatory or exploratory throughout.

The first two experimental Chapters explore an almost universal yet under researched phenomena in a socially derived time cycle. Despite its repetitive nature, people often become confused when aligning themselves with the current day of the week. Through a series of experiments, I explore how errors in timing are no longer limited to seconds, but are more frequent when it comes to understanding why a Wednesday can sometimes feel like a Thursday.

In Chapters 4 and 5, I consider how the associations people have with each day of the week may translate into other behavioural patterns outside the lab. I explore the rate of non-attendance in medical appointments across the week and consider how well these patterns fit with the emotional associations outlined in previous chapters.

Chapter 6 then considers how personality and mood fluctuates across another socially derived time structure, the working day. In particular, levels of extraversion show a consistent pattern across the working day. This mirrors patterns observed in self-reported levels of prospective and retrospective happiness and ties into current theory supporting the notion that personality remains the best predictor for subjective well-being (Deary, Weiss & Batty 2010).

As discussed earlier, individual differences remain an issue for the everyday application of time and Chapter 7 examines self-reported and actual punctuality. The results suggest that punctuality, like time perception, is both highly variable and difficult to predict using traditional individual difference measures.

Finally, Chapter 8 considers the effects of daily exposure to a standard time cue - in this instance, watch wearing. Buying a watch may not simply be driven by a desire to know the time and in several comparisons, watch wearers display a significant increase in conscientiousness over their non-watch wearing counterparts. A second experiment set out to determine the direction of this relationship in a randomised control trial. The results suggest that a watch can serve as a personality marker and may even be able to change some individuals' personality and improve their punctuality.

Taken together the issues addressed in this thesis are of theoretical and practical significance as the findings could have a direct impact across a variety of domains. For example, by considering the importance of behaviour and cognitive trends across the day and week, efficiency savings could be made in a variety of settings (Chapter 4). From a theoretical perspective, the results highlight the current limitations of existing cognitive models that attempt to explain and predict time-related behaviours (Chapter 7). Finally, 'mental time travel' theory may benefit by incorporating everyday representations of time when considering the mechanisms that underpin this phenomena (Chapter 9).

At the core of my argument is the premise that without forgetting past successes, psychological time research would benefit considerably by broadening its horizons beyond low-level psychophysical experiments.

Chapter 2
Weekday mismatches

Introduction

'If aliens landed on earth and began observing human behaviour, three temporal patterns would become obvious - behaviour varies by hours of the day, days of the week, and seasons of the year'

(Areni & Burger 2008; p1228)

There is considerable scope for exploring time scales which have been largely ignored in the current literature, particularly as one might predict that temporal cognition is different on an everyday timescale, because it does not rely on biologically defined mechanisms. However, everyday units of time are often cyclic. For example, the diurnal cycle of night and day, and the annual cycle of the four seasons. These daily and annual cycles are reflections of celestial motion, specifically, the rotation of the Earth on its axis, and the orbit of the Earth around the Sun respectively. Similarly, the lunar month is defined by the orbit of the Moon around the Earth. Given the stability of these cycles on the evolutionary timescale, it is unsurprising that many biological processes track them. In many cases, psychological correlates of different phases in these cycles have been intensively studied, for example, the sleep/wake cycle (days) (Gross & Gotman 1999), menstrual cycle (months) (Gangestad, Simpson, Cousins, Garver, Apgar & Christensen 2004), and seasonal affective disorder (years) (Lurie, Gawinski, Pierce & Rousseau 2006).

However, much of our social activity is organised around the weekly cycle. Unlike days, months, and years, the 7-day week is an artificial cycle in the sense that it is not derived from any celestial cycle. As such, it is a far more recent construct around which to organise behaviours, but no less important (Areni 2008; Areni & Burger 2008). For example, in an online study, Areni (2008) considered stereotypes for each day of the week and found that when people predicted their mood for the upcoming week, they would rate Monday as more negative than Thursday or Friday. However, this did not predict actual mood when participants responded on the actual day.

On the other hand, a recent meta-analysis has confirmed a small but reliable 'Monday blues' effect in mood (Areni, Burger & Zlatevska 2011) however, part of the Monday blues phenomenon may stem from biased memories of that day of the week rather than the actual moods experienced (Stone, Hedges, Neale, & Satin 1985). For example, Stone, Schnelder & Harter (2012) found an effect of improved mood on a Friday, but no effect of Blue Monday. However, while they used a large telephone interview sample (N=340,000), their mood question was limited to a yes/no response. These Friday effects were also diminished in older participants, but no difference was observed between men and women. Unfortunately, many studies rely on on single, bi-polar measures which fail to capture qualitative differences between positive (e.g., pride vs. relief) and negative (e.g., loneliness vs. anger) affective states. Monday and Friday are also given more attention than days in the middle of the week and small samples often make meta-analysis difficult.

However, while previous research is consistent when it comes to demonstrating that weekday elicits a specific emotional response in memory, no work has yet considered what these actual moods or cognitive associations consist of and how they might predict temporal errors. The purpose of these initial studies was therefore to investigate mental representations of weekdays specifically, their relative strengths, distinctiveness and affective valence. I begin by considering the confusability of weekdays, as confusability has been used in other contexts to examine similarity and distinctiveness among items (Bradshaw & Anderson 1982; Craik & Tulving 1975). Moreover, informal observation suggests that confusion of weekdays is common in everyday life. However, it remans unclear for example how an individual might be under the impression that it is Tuesday only to discover that it is in fact a Wednesday. Confusions of this type may in turn have serious implications for event scheduling and co-ordination.

Study 2.1 Weekday mismatches in a large sample

To first establish whether the actual day is in fact regularly out of sync with the day felt across the general population, I conducted a simple poll to gauge their permanence. 100 students studying at The University of Glasgow (50% female) were recruited from outside the University Library. Participants were asked:

'*Have you ever felt that you are on the wrong day of the week. For example, have you ever felt it was a Wednesday when it was in fact a Thursday?*'

Almost all participants (97 out of 100) responded in the affirmative indicating that they had experienced mismatches between the actual day and the apparent day of the week on at least one occasion. Such weekday confusions are perhaps reminiscent of well-documented errors in temporal cognition that occur at other timescales. For example, when removed from light cues, people have a tendency to slip into a 25 hour sleep/wake cycle (Alvarex, Dahiltz, Vignau & Parkes 1992; Lavie 2001; Palm, Blennow & Wetterberg 2004).

In addition, traditional judgements of minutes and seconds have also been shown to be affected by emotion (Wittmann & van Wassenhove 2009). For example, participants have been shown to overestimate the duration of pictures depicting arousing emotional faces (expressing fear and anger) when compared to more neutral faces (Droit-Volet & Gil 2009).

These errors at other time scales are systematic in at least two senses. First, they are stable across individuals, meaning that deviations from accurate temporal cognition are the norm in those situations. Second, the deviations do not merely reflect a random distribution, but instead have a definite direction. Indeed, it is the systematic nature of these errors that provides insight into underlying cognition. Following this principle, a second study was designed to help further distinguish between the *actual day* (the current weekday according to the calendar) and *apparent day* (the weekday that the current day feels like, according to the respondent).

Study 2.2 Distribution of weekday mismatching

This next study sought to establish whether mismatches between actual day and apparent day are distributed evenly across the week, or whether they cluster in informative patterns. Given that the working week (Monday to Friday) and the weekend (Saturday and Sunday) involve rather contrasting routines for many people, I hypothesised that weekends might provide an especially salient marker in the weekly cycle. Accordingly, Mondays and Fridays may be more distinctive because they begin and end the working week. By the same token, Tuesdays, Wednesdays and Thursdays should be less distinctive as none of them border the weekend. I therefore expected to see more confusion between Tuesday, Wednesday and Thursday and less on a Friday and Monday.

In setting out this study, it will be useful to distinguish between the actual day, that is, the veridical weekday according to the calendar, and apparent day, that is, the weekday that the current days feels like according to respondents. A weekday confusion error can then be defined as a mismatch between the actual day and the apparent day.

The general approach to data collection in this study is to elicit the apparent day from a group of independent respondents, separately for each actual day of the week. In other words, data will be collected over the whole seven-day cycle. Analysing weekday-mismatches across the whole cycle should reveal any regularities in their distribution. My initial interest is in the following patterns as these could potentially reflect differences in the mental representations of weekdays.

First, there may be some days of the week for which the apparent day is especially likely to be out of register with the actual day. For example, Fridays might always feel like Fridays, but Wednesdays might sometimes feel like other days. Second, some days of the week might attract the apparent day especially strongly. For example, the apparent day might gravitate towards Mondays or Fridays disproportionately. Alternatively, the apparent day might lag or lead the actual day by a regular interval. Finally, I will examine the role of the weekend/ working week transition in determining weekday mismatches. This will be achieved by collecting data across a normal and bank holiday week, so that the distributions of errors in these two situations can be compared.

Therefore, if Mondays and Fridays are more salient and distinct in memory, less confusion is likely to be observed with more confusion for those days where there are no differences in their mental representations.

Method

Design and Stimuli

Participants were invited to complete an online survey that was advertised at regular intervals via email shots and was subsequently listed on a number of prominent Twitter and Facebook feeds. Participants were presented the following question:

'*People sometimes have the feeling that they are on the wrong day of the week. For example, it might 'feel like' Friday when it is a Wednesday*

What day of the week does today 'feel like' to you?'

Crucially, the survey was open to respondents across a two week period, with one of those weeks encompassing a bank holiday Monday. Their IP address was also recorded to prevent multiple responses and to accurately code for respondents' location and time zone. There were on average 79.6 responses each day.

Participants

A total of 1115 respondents contributed data. In Week 1 (Normal week), 502 respondents took part [301 female, 201 male; modal age bands 21-30 (41%), 31-40 (26%); modal locations UK (59%), Other Europe (24%), North America (14%)]. In Week 2 (Bank Holiday week), 613 respondents took part [248 female, 365 male; modal age bands 21-30 (37%), 31-40 (24%); modal locations UK (66%), Other Europe (8%), North America (21%)].

Procedure

The procedure began with presentation of the following apparent weekday prompt, which remained onscreen until response:

"People sometimes have the feeling that they are on the wrong day of the week. For example, it might 'feel like' a Friday when it is in fact Wednesday. What day of the week does today 'feel like' to you?"

Participants indicated their response by selecting one of the seven weekdays from a drop down menu (7AFC). They were then asked to select their gender, age band, and current location (country) before leaving any open comments.

Results

All responses were included in the analysis. Responses included a GMT (Greenwich Meantime) field specifying the moment of response submission. For each response, this time field was adjusted for timezone to ensure that actual day was coded relative to the respondent's frame of reference. Responses were coded as Holiday Week if the Monday of that week was a public holiday in the respondent's country, and Normal Week if it was not.

Responses during a normal week show a reduction of errors on a Monday, Friday, Saturday and Sunday, but increase mid-week as predicted (table 2.1).

Table. 2.1. Percentages (and number of respondents) showing correct and incorrect responses when identifying with the day across a normal week. (Correct responses are highlighted in bold).

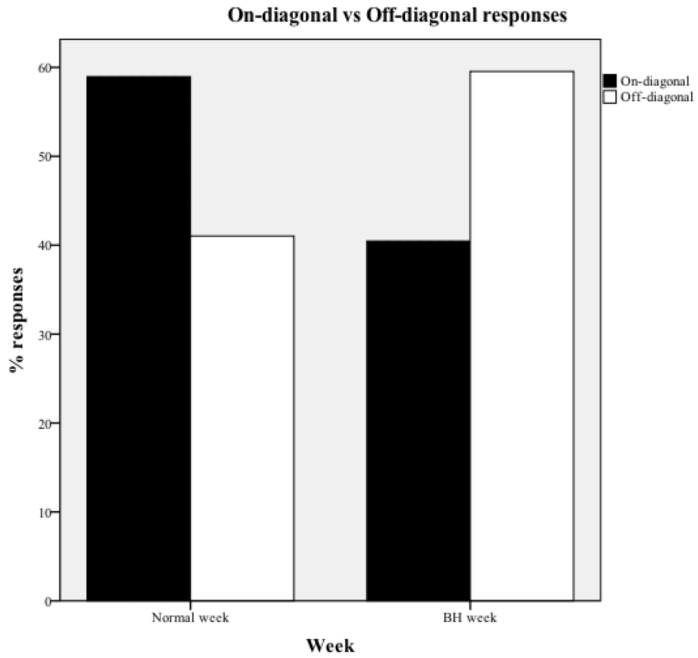
Reported >	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Actual							
Mon	**74.6**	4	4.8	4	3.2	0.8	8.7
	(94)	(5)	(6)	(6)	(4)	(1)	(11)
Tues	27.6	**34.4**	24.1	10.3	3.4	0	0
	(8)	**(10)**	(7)	(3)	(1)	(0)	(0)
Wed	9.5	11.9	**59.5**	11.9	2.4	2.4	2.4
	(4)	(5)	**(25)**	(5)	(1)	(1)	(1)
Thu	3.7	3.2	17.1	**48.6**	24.5	2.8	0
	(8)	(7)	(37)	**(105)**	(53)	(6)	(0)
Fri	3	3	3	19.7	**68.2**	3	0
	(2)	(2)	(2)	(13)	**(45)**	(2)	(0)
Sat	0	0	0	5.6	5.6	**72.2**	16.7
	(0)	(0)	(0)	(1)	(1)	**(13)**	(3)
Sun	20	0	0	0	0	0	**80**
	(1)	(0)	(0)	(0)	(0)	(0)	**(4)**

On the other hand, during a bank holiday week, the number of incorrect identifications increases across every day with a slight reduction at the weekend (Table 2.2).

Table. 2.2 Percentages (and number of respondents) showing correct and incorrect responses when identifying with the day across a bank holiday week. Correct responses are highlighted in bold).

Reported >	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Actual							
Mon	**31**	5.3	3	2	1.3	4	53.5
	(94)	(16)	(9)	(6)	(4)	(12)	(162)
Tues	41.2	**31.2**	16.3	4.7	1.2	2.3	2.3
	(36)	**(27)**	(14)	(4)	(1)	(2)	(2)
Wed	11	19	**47.6**	9.5	7.1	4.8	0
	(5)	(8)	**(20)**	(4)	(3)	(2)	(0)
Thu	0	7.7	34.6	**34.6**	23.1	0	0
	(0)	(2)	(9)	**(9)**	(6)	(0)	(0)
Fri	0	0	11.1	33.3	**44.4**	11.1	0
	(0)	(0)	(1)	(3)	**(4)**	(1)	(0)
Sat	0	0	0	0	16.7	**83.3**	0
	(0)	(0)	(0)	(0)	(2)	**(10)**	(0)
Sun	13.3	3.7	3	3.7	4.4	9.6	**62.2**
	(18)	(5)	(4)	(5)	(6)	(13)	**(84)**

Fig.2.1. Showing percentage response difference between correct and incorrect responses during a normal and bank holiday week.



When comparing correct vs incorrect responses (fig 2.1), people more readily identified with the correct day on a normal (62.5%) week in comparison to a week containing a bank holiday (47.76%) [X^2 (1, N = 1115) = 37.1, $p < 0.001$].

More specifically, significant differences were observed between the number of errors during mid-week days (Tuesday, Wednesday, & Thursday) (47.5%) and Monday & Friday (71.4%) in a normal week [X^2 (1, N = 479) = 26.4, $p < 0.001$]. On the other hand, during a bank holiday week, more errors occur in general and these appear to be relatively consistent across the week with a slight reduction at the weekend. An identical comparison between the number of errors during mid-week days (Tuesday, Wednesday, & Thursday) (37.8%) and Monday & Friday (37.7%) in a bank holiday week did not reveal a significant difference [X^2 (1, N = 466) = 1.14, $p > 0.25$].

As predicted, some days are more likely to be mismatched than others (for example, Tuesdays, Wednesdays and Thursdays), while others attract relatively few (Mondays and Fridays). However, when considering what day people 'feel like' they are currently aligned with, responses can also be sorted by actual day of response vs subjective feeling in terms of the number of days cognitively ahead or behind. The trends outlined in figures 2.2 and 2.3 were consistent across male and female participants.

Fig. 2.2. Showing percentage response difference between actual day and subjective feeling across a normal week (note: 0 = actual day).

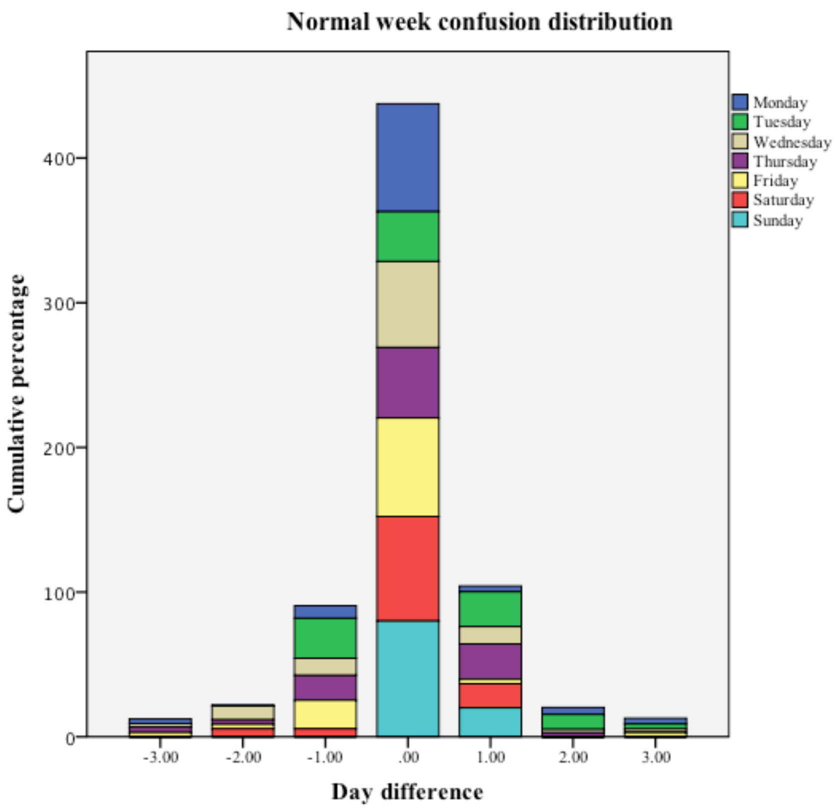
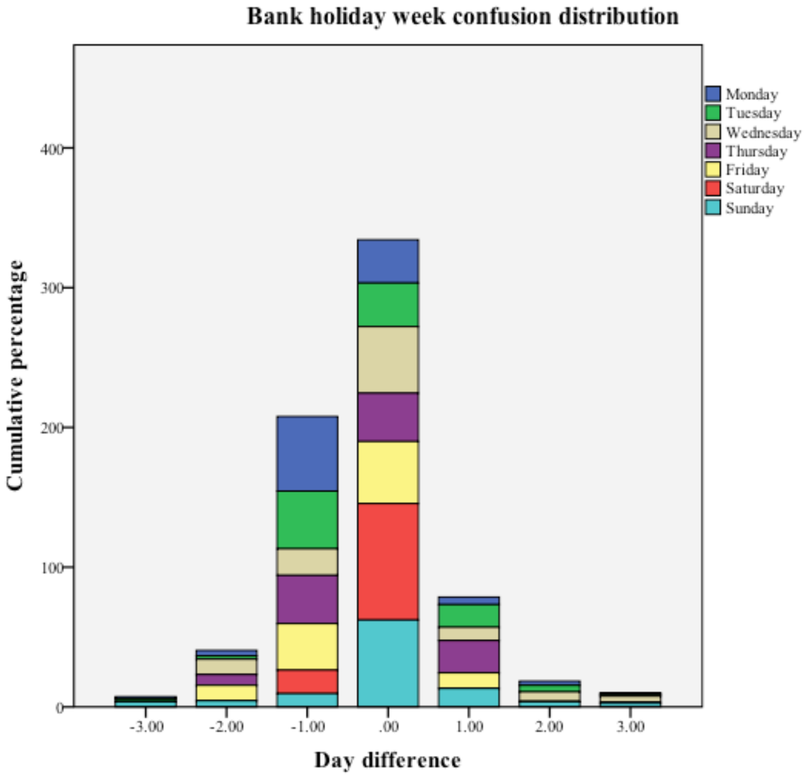
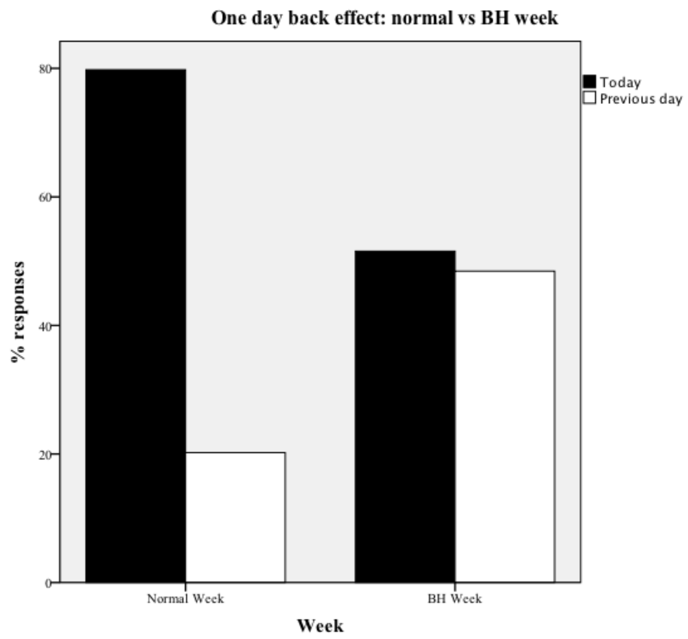


Fig. 2.3. Showing percentage response difference between actual day and subjective feeling across a bank holiday week (note: 0 = actual day).



In general, people feel that they are either one-day back or forward from the actual day (figure 2.4), but this one-day back effect becomes stronger during the bank holiday week [X^2 (1, N = 852) = 71.073, p< 0.001].

Fig. 2.4. Showing percentage response difference between actual day and one day back effect on a normal and bank holiday week.



Finally, many participants reported that a bank holiday Monday feels like a Sunday and this effect was reliably stronger during a bank holiday week (53.5%) when compared to a normal week (8.7%) [X^2 (1, N = 361) = 81.090, $p < 0.001$].

Discussion

Taken together, these results demonstrate that mismatches between the apparent day and actual day were surprisingly common. In addition, people commonly feel that they are either one day-forward or one day-back from the actual calendar day. In the same way that changing the clocks and working abnormal shift patterns can disrupt an individual's circadian rhythm, a bank holiday Monday appears to have a similar effect. Alternatively, some mismatching within the week is always present, but is merely exaggerated after a bank holiday weekend. At present, it remains unclear as to what cognitive process underlies these widespread temporal confusions.

One important limitation to consider however, is the variability in the number of responses across each day. While the average number of responses each day was around 80, some days attracted very few responses. For example, the number of respondents increased on days when the study was first advertised on social media, but decreased dramatically at the weekend. On the other hand, this tailing off is in line with recent research. Recent research from Survey Monkey also found a decrease in online survey responses at the weekend because less people are online. Interestingly, responses across the week were relatively static, but peak on a Friday suggesting that an online survey might appear more attractive at the end of the working week (Wagner, Barnes, Lim, & Ferris 2012; Survey Monkey 2013).

Chapter Summary

The consistent pattern of days across the calendar week is an inescapable part of humans' habitual, organisational behaviour, yet people often have the feeling that they are on the wrong day. Not only do these errors exist across the general population, some days attract more mismatches than others (Tuesday, Wednesday and Thursday), while others attract relatively few (Friday and Monday).

In the past, distortions of time have largely been witnessed within clinical populations, but this mismatch effect surrounding the current day appears to be an almost universal phenomenon (Orme 1969). However, what force drives these cognitive confusions remains unclear. In the next chapter I explore these associations in more depth. Given the prevalence of this phenomenon, understanding our relationship with the calendar week deserves further investigation from both a basic and applied perspective. While this Chapter gives some indication of both the prevalence and widespread existence of this phenomenon, Chapter 3 will consider what it means for one day to 'feel like' another.

Chapter 3
Mental representation of weekdays

Introduction

Like other timescales and some time perception errors, weekday errors are systematic. They are stable across individuals and do not merely reflect a random distribution, but instead have a definite direction. Indeed, it is the systematic nature of these errors that provides insight into underlying cognition.

People often use colourful literary expressions to describe certain days for example, 'having the Monday blues' or 'that Friday feeling' and so the associations may be relatively consistent between people. In a survey of 202 participants, Areni and Burger (2008) found Monday was cited most frequently as the worst day of the week in the morning and evening, whereas Friday and Saturday were viewed as the best morning and evening. The literary associations that could explain such a result may also help explain why some days appear to be more confusable than others if they hold a similar schematic pattern within memory. This is unclear from previous research (e.g. Areni 2008; Egloff, Tausch, Kohlmann & Krohne 1995), which has often relied on single, bi-polar measures which fail to capture qualitative differences between positive (e.g., pride vs. relief) and negative (e.g., loneliness vs. anger) affective states. Based on the results from Chapter 2, I predicted that mid-week days are likely to have a similar associative pattern, with Monday and Friday diverging from this norm.

Study 3.1 Associations with each day of the week

In this study, participants were invited to take part in a short free association task and write down any words they associated with each day of the week. I then analysed both the number of words produced for each weekday and quantified their emotional content using the Affective Norms for English Words (ANEW) system.

Method

Design and Stimuli

Response sheets had each day of the week listed in a random order or in the order they appear in the calendar. Space was provided next to each day and participants were required to write as many or as few words that they associated with each day of the week. Thirty-six participants received the days of the week in a random order. An additional 24 participants were presented with days in the order they appear in the calendar

Participants

Sixty psychology students (46 females, 14 males; mean age = 19) enrolled at the University of Glasgow were recruited to take part in a short pen and paper task.

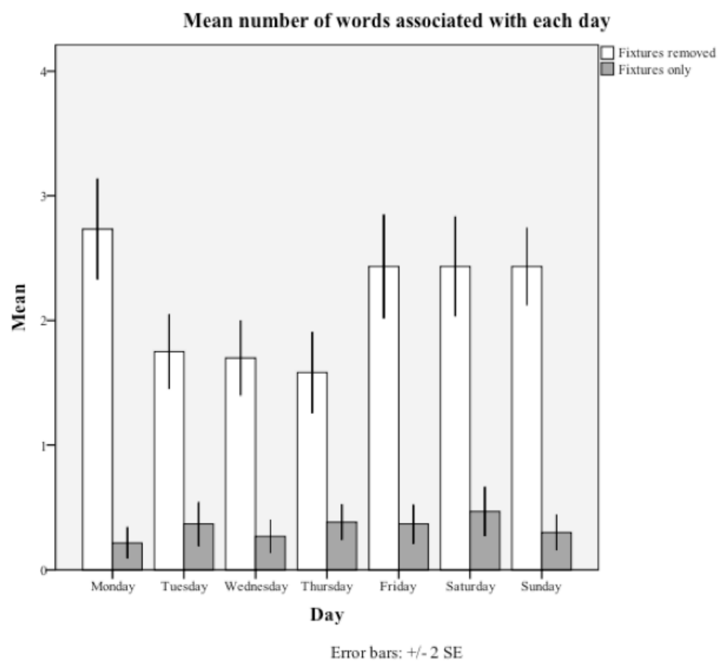
Procedure

In small groups, participants were told that people might associate specific words with each day of the week and considering this, they were encouraged to spend a few minutes on their own, writing down as many or as few words they wanted on the response sheet provided. When finished, participants simply handed their completed answer sheet to the experimenter who thanked them for their time.

Results: Number of Associations

Subjects responses were initially analysed based on the number of words associated with each day (figure 3.1). Fixtures were deemed to be events that regularly occurred on that day for example, 'Gym' or 'Tutorial'. These were removed for separate analysis.

Fig. 3.1. Mean number of words (and standard deviations) associated with each day of the week.



A one-way analysis of variance (ANOVA) revealed no main effect of weekday order on the number of words produced [$F(1,57) = .002$, $p = .695$]. An additional 7x2 mixed ANOVA revealed no significant interaction between the order days were presented to participants and the number of words produced (fixtures removed) across each day [$F(6,342) = 1.52$, $p = .17$].

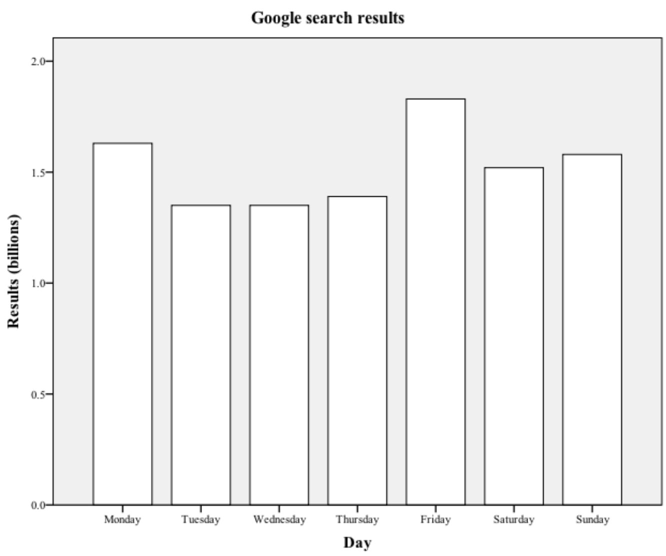
However, a second one-way analysis of variance (ANOVA) on the mean number of words produced for each day illustrated a significant main effect of day on the number of words produced [$F(6,413) = 6.68$, $p<0.001$].

I previously predicted that more words would be produced for the Monday and Friday condition in comparison to Tuesday, Wednesday and Thursday. Therefore, uncorrected paired-sample t-tests were employed to compare the mean number of words associated with each day. A significant difference was observed between the number of words associated with Monday ($M = 2.7$, $SD = 1.6$) and mid-week days Tuesday ($M = 1.8$, $SD = 1.2$) [$t(59) = 5.32$, $p<0.001$], Wednesday ($M = 1.7$, $SD = 1.2$) [$t(59) = 5.10$, $p<0.001$] and Thursday ($M = 1.6$, $SD = 1.3$) [$t(59) = 6.53$, $p<0.001$]. Additional t-tests revealed significant differences between the number of words produced in the Friday condition ($M = 2.4$, $SD = 1.6$) and mid-week conditions Tuesday [$t(59) = 3.53$, $p <0.001$], Wednesday [$t(59) = 3.37$, $p <0.001$] and Thursday [$t(59) = 4.28$, $p < 0.001$].

A final one-way (ANOVA) on the mean number of words given for each day (fixtures only) showed no significant main effect of day on the number of words produced [$F(6,413) = 1.13$, $p = 0.343$].

Interestingly, this pattern can be replicated when conducting a Google search for each day of the week using Ngram Viewer (figure 3.2) http://ngrams.googlelabs.com/. Ngram viewer is a phrase-usage mapping tool which charts the yearly count of n-grams (letter combinations) or words or phrases. As of 2008 it contains a library of over 5.2 million books digitised by Google.

Fig. 3.2. Results from a basic Google search.



Finally, a significant positive correlation was observed between age of participant and the number of words produced for a Monday and Tuesday (table 3.1 and figure 3.3).

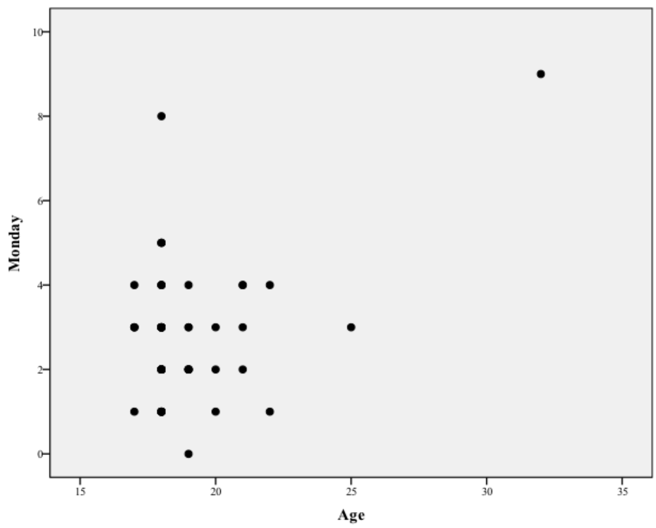
Table. 3.1. Showing correlations between number of words produced and age of participant.

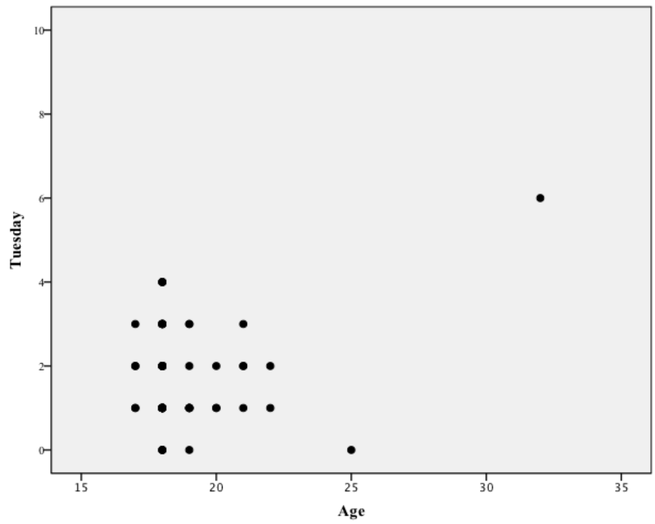
	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Age	.41**	.28*	.10	.17	-.12	.16	-.10

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Fig. 3.3. Showing scatter plots between age and number of words produced for a Monday and Tuesday (fixtures removed) based on a participant's age.





However, additional analysis revealed that this effect was driven by an outlier, in this case a participant who was considerably older than the majority of the sample. A second analysis with this outlier removed revealed no significant correlation between age of participant and the number of words produced in the Monday or Tuesday condition [p>.2]. At the same time, a negative correlation was now observed between age and the number of words produced in the Friday condition [r(57) = -.35, p = .007].

Results: Content of Associations

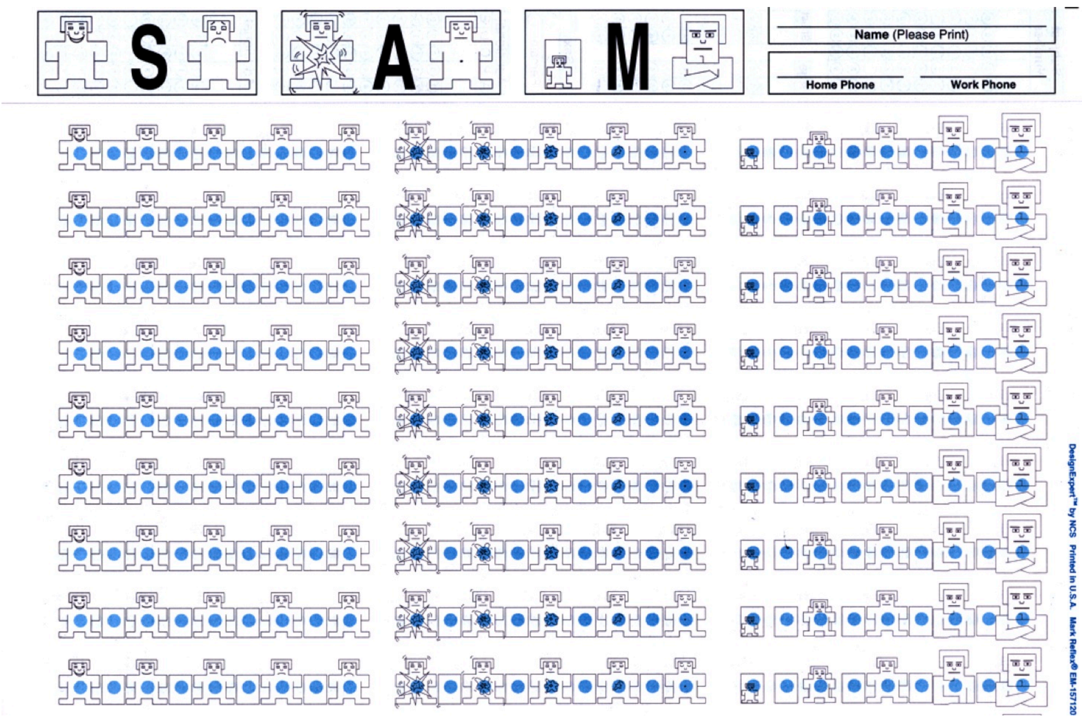
The Affective Norms for English Words (ANEW) system developed by Bradley and Lang (1999) allows words to be assessed on three-dimensions, pleasure, arousal and dominance, using a self-assessment manikin (SAM). Bradley and Lang (1999) determined that the SAM correlates well with factors of pleasure and arousal obtained using the longer, verbal Semantic Differential Scale (Mehrabian & Ryssell 1974). Dimensions of pleasure–

displeasure (the emotional counterpart of Evaluation), arousal–nonarousal (the emotional correlate of stimulus Activity), and dominance–submissiveness (the converse of stimulus Potency) provides a general description of emotions. Their preliminary measures of pleasure, arousal, and dominance accounted for 27, 23, and 14 percent of variance, respectively, of emotional reactions to highly varied everyday situations (Mehrabian & Russell 1974).

Russell and Mehrabian (1977) also showed that most of the reliable variance in 42 verbal-report scales could be accounted for in terms of the PAD (i.e., pleasure, arousal, and dominance) emotion scales. Shaver, Schwartz, Kirson & O'Connor (1987) used multidimensional analyses to study 135 emotion terms, and their results corroborated the PAD Emotion Model. Although they obtained two-dimensional (Evaluation and Intensity) and three-dimensional (Evaluation, Potency, and Activity) solutions, they found the three-dimensional representation of affect to be more informative than the two-dimensional one (Shaver et al., 1987, p. 1071). Therefore, the PAD Emotion Model allows for a superior analysis of weekday emotional associations in comparison to previous attempts by Areni (2008).

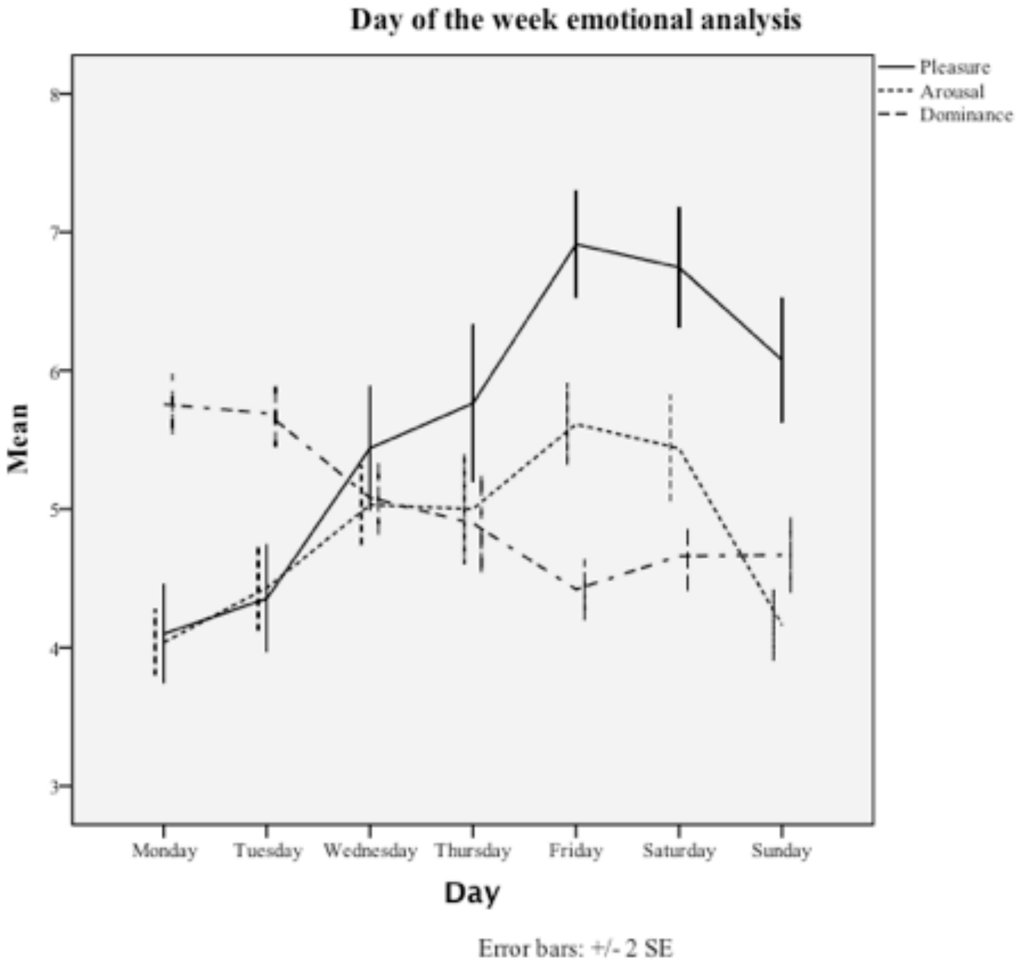
The graphic SAM (figure 3.4) comprises bipolar scales that depict different values along each emotional dimension. Pleasure is defined as words which make a participant happy or unhappy. Excited or calm for arousal and controlled vs in control for dominance. These words were rated using an illustrated, 9-point likert scale. Thirty subjects were asked to rate one of three random word lists for pleasure, arousal and dominance. Each list contained 80 words taken from Study 3.1

Fig. 3.4. Showing the Bradley and Lang illustrated scale scoring sheet.



Mean scores for each word were then applied to the word lists generated from the weekday association task to produce ratings of pleasure, arousal and dominance for each day of the week.

Fig. 3.5. Mean emotional ratings for words (and standard errors) provided for each day of the week (fixtures removed).



As predicted, Monday is associated with a very dominant, negative stereotype in contrast to Friday, which appears less dominant and significantly higher in pleasure. There is a consistent pattern whereby feelings of pleasure increase as the working week comes to an end. Simultaneously, levels of dominance peak on a Monday and tail off as the week progresses. Arousal remains relatively static, but also peaks on a Friday (figure 3.5).

Statistical analysis using a between-subjects one-way ANOVA revealed significant differences between day and pleasure [$F(6, 633) = 28.54$, $p<0.001$], arousal [$F(6,633) = 18.69$, $p<0.001$] and dominance ratings [$F(6,633) = 18.142$, $p<0.001$].

By plotting each calendar day in a 3D space showing pleasure, arousal and dominance (figure 3.6) , the linear distance between each day can be calculated using Pythagoras theorem (distance = sqrt($a^2 + b^2 + c^2$).

Fig. 3.6. XYZ plot showing each day in 3D space along with distance between each day.

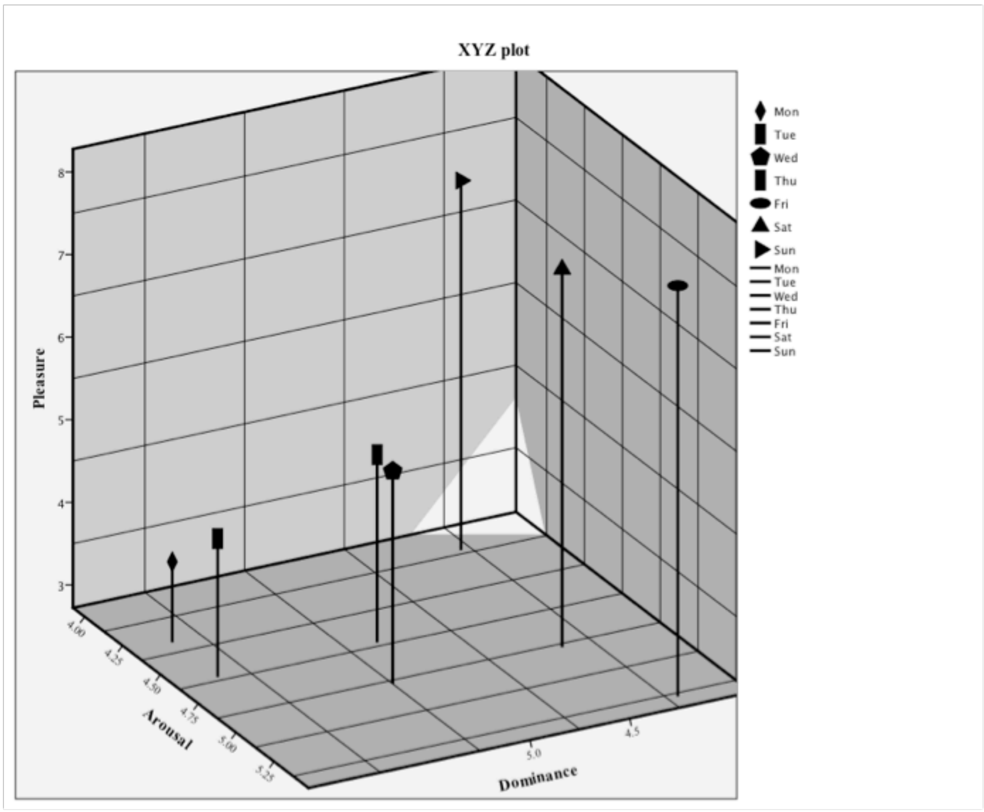


Table 3.2 Linear distances between weekdays in affective space, computed from *Pleasure*, *Arousal* and *Dominance* ratings.

	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Mon	**0**	.47	1.80	2.10	3.47	3.19	2.26
Tues	.47	**0**	1.39	1.71	3.10	2.80	2.03
Wed	1.80	1.39	**0**	.37	1.71	1.44	1.16
Thu	2.10	1.71	.37	**0**	1.39	1.11	.92
Fri	3.47	3.10	1.71	1.39	**0**	.33	1.69
Sat	3.19	2.80	1.44	1.11	.33	**0**	1.44
Sun	2.26	2.03	1.16	.92	1.69	1.44	**0**

Peak differences in associations occur between the start and end of the working week (Monday and Friday) and are at their smallest during mid-week days (Tuesday, Wednesday and Thursday) (table 3.2). A hierarchical cluster analysis was also performed, based on mean ratings of pleasure, arousal and dominance. Using Ward's method, this analysis produced three clusters. The first cluster was characterised by days which had high dominance and low pleasure (Monday and Tuesday). A second cluster consisted of days which were largely equal in pleasure and dominance (Wednesday and Thursday). A final third cluster combined days that were higher in pleasure and lower in dominance (Friday, Saturday and Sunday).

In addition to Monday and Friday being the days which have very distinctive associations, a cluster analysis also reveals that people tend to think about the week as having three distinct sections with a beginning (Monday and Tuesday), middle (Wednesday and Thursday) and an end (Friday, Saturday and Sunday).

Discussion

These results suggest that people tend to view the start of the working week negatively and the end in a more positive light. Furthermore, there are more words and emotionally stronger associations with the beginning and end of a working week with less distinction in the middle. These differences are not caused by fixtures of regular events that could inadvertently effect an individual's association with each day.

This coincides with previous confusion patterns surrounding the current day. In addition to having a richer schematic representation, there may also be a richer elaboration in memory retrieval when it comes to identifying with the current day (Bradshaw & Anderson 1982). These representations may also help explain the feeling of being one day forward or one day back from the actual day as the character of each day is roughly the average of yesterday and tomorrow. However, while the confusability between days in Chapter 2 is congruent with the extreme emotional nature of Monday and Friday, the fact that Monday and Tuesday are rarely confused whereas Tuesday and Wednesday are, is not. On the other hand the mismatches outlined in Chapter 2 are congruent with the number of associations suggesting that the overall effect is driven by an interaction between the number of associations and emotional content.

In light of recent research concerning 'mental time travel' (e.g. Miles, Karpinska & Macrae 2010), it may be of interest to explore how these associations govern such a phenomena as people travel back from the day felt to the actual day. For example, stronger associations with a specific weekday should result in more rapid identification. This was the focus of my next experiment.

Study 3.2 Congruency task to test association strength

This idea of often feeling one day back or forward may be better understood by considering how quickly people can identify with the current day in relation to others that surround it. An early experiment to try and quantify this effect used a simple congruency task where subjects were asked to judge whether a day of the week randomly presented on screen was or was not the current day. I predicted that subjects would take longer to reject days that were nearer the current day and faster to reject days further away from the current day.

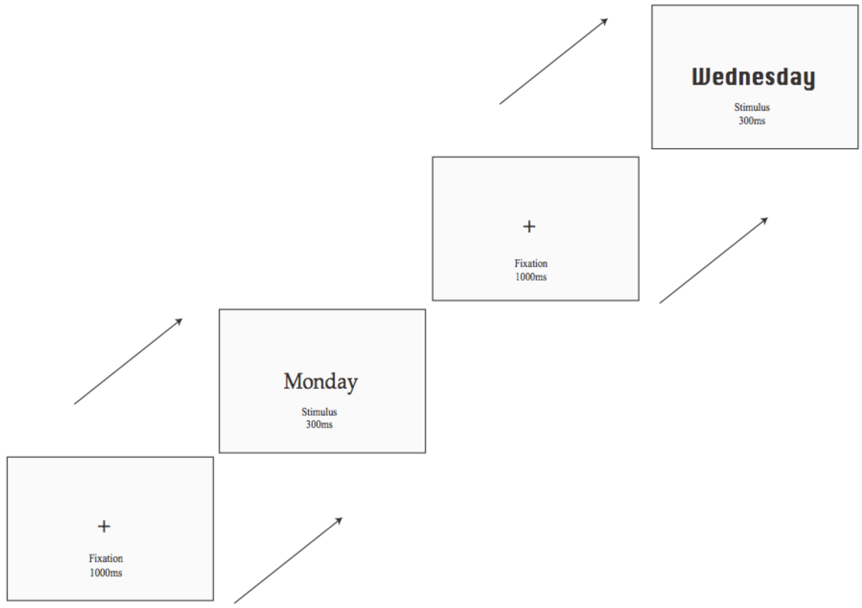
In addition, given the quantity and strength of associations that an individual has with the beginning and end of the week, I also expect participants to correctly identify the actual day more quickly if it falls on a Monday or a Friday.

Method

Design and Stimuli

An iMac running Mac OS X 10.5.5 and Superlab version 4.0.5 presentation software was used to present stimuli and record data. In addition, each day of the week was shown 12 times within each block (6 in total) and to prevent any recall effects from the first letter, 12 different fonts were used for each day.

Fig. 3.8. Showing an example trial.



Participants

Forty-five psychology students (30 male, 15 female; mean age = 19) enrolled at the University of Glasgow were recruited to take part in a short congruency task. All participants had normal or corrected to normal vision. Nine participants were tested on each weekday.

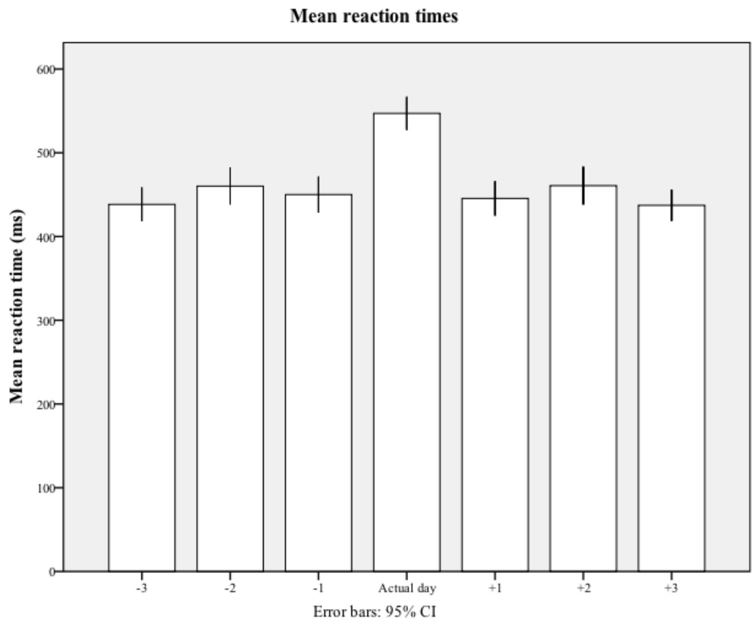
Procedure

Participants were welcomed to the lab and told they were going to take part in a simple cognitive experiment. After being seated 70cm from a 15 inch CRT screen they were instructed to respond to the days that flashed in front of them onscreen (each presentation consisted of a 1000ms fixation and a 300ms presentation). If the day onscreen was the actual day, they should press 1 and if any other day appeared that did not correspond to the actual day they should press 2. Participants were encouraged to be as accurate and respond as quickly as possible (figure 3.8).

Results

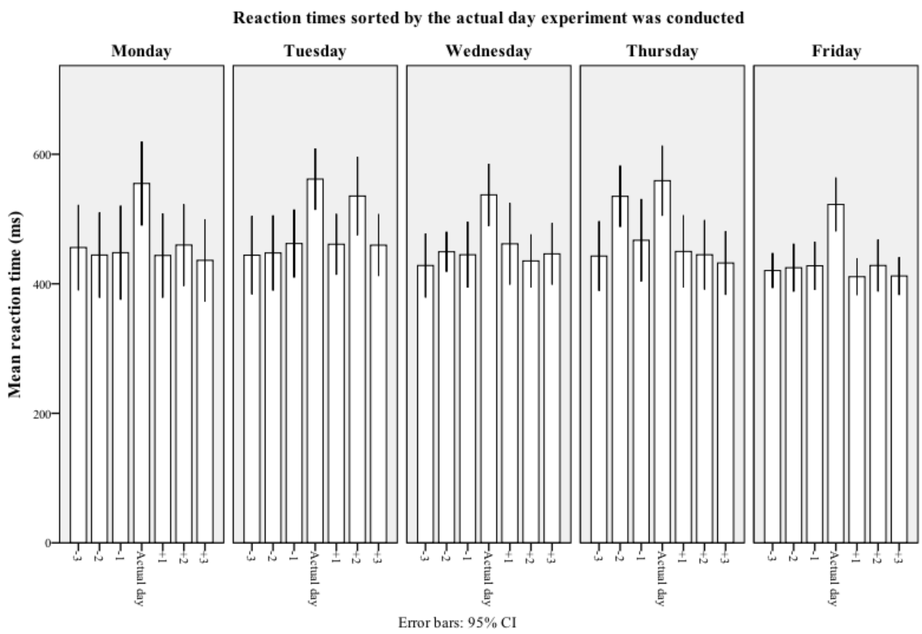
On initial inspection, these results appeared to support my initial predictions (figure 3.9). Incorrect responses were removed and a one-way ANOVA showed a significant main effect of number of days forward/back and reaction time. [$F(5,220) = 3.64$, $p = 0.003$].

Fig. 3.9. Showing mean reaction time (and 95% confidence intervals) for number of days away from the actual day.



It would appear on initial inspection that subjects were quicker to dismiss one and three days back or forward and slower to do the same on days plus or minus two days. However, after splitting the data into responses given on each day, a different pattern emerged. The initial delay observed in the -2 and +2 conditions was only observed on a Tuesday and Thursday (figure 3.10).

Fig. 3.10. Showing mean reaction time (and 95% confidence intervals) for number of days away form the actual day - sorted by day tested.



After removing Tuesday and Thursday responses from the data set, no reliable effect was present [$p > .5$]. On closer inspection, the original pattern of results was caused by a simple linguistic delay when responding to Tuesday or Thursday and therefore, this experiment does not support my initial predictions.

Considering responses to the actual day (when a participant has to correctly identify the actual day), no main effect was found between the actual day and the time taken to respond. [$F(4,40) = .553$, $p = .698$].

Discussion

The unexpected results above were likely to have been caused due to visual similarities between Tuesday and Thursday. In addition, any cognitive confusion surrounding the current day was perhaps extinguished within the first few trials and unlikely to be an issue thereafter.

While this experiment did not yield the results I expected, it did help hint towards a new approach, specifically, a one-shot type experiment would prevent subjects becoming familiar with the question posed and thus accurately measure cognitive confusion based on the associations outlined previously. This was the focus of Study 3.3.

Study 3.3 One-shot reaction time task

As a revision to the previous experiment, I predicted that it would take longer for subjects to recall the current day during mid-week days and less time to do the same for those days that act as markers for the beginning and end of the working week (Monday and Friday).

Method

Design and Stimuli

Participants were invited into the lab across the week and simply asked '*Can you tell me what day of the week it is today?*'. Their reaction time to the question was recorded. An iMac computer running Garageband 08 was used to present the pre-recorded question and simultaneously record the participants' verbal response. The day of the week is usually displayed in the top right hand corner of the screen, but this was hidden from view for the duration of the experiment.

Participants

Sixty-seven undergraduate students (72% female) enrolled at the University of Glasgow were recruited from an online subject pool. All subjects were native English speakers. Their ages ranged from 17-23. Thirteen participants were tested on each weekday (for exclusions, see results).

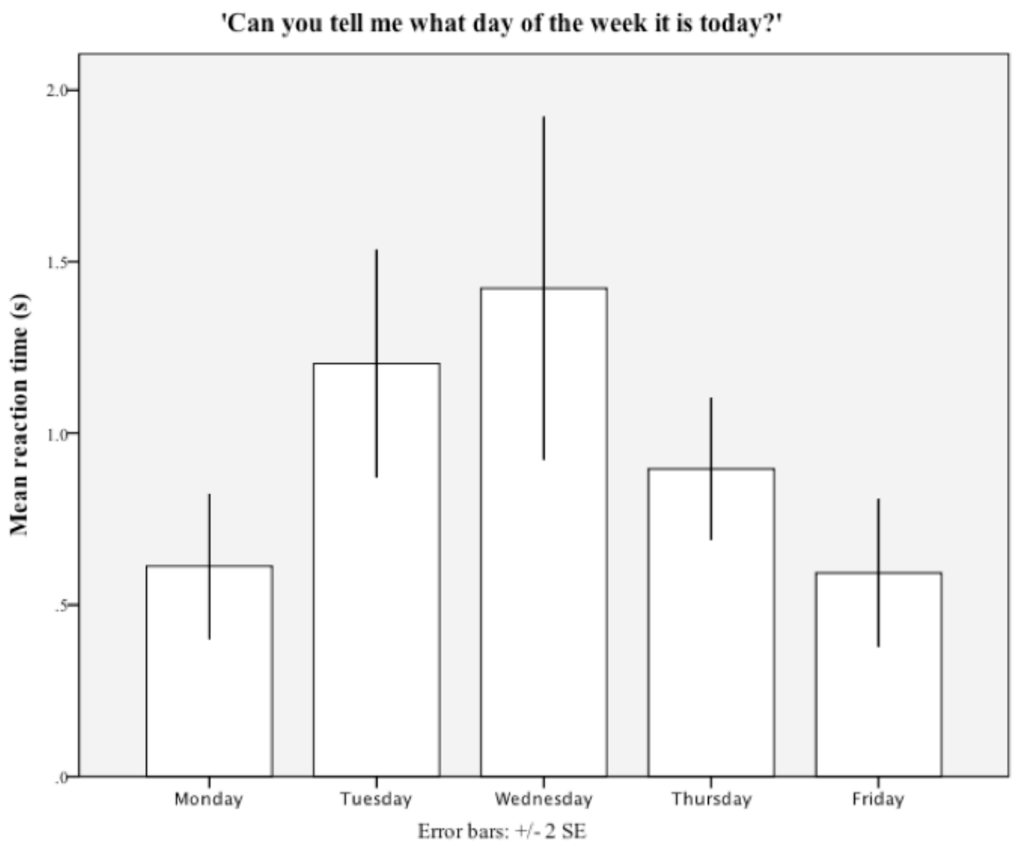
Procedure

After being welcomed into the lab it was explained to participants that they were going to be asked a question and simply had to respond as quickly as possible. They were also made aware that the question was pre-recorded and that their responses were being recorded to measure their reaction time to the question posed.

Results

Reaction time was always measured from the end of the word 'today' in the initial question until a correct response was produced. Two subjects who provided an incorrect response, were removed from the analysis. Mean reaction times are displayed below (figure 3.11).

Fig. 3.11. Mean reaction times in seconds (and standard errors) taken for subjects to answer the question "Can you tell me what day of the week it is today?' across each weekday.



A between-subjects one-way ANOVA revealed a significant main effect of day on reaction time [$F(4, 60) = 5.38$, $p<0.001$].

Again, planned comparisons were employed because my predictions were based on the results from Study 3.1. Uncorrected independent sample t-tests tests revealed additional significant differences between reaction times to recall a Monday ($M = 0.61$, $SD = 0.38$) from a Tuesday ($M = 1.2$, $SD = 0.60$) [$t(24) = -3.0$, $p = 0.006$], Monday from a Wednesday ($M = 1.42$, $SD = .61$) [$t(24) = -2.99$, $p = .006$ but not Monday from a Thursday ($M = 0.90$, $SD =$

0.37) [$t(24) = -1.92$, $p = .067$].

Independent sample t-tests also revealed significant differences between reaction times on a Friday ($M = 0.59$, $SD = .39$) in comparison to a Tuesday[$t(24) = -3.02$, $p = .005$], Friday and Wednesday [$t(24) = -3.05$, $p = .006$], but not Friday and Thursday [$t(24) = -2.03$, $p = .054$].

Discussion

As expected, reaction times to recall the actual day are quicker on a Monday and Friday, but slow through the mid-week days. This suggests more cognitive confusion when trying to identify with the correct day. While supportive of my predictions, the overall result is nevertheless surprising given that several emails were exchanged to arrange a convenient day and time to come into the lab.

Is it possible that this result is caused by differences in motor programming (Abbs, Gracco & Cole 1984) or a delay in vocalisation (Santiago, MacKay, Palma & Rho 2000) of the different days of the week. However, given that it took participants, on average, twice as long to recall a Wednesday in comparison to a Monday or a Friday, even after accounting for a potential delay in vocalisation, the effect demonstrated here is likely to persist.

My next step was to look for a similar pattern in larger online data sets, where the question posed was similar to the above, but time was automatically measured using metrics that recorded the time spent on each web page.

Study 3.4 One-shot reaction time task - online replication

I attempted to replicate the above findings in a larger online experiment while simultaneously examining confusion effects based on reaction time differences between the actual calendar day and the day felt. Given that some confusion often exists when it comes to deciding what day it 'feels like', I predicted that participants would take longer to answer this question when compared to the time spent confirming the actual day.

Method

Design and Stimuli

After following a link, participants were presented with a series of cognitive tasks as part of a larger experiment (see Appendix A). Participants were first asked:

'*People sometimes have the feeling that they are on the wrong day of the week.*
For example, it might "feel like" Friday when in fact it is Wednesday.
What day of the week does today "feel like" to you?

After completing a series of control questions, they were then asked '*What is the actual day today?*'. The length of time each participant spent on these pages was recorded.

Participants

642 people completed the experiment (48.1% female). Their ages ranged from 13-88.

Procedure

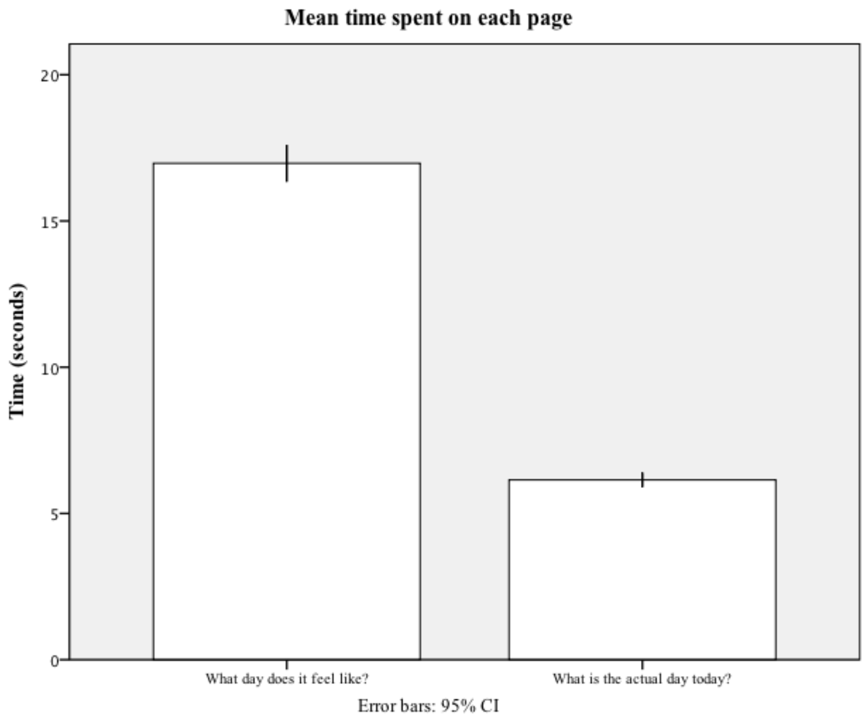
After following a link, participants were presented with the question '*What is the actual day today?*'. Participants had the option of choosing any day of the week from a drop down menu. On the following pages, they were also asked for some basic demographical information including their age, sex and location.

Results

Participants who spent more than 2 minutes on any page or who took longer than 25 minutes to complete the online experiment in total were removed from the analysis. This amounted to less than 3% of the total sample.

Firstly, the mean length of time spent time on each page was calculated. Below shows a comparison between '*What day does it feel like?*' and '*What is the actual day today?*'. Participants, on average, spent significantly more time considering what day it felt like (M = 16.97, SD = 8.12) in comparison to the actual day (M = 6.15, SD = 3.22), [$t(635) = 36.00$, $p<.0001$] (figure 3.12).

Fig. 3.12. Showing differences in mean time (and 95% confidence intervals) spent between each page.

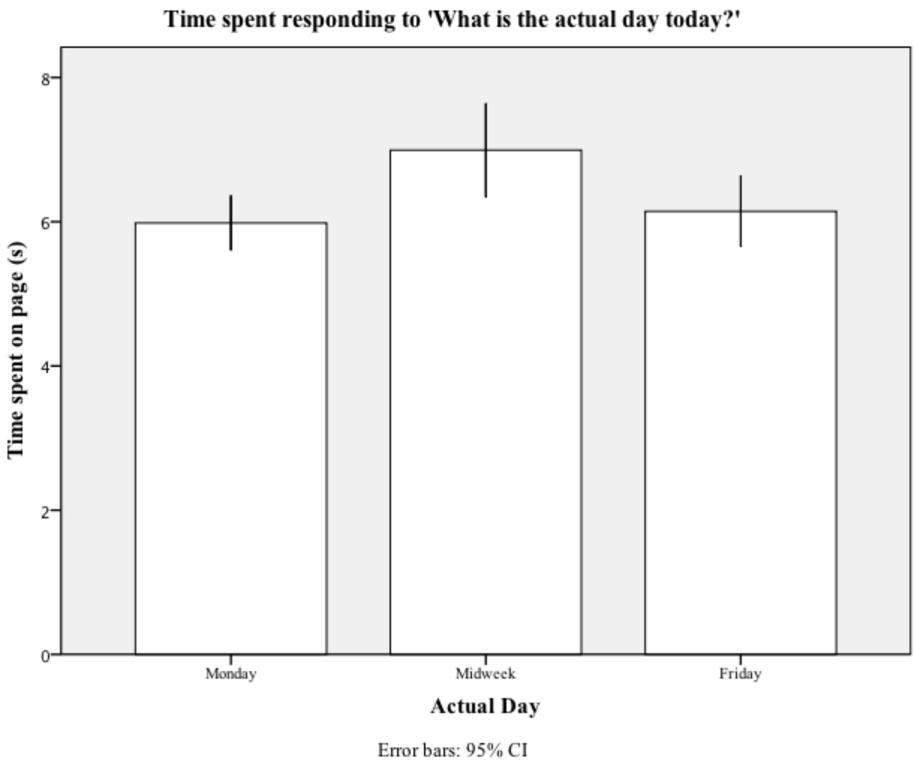


'What is the actual day today?'

The majority of responses were collected on a Monday ($N = 296$) and Friday ($N = 159$). Mid-week responses (Tuesday, Wednesday and Thursday) were pooled into one group ($N= 120$).

Replicating my previous findings, participants again took longer to confirm that the actual day was a Tuesday, Wednesday and Thursday in comparison to a Monday and Friday [$F(2, 572) = 3.95$, $p = .02$].

Fig. 3.13. Showing mean time (and 95% confidence intervals) spent to confirm the actual day on a Monday, mid-week or Friday.



As predicted, Independent sample t-tests revealed a significant difference between Monday (M = 5.98, SD = 3.35) and mid-week responses (M = 6.99, SD = 3.62) [$t(414) = -2.7$, p = 0.007] (figure 3.13). A significant difference was also observed between Friday (M = 6.14, SD = 3.14) and mid-week responses [$t(277) = -2.1$, p = 0.038].

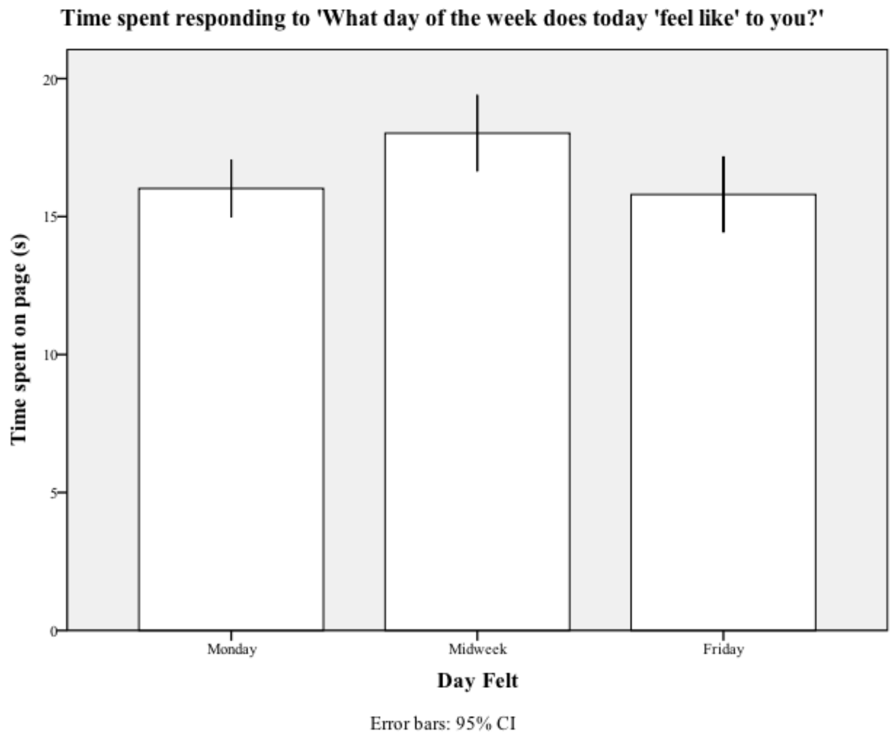
'People sometimes have the feeling that they are on the wrong day of the week.'

For example, it might "feel like" Friday when in fact it is Wednesday.

What day of the week does today "feel like" to you?

Responses were again pooled into Monday, mid-week and Friday. The pattern of results are broadly similar to those already outlined above (figure 3.14) [$F(2,485) = 3.72$, $p = .02$].

Fig. 3.14. Showing mean time spent (and 95 % confidence intervals) to confirm whether the day felt like a Monday, mid-week or Friday.

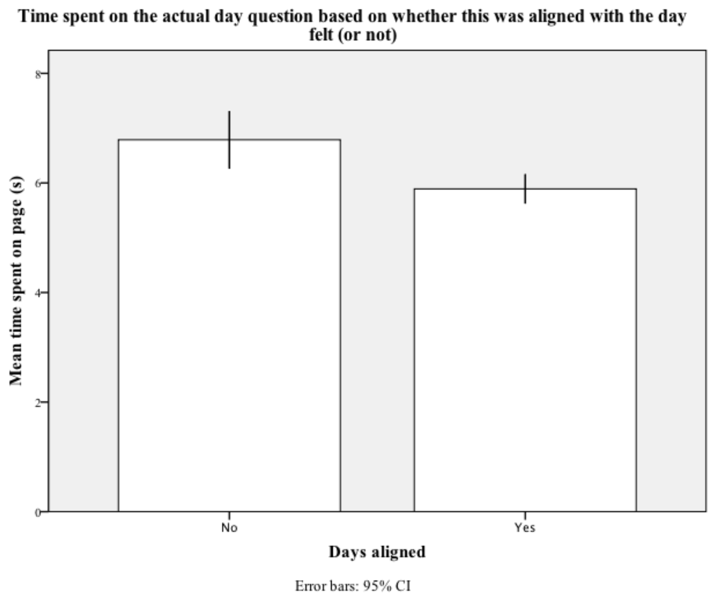


Planned comparisons revealed a significant difference between Monday (M = 16.02, SD = 7.94) and mid-week responses (M = 18.02, SD = 8.49) [$t(366) = -2.3$, $p = 0.022$]. A significant difference was also found between Friday (M =15.08, SD = 7.86) and mid-week responses [$t(271) = -2.23$, $p = 0.026$].

These data also allowed me to examine the response time for the two experimental questions in addition to several control questions, based on whether the day felt and the actual day were in perfect alignment (or not). Based on the previous findings outlined earlier in this Chapter, I predicted that there should be a significant delay in the time to respond to both the day felt and actual day questions, as the disparity between the two increases. In addition, this should not affect the time spent on other pages if it is specifically associated with confusion around the current day and day felt.

To test this prediction, the time spent on each page was compared to when the day felt and actual day were either in perfect alignment, or a day or more away from the actual day (figure 3.15).

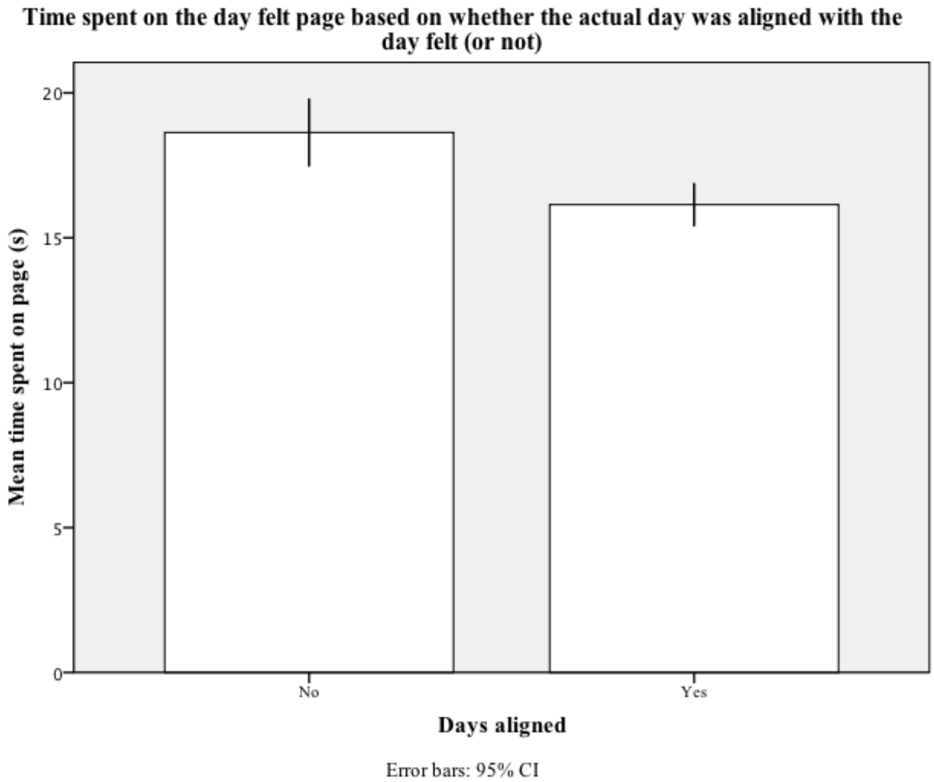
Fig. 3.15. Showing mean time spent (and 95 % confidence intervals) on the day felt question based on whether or not the day was correctly aligned with the actual day (or not).



As expected, when the actual day and day felt were not in perfect alignment, participants spent longer to respond to the question regarding what day it felt like. A paired sample t-test revealed this difference between yes (*M* =16.15, *SD* = 7.74) or no (*M* = 18.63, *SD* = 8.6) was significantly robust [$t(634) = 3.68$, $p = .039$].

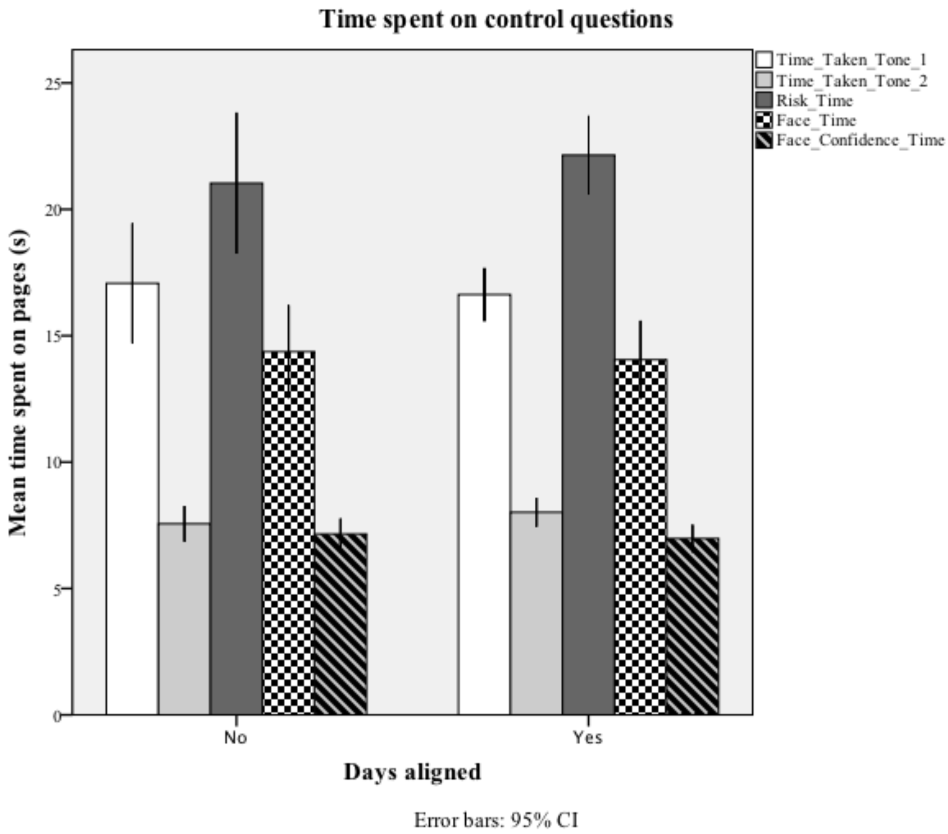
An identical analysis was performed for the average time participants spent answering the question for the actual day when it was (or was not) correctly aligned with the day felt (figure 3.16). Again, this difference was also found to be significant between yes (*M* =5.89, *SD* = 2.84) and no (*M* =6.79, *SD* = 3.89) alignment conditions [$t(640) = 3.32$, $p = < .001$].

Fig. 3.16. Showing mean time spent (and 95 % confidence intervals) on the actual day question based on whether or not the day was correctly aligned with the day felt (or not).



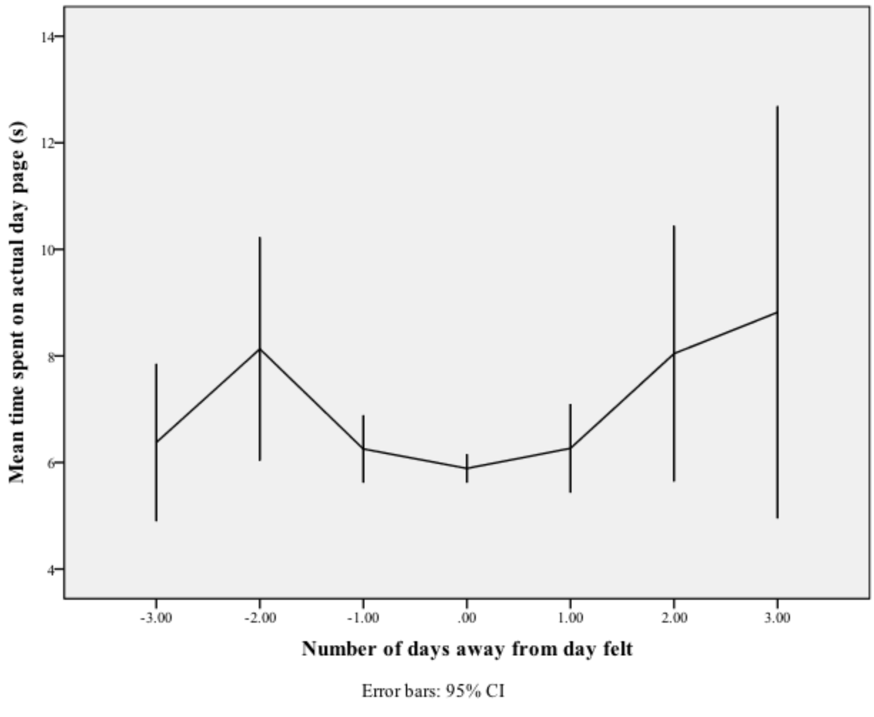
To ensure that this trend was not present on every page, I conducted an identical analysis on a number of control questions involving similar one button responses (figure 3.17). No significant differences were observed between yes/no alignment [$p > .18$].

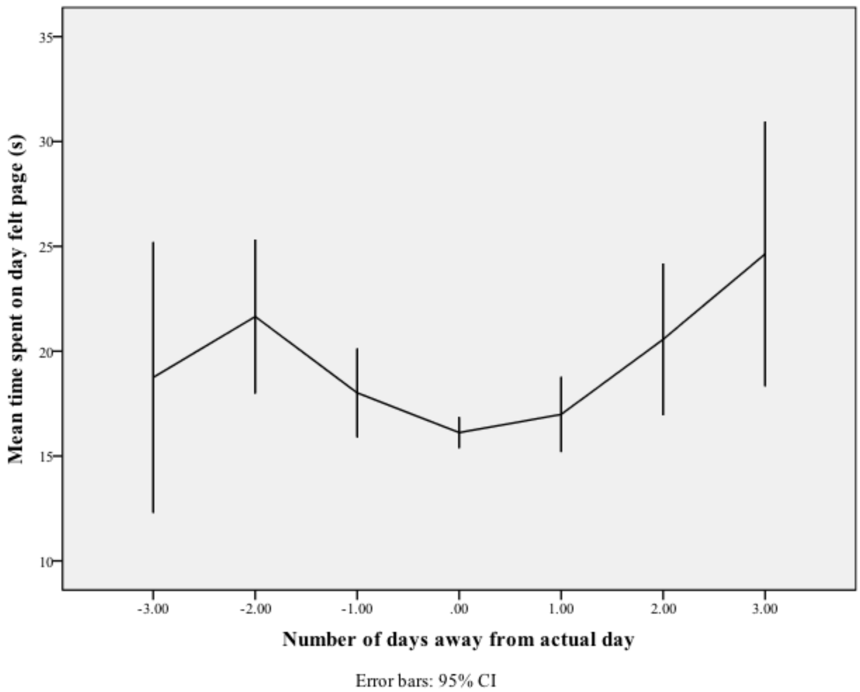
Fig. 3.17. Showing mean time spent (and 95 % confidence intervals) on other control question pages, based on whether the day felt and actual day were in perfect alignment (yes or no).



Finally, I compared the time spent on each page as confusion increased between the actual day and the day felt. Based on previous results, as the distance between these increases, the time taken to respond should also increase accordingly. The plotted means suggest that this is both directional and in line with my previous findings (figures 3.18-3.19).

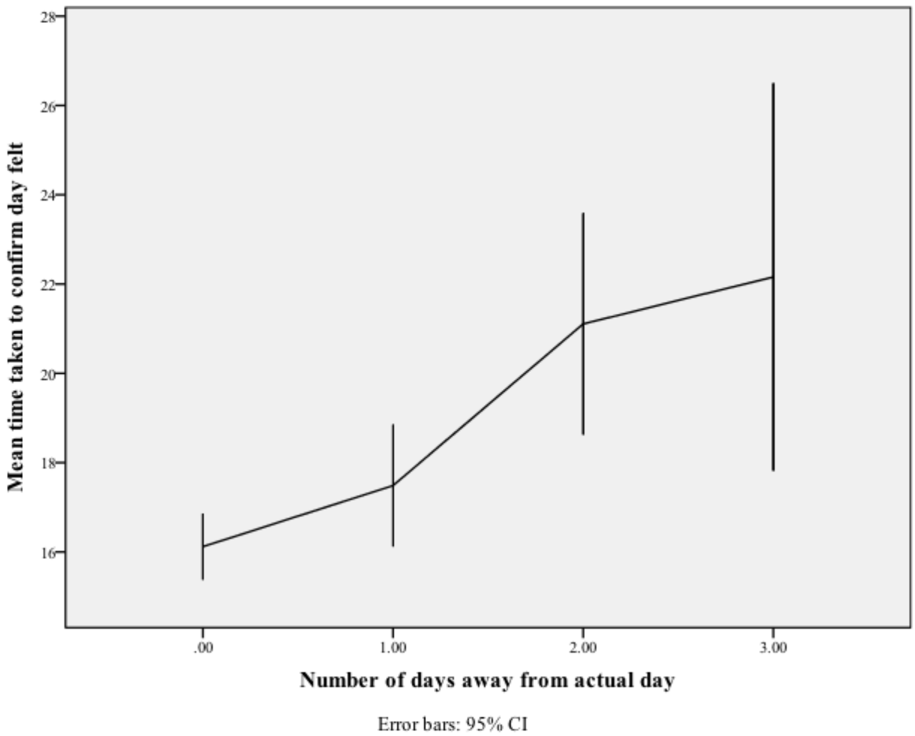
Fig. 3.18. Showing mean time spent (and 95 % confidence intervals) on day felt and actual day questions based on the level of confusion.

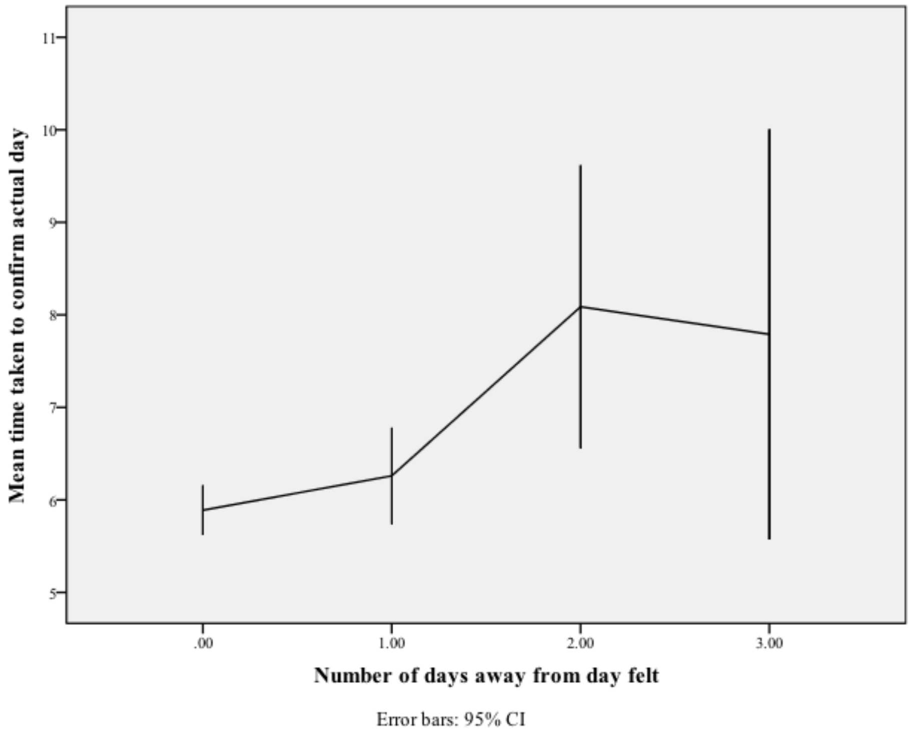




35
30
25
20
15
10
Mean time spent on day felt page (s)
-3.00
-2.00
-1.00
.00
1.00
2.00
3.00
Number of days away from actual day
Error bars: 95% CI

Fig. 3.19. Showing mean time spent (and 95 % confidence intervals) spent on day felt and actual day questions based on the level of confusion (direction removed).





With the direction of the confusion removed, two separate ANOVAs found a significant main effect of confusion for time taken in both the day felt [$F(3,632) = 8.62$, $p < .0001$] and actual day responses [$F(3,638) = 8.29$, $p < .0001$].

Follow up, Tukey tests for the time taken in the day felt condition are shown below. Tukey tests were chosen in this instance due to the number of comparisons and the large variability in sample size. In addition, this analysis was driven, in part, by data availability in addition to my own predictions (table 3.3).

Table. 3.3. Showing multiple Tukey comparisons (and 95% confidence intervals) for the day felt condition.

Confusion (days)	Confusion (days)	Mean Difference	Std. Error	Sig.
0 (N=431)	1	-1.37	0.765	0.281
	2	-4.99	1.238	**0.001**
	3	-6.04	1.871	**0.007**
1 (N=146)	0	1.37	0.765	0.281
	2	-3.62	1.349	**0.037**
	3	-4.67	1.946	0.078
2 (N=46)	0	4.99	1.238	**0.001**
	1	3.62	1.349	**0.037**
	3	-1.05	2.176	0.963
3 (N=19)	0	6.04	1.871	**0.007**
	1	4.67	1.946	0.078
	2	1.05	2.176	0.963

Additional follow up Tukey rests, for the time taken in the actual day condition are also displayed in table 3.4.

Table. 3.4. Showing multiple Tukey comparisons (and 95% confidence intervals) for the actual day condition.

Confusion (days)	Confusion (days)	Mean Difference	Std. Error	Sig.
0 (N=431)	1	-0.37	0.306	0.618
	2	-2.2	0.496	**0.001**
	3	-1.9	0.749	0.055
1 (N=146)	0	0.37	0.306	0.618
	2	-1.83	0.54	**0.004**
	3	-1.53	0.779	0.203
2 (N=46)	0	2.2	0.496	**0**
	1	1.83	0.54	**0.004**
	3	0.3	0.871	0.986
3 (N=19)	0	1.9	0.749	0.055
	1	1.53	0.779	0.203
	2	-0.3	0.871	0.986

In summary, these follow up comparisons are limited in some respects as the sample size tends to reduce as less participants experience a full 3 days confusion. However, what they do reveal is that this delay in confirming both the actual day and the day felt appear to peak when 1 to 2 days out of alignment.

Discussion

While this study lacks the additional control of a lab based experiment, it supports my pervious findings. Firstly, the results replicate findings from Chapter 2 as it remains clear that weekday confusions are widespread in the normal population. Secondly, reaction time taken to align with the actual day or day felt is dependent on the distance between the two. In other words, it may be possible that participants are cycling through each day of the week in memory to reach the correct response. The further away the two days are, the longer this process takes. This trend appears to ease off after reaching 3 days of confusion, possibly because the distance between the actual day and day felt is great enough to reduce the overall level of confusion.

Continuing with an online methodology, but returning to the emotional associations from Study 3.1, I next attempted to replicate the same associational patterns in a data mining exercise using the popular microblogging website: Twitter.

3.5 Using Twitter to better understand weekday emotional associations

Online networking and communication have transitioned from fad to mainstream global phenomena over the last few years. For example, Facebook now attracts more page visits than Google, confirming a definite shift in how people spend their time online (Ellison, Steinfield & Lampe 2007).

The advantage to psychology is two-fold. Firstly, people using these facilities leave a vast amount of linguistic data about themselves that goes further than existing self-report measures. Secondly, this data is often freely available for analysis (Miller 2001; Qiu, Lin, Ramsay & Yang 2012).

Twitter is an online social networking service and microblogging service that enables its users to send and read text-based messages of up to 140 characters, known as "tweets", which can be downloaded in real time and stored for future analysis. Simple techniques can be applied as the deluge of online data has led to the development of new software-based tools, which are now freely available and easy to use (e.g. Python with Application Programming Interfaces (APIs), Processing, R,). In what will be this Chapter's final study, I briefly explore the language people use when discussing the weekday in tweets. Based on previous results, I predicted that tweets including the word Monday for example, will include fewer positive associations, which will steadily increase towards, and peak on a Friday.

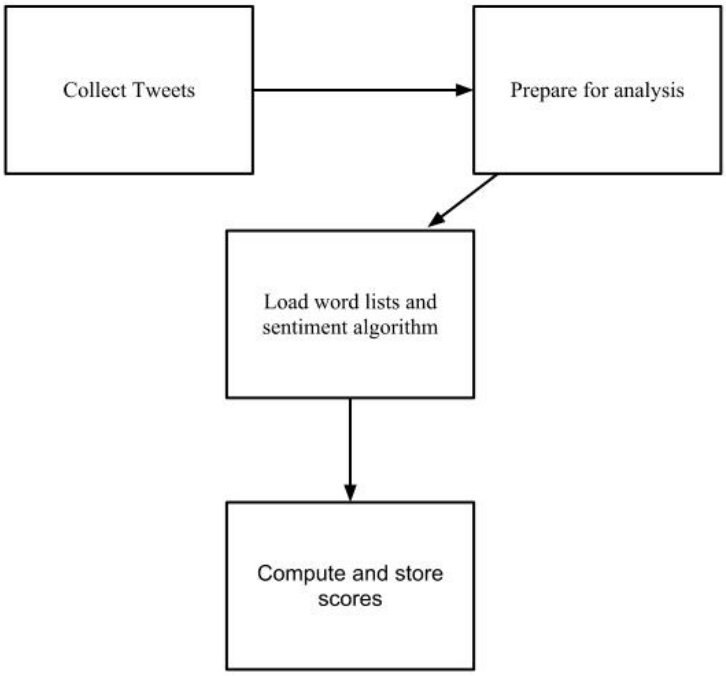
Data Collection and Analysis

Data was collected from Twitter over a 48 hour period on the 28th and 29th of October 2012 between the hours of 11am and midnight (UK time)

Each hour, 250 Tweets were harvested that contained a mention of each weekday (1250 Tweets in total per hour (32,500 tweets in total)). These were then processed and stored for later analysis (figure 3.20). Punctuation and web links were removed. A sentiment function was then applied to these tweets using word lists developed by Hu and Liu, (2004). This is a list of positive and negative opinion words or sentiment words for English (around 6800 words) (Liu 2012).

Tweets for each day were then scored based on the number of positive and negative words used in each Tweet. For example, a tweet with three positive words (3) and one negative word (-1) would score 2 (3-1=2). These scores were then averaged (figure 3.20).

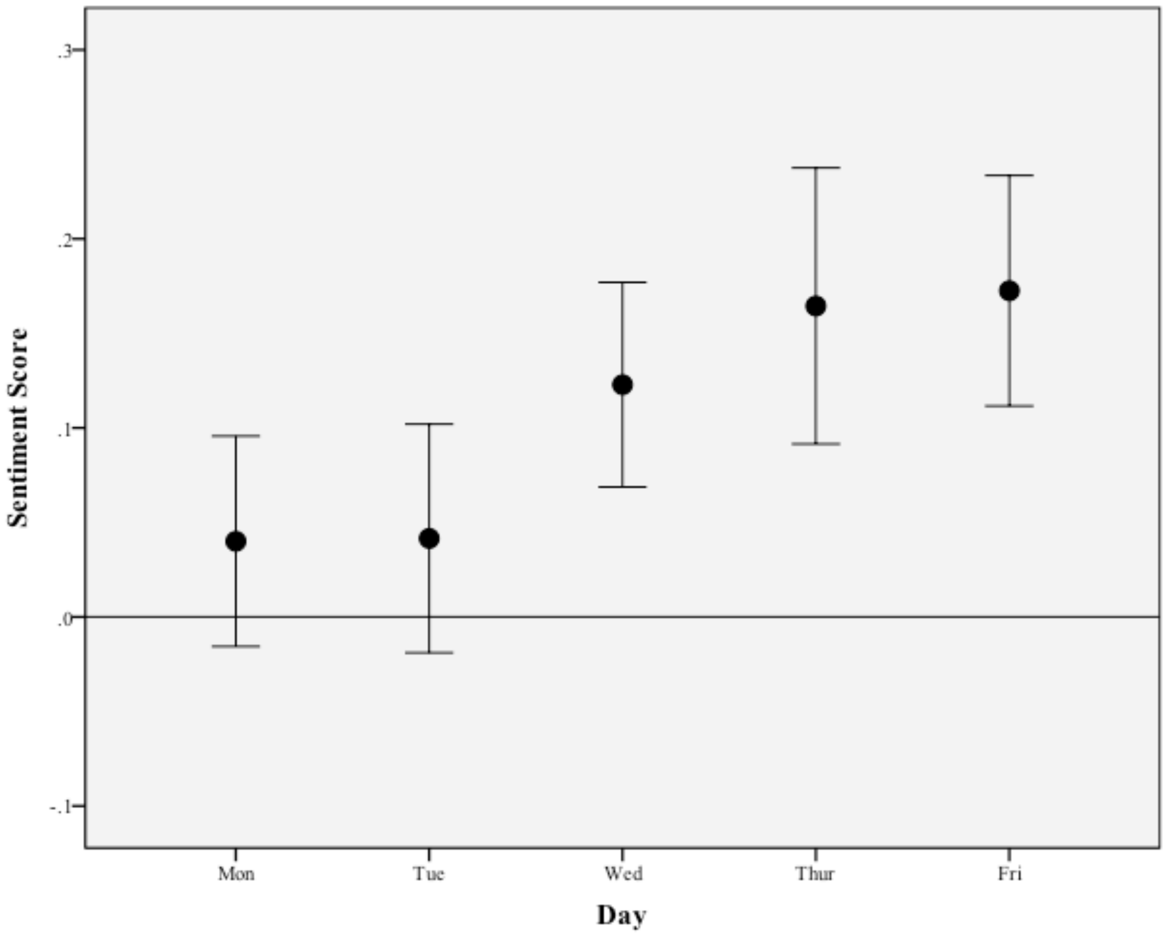
Fig. 3.20. Data path for sentiment analysis.



Results

The average sentiment score for each weekday set of tweets was computed (figure 3.21).

Fig. 3.21. Mean (and 95% confidence intervals) of sentiment analysis across each weekday.



A one-way ANOVA revealed a significant difference between the day mentioned in a Tweet and sentiment score [$F(4,175) = 4.34$, $p = .002$]. Tukey follow-ups comparing each day are reported in table 3.5. Tukey tests were again chosen despite my earlier predictions because these comparisons were exploratory in nature.

Table. 3.5. Showing multiple Tukey comparisons (and 95% confidence intervals) based on sentiment score per day.

Day (days)	Confusion (days)	Mean Difference	Sig.
Monday	Tuesday	-0.0015385	1
	Wednesday	-0.0828846	0.315
	Thursday	-0.1245385	**0.037**
	Friday	-0.1325615	**0.022**
Tuesday	Monday	0.0015385	1
	Wednesday	-0.0813462	0.334
	Thursday	-0.123	**0.041**
	Friday	-0.1310231	**0.025**
Wednesday	Monday	0.0828846	0.315
	Tuesday	0.0813462	0.334
	Thursday	-0.0416538	0.872
	Friday	-0.0496769	0.781
Thursday	Monday	0.1245385	**0.037**
	Tuesday	0.123	**0.041**
	Wednesday	0.0416538	0.872
	Friday	-0.0080231	1
Friday	Monday	0.1325615	**0.022**
	Tuesday	0.1310231	**0.025**
	Wednesday	0.0496769	0.781
	Thursday	0.0080231	1

Discussion

The results here are in line with previous experiments as Monday appears to be the most negative day and this score increases in a linear fashion peaking on a Friday. This simple analysis replicates the pleasure based emotional associations observed in earlier experiments in a real-world context suggesting that earlier associations are robust outside the lab.

However, the sentiment analysis used here is comparatively simplistic and is unable to deal with any abbreviations, words not in the dictionaries used or complex linguistic intent. For example, the algorithm is unable to understand sarcasm i.e. "Don't you just love Mondays' would be coded as positive rather than negative. These limitations should be taken into account when drawing conclusions.

Chapter Summary

The consistent pattern of days across the calendar week is an inescapable part of repetitive, organisational behaviour, yet people often have the feeling that they are on the wrong day. Not only do these errors exist across the general population, but some days attract more mismaching than others (Wednesday and Thursday), while others attract relatively few (Friday and Monday). These days are cognitively easier to recall because (a) they have more associations in comparison to other days and (b) these associations, or stereotypes are schematically different enough to result in more elaborate learning within memory (Craik & Tulving 1975; Bradshaw & Anderson 1982).

Furthermore, the distance between the day felt and the actual day appears to correlate with processing delays when aligning the two in memory. For example, if a day feels like a Thursday, but it is in fact a Tuesday, this will take longer to recall in memory than if the actual day was Wednesday. This may be better explained using a mental time travel framework as people may be cycling through weekdays when recalling the actual day or day felt. However, this would require further investigation as this is likely to interact with the permanence of the actual day in memory. It may be the case that such a cycling effect may only exist during mid-week days that are naturally more confusable, but not on those days which appear to hold a universal significance (Mondays and Fridays).

In the past, distortions of time have largely been witnessed within clinical populations, but cognitive confusion surrounding the current day appears to be an almost universal phenomena. However, what force drives these associations and subsequent cognitive confusions remains unclear. Differences in sleeping patterns between the weekend and working week may for example, explain the 'blue monday' effect (Taylor, Wright & Lack 2008). Alternatively, these stereotypical associations may develop from childhood as an individual quickly becomes accustomed to a normal working week though their educational environment.

In an applied context, biological time cycles have shown strong behavioural correlates. For example, changes in circadian rhythms when transitioning to daylight-saving time in spring has been shown to have a negative impact on both the functioning of financial markets and the human heart (Kamstra, Kramer & Levi 2000; Taylor & Hammer 2008). Based on recent findings from those studying embodied cognition (Sherman, Gangi & White 2010), it is reasonable to assume that the associations and confusions outlined in this Chapter may too have additional, everyday behavioural correlates.

Given the prevalence of this phenomenon and the likely economic and personal costs involved, understanding our relationship with the calendar week deserves further investigation from an applied perspective and in the following two Chapters, I examine how these associations might help explain and highlight weekly patterns of behaviour that take place outside the lab.

Chapter 4
Weekday affects attendance rate for medical appointments: Large-scale data analysis and implications

Introduction

Chapters 2 and 3 explored a social time cycle: the calendar week is different from other cyclical patterns as it is not linked to seasonal, lunar or circadian rhythms like days, months and years (Zimecki 2006). Confusions over the day of the week are surprisingly common. In particular, Monday and Friday appear to be relatively distinct, compared with the days in between. Confusions were normally distributed around the actual day, such that the preceding day and the following day exerted the strongest influence. In subsequent studies, I investigated the mental representation of different weekdays. Monday and Friday gave rise to significantly more semantic associations than the other weekdays, implying richer elaboration in memory. Moreover, semantic analysis of these associations revealed that they were effectively negative for Monday, positive for Friday, and neutral for the intervening days. Consistent with differential representation strengths, RTs to name the current day in a surprise single-trial challenge were half as long for Monday and Friday as for the other days. The strength and valence of these representations predict the observed pattern of confusability.

Counter to the conclusions from earlier researchers (Stone, et al., 1985; Areni, 2008; Areni & Burger, 2008), the results of a recent meta-analysis suggest the Monday blues phenomenon is real although the effect is rather small, as Monday is a slightly below the average day in terms of real-time moods experienced throughout the week (Areni, Burger & Zlatevska 2011). However, this conclusion must also be qualified. Previous research has established that people experience more positive affect on weekends compared to weekdays (Stone, et al., 1985). Unfortunately, meta-analysis requires an effect size based on a mean difference, hence, it is not possible to account for the entire 7-day pattern presumed to underlie Monday morning blues (Areni, 2008; Areni & Burger, 2008). It could simply be the case that the small Monday blues effect for real-time moods reflects the difference between weekend and week-day moods. In other words, Mondays might not really be worse than other weekdays.

On the other hand, associations outlined previously often match up to trends observed in real-world health and financial behaviours. For example, Monday is the most common day for work absences and generally viewed as the worst day to launch a new product (Parkin 2009). In conventional economics, time is treated as a commodity ('time is money'), to be bought or sold at will, but the social aspects of time may go beyond this historical construct and affect other aspects of cognition such as motivation, memory and risk-taking. (Boyd & Zimbardo 2005).

While there is a reasonable body of literature on cohort and period effects in psychology, these have arguably been better deployed across large scale data sets. For example, people are more likely to commit suicide on a Monday and for both men and women the general trend shows a fall in the suicide rate as the week progresses (ONS 2005). People are least likely to kill themselves during the weekend. In Japan, the suicide death ratio on Mondays was found to be significantly higher than other days and decreased over the course of the week however, this trend was stronger in men (Ohtsu, Kokaza, Osaki, Kaneita, Shirasawa, Ito, Sekii, Kawamoto, Hashimoto & Ohida 2009). The authors argue that the structure of the working week influences suicides because for a person suffering from depression, the beginning of the working week triggers feelings of personal failure and isolation (Erazo, Baumert & Ladwig 2004).

Financial markets have also shown to be influenced by a weekday effect originally illustrated by French in 1980. More recently, the Canadian Stock Exchange has also shown an influence of a 'weekday effect'. Athanassakos and Robinson (1994) found that between 1975 and 1989, low-capitalization stocks tended to have a larger negative return on Tuesdays rather than Mondays. Overall however, Monday returns were shown to be significantly negative after controlling for other factors. They explained this effect based on information flows, as smaller macro announcements cause negative Monday returns. Sakiter (2012) considered both January and Monday effects. While no January effect was found, a significant Monday effect again existed in several countries stock exchanges. Weekday effects have also continued to exist during tough economic times. Aksoy, Secme, Karatepe and Benli (2012) analysed the price dynamics of stock markets during the global financial crisis in Portugal, Italy, Greece, Spain and Ireland. In this analysis, they considered respective stock index data from 2006 to 2011and produced time series plots for daily returns. They found a significant volatility pattern across days of the week for all indexes, but again lower returns were observed on a Monday. The authors suggest here that a Monday affect may indeed be a world-wide anomaly rather than the result of a special institutional arrangement in any given country.

In this chapter however, I sought to examine weekday trends in a health related context. Specifically, I was interested to know if any recommendations could be made to help alleviate a societal problem that is both expensive for the patient and society at large.

Introducing non-attendance for medical appointments

Non-attendance at outpatient appointments costs the UK healthcare system an estimated £600M per year (Foster 2011). On top of this financial cost, missed appointments increase health risk to patients (Murdock, Rogers, Lundsay & Tham 2002; Weinger, McMurrich, Lin & Rodriguez 2005; Gucciardi 2008). Despite longstanding interest in the causes of missed appointments, actionable recommendations for reducing their prevalence are scarce. This is partly because the causes of non-attendance are not well understood. Previous studies have often reported conflicting results, possibly due to their reliance on small samples from disparate settings (Cashman, Savageau, Lemay & Ferguson 2004; Masuda, Kubo, Kokaze, Yoshida, Sekiguchi, Fukuhara & Takashima 2006; Lehmann, Lehmann, Olivet & Stalder 2007; Neilsen, Faergman, Foldspang & Larsen 2008). Nevertheless, there is some consensus on a number of determinants. These include patient factors such as age (Cashman et al 2004; Hussain-Gambles, Dempsey, Lawlor & Hodgson 2004; Lehmann et al 2007), gender (Frankel, Farrow & West 1989; Waller & Hodgkin 2000; Farley, Wade & Birchmore 2003), and transport logistics (Farley et al 2003; Neal, Hussain-Gambles, Allgar, Lawlor & Dempsey 2005; Neilsen et al 2008), as well as clinic or practitioner factors such as booking efficiency (Mason 1992) and staff-patient rapport (Lacy, Paulman, Reuter & Lovejoy 2004). Common to all of these factors is that they do not suggest any straightforward intervention strategies. The age, gender, and transport options of patients are not under administrative control; and changes in institutional practice can be costly to implement due to additional equipment or procedural requirements (e.g. telephone reminders (ImpAct 2000)).

Based on previous results from Chapter 3 showing that motivation might be affected across the week, I predicted that more appointments are likely to be missed on a Monday in comparison to a Friday. In this Chapter, I show how Did Not Attend (DNA) rates fluctuate across the week. Previous Chapters have shown that the days of the week evoke distinct emotional responses. Monday is most negative, Friday is most positive, and emotional tone brightens steadily over the intervening days. Given that attending a medical appointment may place additional burdens on the patient (e.g. organising work absence or travel logistics; confronting unpleasant treatment (Paterson, Charlton & Richard 2010), I wondered whether the contrasting emotional characters of different weekdays might translate to contrasting attendance rates. Specifically, I asked whether DNA rate mirrors the psychological peaks and troughs of the weekly cycle, with emotionally positive days boosting patient resilience (Tugade & Fredrickson 2004)

To test this hypothesis I conducted two independent analyses, the first based on national outpatient data across Scottish hospitals, and the second based on attendance data from a general practitioner's (GP) clinic in Glasgow, Scotland.

Study 4.1 National Outpatient Data

Analysis

Information Services Division Scotland provided a complete record of outpatient hospital appointments for the whole of Scotland, from January 1st 2008 to December 31st 2010 (4,538,294 appointments in total). To my knowledge, this is the largest corpus of data for which DNA rates have been analysed. Weekend appointments were infrequent (<2% of cases) and were excluded from the analysis. The remaining appointments were split into those where a patient attended (A), did not attend (DNA), or could not wait (CNW). Could not wait (<1% of cases) are recorded when a patient did arrive for their appointment, but the clinic was running behind and they were unable to wait. In the subsequent analysis, these were counted as appointments that were attended (A).

To test for a weekly trend in non-attendance, I categorised the remaining 4,463,369 appointments according to weekday, and calculated DNA rates (i.e. the percentage of appointments that were missed) separately for each weekday.

Results

Table 4.1 shows DNA rate as a function of weekday. As can be seen from the table, DNA rate is highest on Mondays (11%), lowest on Fridays (9.7%), and declines monotonically through the week (Relative Risk Reduction 11.8%). Chi-square comparison of the frequency of attended versus non-attended appointments revealed a highly reliable difference between Monday and Friday [$\chi^2(1, N = 1{,}585{,}545) = 722.33$, $p < 0.0001$].

Table 4.1. Overall DNA rates by weekday in Study 4.1.

DNA rate		Weekday effect				
Monday n=967912	Tuesday n=1032417	Wednesday n=957447	Thursday n=887960	Friday n=617633	Mon-Fri difference	Mon-Fri RRR*
11.0%	10.9%	10.3%	10.1%	9.7%	1.3%	**11.8%**

*Relative Risk Reduction

Table 4.2 shows DNA rates in Study 4.1 separately for male and female patients and for different age bands. The overall demographic trends are consistent with those in previous studies. DNA rates were generally higher for males than for females, and highest overall for young males (Beauchant & Jones 1997, Frankel, Farrow, & West 1989; Paterson, Charlton & Richard 2010). Importantly, the decline in DNA rate over the week is seen in both male and female patients, and in all age bands. Note however that the steepness of decline varies with patient age. Specifically, weekday predicts DNA rate more strongly in younger patients than in older patients.

Table 4.2. DNA rates in Study 4.1. Percentage non-attendance rates for each weekday are shown separately for male patients (top) and female patients (bottom) in different age bands.

		DNA rate (Male)		Weekday effect				
		Mon	Tue	Wed	Thu	Fri	Mon-Fri	Mon-Fri
Age band		n=396567	n=433157	n=394641	n=359344	n=261418	difference	RRR*
0-9	n=150538	12.4%	11.0%	11.7%	10.8%	10.9%	1.5%	**12.1%**
10-19	n=141121	13.7%	13.9%	13.5%	13.1%	13.0%	0.7%	**5.1%**
20-29	n=179614	24.0%	23.9%	23.2%	22.7%	22.1%	1.9%	**7.9%**
30-39	n=201834	20.9%	20.8%	19.4%	19.5%	18.6%	2.3%	**11.0%**
40-49	n=260940	15.0%	15.1%	14.4%	14.6%	13.9%	1.1%	**7.3%**
50-59	n=267595	10.1%	10.1%	10.0%	9.6%	9.4%	0.7%	**6.9%**
60-69	n=286983	6.5%	6.3%	6.1%	6.1%	5.7%	0.8%	**12.3%**
70-79	n=239210	5.4%	5.0%	5.0%	5.0%	4.6%	0.8%	**14.8%**
80+	n=117292	6.5%	5.8%	5.8%	5.8%	5.0%	1.5%	**23.1%**
All ages	n=1845127	12.5%	12.3%	11.7%	11.6%	11.1%	1.4%	**11.2%**

*Relative Risk Reduction

		DNA rate (Female)		Weekday effect				
		Mon	Tue	Wed	Thu	Fri	Mon-Fri	Mon-Fri
Age Band		n=571345	n=599260	n=562806	n=528616	n=356215	difference	RRR*
0-9	n=117160	12.4%	11.5%	12.0%	10.4%	10.7%	1.7%	**13.7%**
10-19	n=159731	13.0%	12.4%	12.0%	11.8%	11.8%	1.2%	**9.2%**
20-29	n=354468	16.1%	16.0%	14.1%	14.0%	13.8%	2.3%	**14.3%**
30-39	n=375747	12.4%	12.5%	11.5%	11.5%	10.9%	1.5%	**12.1%**
40-49	n=412726	10.9%	10.6%	10.2%	10.1%	9.5%	1.4%	**12.8%**
50-59	n=365421	8.1%	8.1%	7.5%	7.4%	7.4%	0.7%	**8.6%**
60-69	n=335763	5.4%	5.5%	5.2%	5.1%	4.7%	0.7%	**13.0%**
70-79	n=302603	5.4%	5.4%	5.1%	4.8%	4.7%	0.7%	**13.0%**
80+	n=194623	7.1%	6.3%	6.3%	6.3%	5.8%	1.3%	**18.3%**
All ages	n=2618242	10.0%	9.8%	9.2%	9.0%	8.7%	1.3%	**13.0%**

*Relative Risk Reduction

To establish the generality of the basic effect, and to examine its relevance for scheduling policy in individual clinics, I next conducted a similar weekday analysis based on data from a single general practice.

Study 4.2 Single Practice Data

Analysis

A General Practitioners' (GP) clinic in Glasgow, Scotland made available a complete anonymous record of their appointment scheduling for January 1st 2009 to December 31st 2009 (10,895 appointments in total). Note that the practice in question did not normally schedule GP appointments for Tuesdays or weekends, and these days were excluded from the analysis. Percentage DNA rates for the remaining weekdays were calculated as in Study 4.1.

Results

As can be seen from Table 4.3, the weekday pattern is strikingly similar to that seen in Study 1. Overall DNA rate was again highest for Mondays (6.2%), lowest for Fridays (4.2%), and decreased over the intervening days (Relative Risk Reduction 32.3%). Chi-square analysis to compare the frequency of attended versus non-attended appointments confirmed that the difference between Monday and Friday was statistically highly robust [$\chi^2(1, N = 4767) = 9.20, p < 0.01$].

Table 4.3. DNA rates by weekday in Study 4.2.

DNA rate		Weekday effect				
Monday n=2511	Tuesday N/A	Wednesday n=2856	Thursday n=3272	Friday n=2256	Mon-Fri difference	Mon-Fri RRR*
6.2%	N/A	5.9%	4.6%	4.2%	2.0%	**32.3%**

*Relative Risk Reduction

Discussion

In two large datasets, I found that DNA rates for medical appointments declined monotonically over the week. This pattern was present for both male and female patients and in all age groups, but was stronger in younger age groups. Importantly, it also generalised across national hospital and single practice settings.

Although the present study does not address the causes of the weekday effect directly, I note that the pattern seen here in real world attendance rates echoes the pattern seen in emotional responses to weekday cues (Tugade & Fredrickson 2004). In line with my predictions, attendance was systematically higher on days that elicit emotionally positive associations (e.g. Friday), and lower on days that elicit emotionally negative associations (e.g. Monday). These findings raise the possibility that medical appointments may be harder to face on some weekdays than on others. This interpretation chimes with the many psychological reasons that patients give for non-attendance (e.g. fear of bad news [Lawson, Lyne & Harvey (2005)], fear of unpleasant treatment [Lawson, Lyne & Harvey (2005)], negative relationships with staff [Lacy, Paulman, Reuter & Lovejoy 2004]). A complete explanation will require further study. For now, the data clearly show that appointments at the beginning of the week were missed more often than those at the end of the week. This observation suggests a simple strategy for reducing non-attendance: where practicable, load appointments towards the end of a week. Interestingly, the actual loading pattern in the hospital data (but not the single practice data) was opposite to this. That is, appointments were disproportionately loaded to the beginning of a week, where DNA rates are highest (see table 4.3.). The contrast between ideal and actual scheduling patterns underscores the practical value of our analysis: Significant health and financial savings could be achieved simply by changing the distribution of appointments over the week.

The effect of weekday on DNA rates in Study 4.1 is numerically smaller than the effect of patient gender (overall Monday-Friday difference 1.3%, Relative Risk Reduction 11.8%; overall Male-Female difference 2.5%, Relative Risk Reduction 20.8%). Importantly however, appointment allocation policy can be changed easily, whereas the gender of patients cannot. For this reason, I suggest that the weekday effect is of greater practical significance despite its smaller size.

For several reasons, I believe that the effect of weekday on DNA rates should be of interest to practitioners, managers, and politicians alike. First, it points to clear recommendations that can be easily acted upon, as outlined above. Second, it brings attendance problems under the control of the service provider, rather than relying on education or punishment of the patient (Hussain-Gambles, Neal, Dempsey, Lawlor & Hodgson 2004; Waller & Hodgkin 2000). Third, changing appointment allocation policy should be inexpensive compared with other approaches to reducing DNA rate, as it does not require any additional equipment or procedures (cf. telephone or text reminders [Hasvold & Wootton 2011; Sharp & Hamilton 2001]). Finally, reductions in DNA rate achieved through reminder schemes and through scheduling improvements may be additive, if these very different approaches target separable causes of non-attendance (e.g., forgetting and motivation, respectively).

A straightforward trial of the weekday effect in a clinical setting could involve shifting appointments from Mondays to Fridays, and comparing overall attendance rates before and after this intervention. Another strategy may be to overbook appointments on Mondays to better take into account the higher rate of non-attendance. I would be very interested to run additional trials taking into account additional individual differences for example, medical notes may reveal additional interactions between weekday and specific health complaints (Ben-Assuli & Leshno 2013). For now however, I show that weekday predicts likelihood of attendance for medical appointments. Exploiting this weekday effect could save money and improve patient care.

Chapter Summary

Taking the findings of Chapter 3 further, the present Chapter highlights how weekday effects are of significant applied importance and as a social time structure are arguably no less important than a biologically ingrained cycle e.g. the sleep/wake cycle. The mental associations first outlined in Chapter 3 may not be limited to simply explaining why people have temporal confusions surrounding the current day. The pattern of non-attendance in medical appointments echoes the pattern seen in emotional responses to weekday cues as attendance was found to be systematically higher on days that elicit emotionally positive associations (e.g. Friday), and lower on days that elicit emotionally negative associations (e.g. Monday).

The exact reasons for these effects are speculative at this stage. It is unlikely that weekday associations alone drive these effects. These results may be driven by motivation as Friday is viewed as a day for social activities and a hospital appointment is a social event. Some younger female participants may show a stronger weekday effect because they tend to experience emotion more strongly in general (Allen & Naccoun 1976, Brody & Hall 1993, Diener, Sandvik & Larsen 1985). This may explain why any weekday effect - assuming it is related to emotionality patterns across the week - is stronger in women. These fluctuations in emotionality may be driven by changes in sleeping patterns between weekdays and the weekend (Baglioni et al 2010; Van Dongen, Rogers & Dinges 2003). For example, sleeping in on Saturday and Sunday often results in small subsequent sleep onset delays over the first few weekdays. This sleep deficit is then recovered towards the end of the week, which will in turn interact with the emotional character of each weekday. Interestingly, gender differences hinted at here tie in with recent research conducted by Sanders, Ellis and Jenkins (unpublished), showing a significant reduction in unsafe pedestrian crossings which reach their lowest level on a Friday. This pattern was absent in male participants.

Clearly, when considering a weekday effect in other large-scale data sets, this trend is not endemic for stock market research as it has been observed in other areas of science, which may (or may not) invoke similar behaviours. This object of research has been previously examined by psychologists, demographers, and others, and it is fruitful to consider any weekday effect in the context of other social and hard sciences. A hospital appointment however, is likely to be linked with long term memory and motivation to attend. Understanding this trend requires additional research to allow for further recommendations. In turn, this may allow for a greater separation of what causes these effects. Is it simply a priming effect based on weekday associations, or an interaction between temporal sleep/wake patterns across the working week or day? In the following Chapter, I explore whether additional appointment recommendations can be made based on other weekday related effects during a bank holiday, transitions into and out of daylight savings and on days which are deemed to be unlucky - Friday the 13th.

Chapter 5

Exceptions to the weekday rule: Large-scale data analysis and implications

Introduction

While a weekday effect has been established in Chapter 4, the aim of this chapter is to explore this data-set in more detail to further understand weekday behaviour changes that could be termed as 'exceptions to the rule'. Previous research suggests that such an approach could be worthwhile. For example, in the case of financial trading, research has tended to try and explain the Monday effect by considering more closely what happens at the weekend. Miller (1988) and Lakonishok & Marbery (1990) argue for example, that weekends provide a low cost opportunity for individuals to re-evaluate their investments. In addition, brokers make many more buy than sell recommendations within the trading week (Rayan & Taffler 2000). Therefore, Monday's trading should be dominated by individual investor selling activity, as shown by Abraham & Ikenberry (1994).

In their study of information processing behaviour of investors in the US stock market, Abraham and Ikenberry (1994) found that when Friday's return is negative the following Monday's return is negative nearly 80% of the time. Since negative Friday returns were themselves rare, the results are even more remarkable. Similar results were obtained if Monday's return was conditioned on the previous Monday to Thursday return. These empirical observations regarding Friday and Monday returns suggests that investors are exerting selling pressure on the market on Mondays if the previous Friday (or whole week) return was negative. Thus, not only do Monday returns appear to be responding to Friday returns, but investors appear to be acting to cut their losses. If, as in the UK stock market, Monday is also a low cost day in which to trade, then the incentive to sell would be expected to be greater still. In a study by Steely (2004), the analysis of Abraham and Ikenberry (1994) regarding adjacent Friday and Monday returns was undertaken in the UK stock market.

Steely (2004) hypothesised that if investors were using Monday as the first opportunity to trade following a weekend of reflection and analysis of their portfolios, then that analysis is likely to include the behaviour of the market during the prior week. However, he was unable to replicate the findings of Abraham and Ikenberry (1994) in the UK stock market. A weekday effect exists, but this is independent of the pervious week. No evidence was found that investors respond to market moves preceding Mondays differently to those preceding other weekdays. This is in complete contrast to previous results for the US stock market. Moreover, previous research has shown that the pattern of arrivals of information into the UK market should make this market more rather than less likely to exhibit such behaviour than the US market. Therefore, these results point to the arrival of information per se rather than the processing of that information as being a more important factor in explaining post-weekend effects in the UK Stock Market.

Given the widespread existence of such anomalies, the fundamental question with which many financial economists are concerned is how can this information be translated into improved portfolio performance? This drives current research, but costs of introducing trading rules or restrictions could be prohibitive. However, the same cannot be said of my health based dataset. It has already been established than non-attendance increases on a Monday and this is stronger in specific groups of patients, possibly driven by the fact that it is the furthest point away from the next available day of rest or leisure (Bryson & Forth 2007). This has allowed for improved appointment scheduling recommendations. Additional, analysis is likely to lead to further recommendations.

Therefore, in a similar vein to financial research that has attempted to explore underlying trends in weekday data, the aim of this chapter was to consider how non-attendance may change during other events that take place during similar time frames. This includes a bank holiday week, transitions into and out of daylight savings time and appointments that happen to fall on Friday 13th.

5.1 The Bank Holiday effect

In some instances, stock-market data has indicated that rather than a Monday effect, there is more of a 'Tuesday effect' in Serbia and Slovenia. In other words, the low returns on Mondays continue and widen for the next day. According to Sajter (2012) this is partly explained as a function of the Monday effect in the most influential market in the world - the US stock market, which is consistent even in emerging stock markets Aggarwal and Rivoli (1989). Holiday effects have also been observed in financial markets (Mills & Coutts 1995). Ariel (1990) reports that the trading day prior to holidays on average exhibits high positive returns to such an extent that he claims that over one-third of the return earned by the market over twenty years accrued on the eight trading days which annually fall before holidays. Mills and Coutts (1995) report similar findings on the London Stock Market where mean returns on pre-holidays are around seven times the size of mean returns for other days.

A bank holiday effect has also been found in health-related datasets. For example, Ohtsu et al. (2009) argue that future research should focus around the arrangement of weekday holidays in terms of reducing suicides, but the same could also be said for the trend of missed appointments in the previous chapter.

In the following analysis, I predicted that during a bank holiday week, Tuesday would show a non-attendance rate comparable to a normal Monday as the Tuesday following a bank holiday becomes the first working day of the week. Such a result would support previous conclusions that medical appointments are harder to face at the start of the working week.

Analysis

Data was taken from the same data set outlined in Chapter 4. However, in this instance DNA rates were only considered for weeks where Monday was a bank holiday in Scotland. Unlike other parts of the world, medical appointments are still issued even if Monday is a bank holiday in Scotland.

Results

Table 5.1 shows DNA rate as a function of weekday during bank holiday weeks between 2008 and 2010 for male and female patients and for different age bands. Considering all the data together, DNA rate is now higher on a Tuesday (11.4%) in comparison to a Monday (11.1%), but lowest on a Friday (10.0%). Chi-square comparison of the frequency of attended versus non-attended appointments revealed a highly reliable difference between Tuesday and Friday [$\chi^2(1, N = 160867) = 79.72, p < 0.0001$].

Interestingly, the increase of Tuesday DNA rate is not consistent across all patients in specific age bands. For example, male patients DNA rates appear to show a stronger tendency to increase on a Tuesday when compared to female patients of the same age.

Table 5.1. DNA rates in Study 5.2. Percentage non-attendance rates for each weekday are shown separately for male patients (top) and female patients (bottom) in different age bands for bank holiday weeks only.

		DNA rate (Male)		Weekday effect			
		Mon	Tue	Wed	Thu	Fri	Mon-Fri
Age Band		n=2571	n=5320	n=4849	n=4424	n=3138	difference
0-9	n=1547	12.3%	11.6%	11.5%	11.0%	11.4%	0.9%
10-19	n=1817	15.7%	14.6%	14.8%	13.8%	14.1%	1.6%
20-29	n=3792	22.6%	24.0%	23.6%	23.5%	22.8%	0.2%
30-39	n=3698	20.8%	21.3%	20.5%	20.7%	18.6%	2.2%
40-49	n=3516	13.8%	16.1%	15.3%	15.1%	14.3%	0.5%
50-59	n=2499	9.9%	11.2%	11.4%	9.6%	9.2%	0.7%
60-69	n=1612	5.9%	6.6%	6.5%	5.9%	6.2%	0.3%
70-79	n=1116	4.7%	5.7%	5.3%	5.0%	5.2%	0.5%
80+	n=705	6.6%	6.8%	7.4%	6.9%	5.7%	0.9%
All ages	**n=20302**	**12.1%**	**13.0%**	**12.5%**	**12.0%**	**11.6%**	**0.5%**
Normal Week		*12.5%*	*12.3%*	*11.7%*	*11.6%*	*11.1%*	*1.4%*

		DNA rate (Female)		Weekday effect				Mon-Fri
Age Band		Mon n=2941	Tue n=5760	Wed n=5314	Thu n=5255	Fri n=3224		difference
0-9	n=1192	12.1%	11.3%	12.7%	10.7%	9.9%		2.2%
10-19	n=1793	13.8%	13.3%	12.4%	12.9%	11.0%		2.8%
20-29	n=4739	17.6%	16.5%	14.2%	14.2%	14.0%		3.6%
30-39	n=3988	12.6%	12.8%	11.6%	12.0%	11.2%		1.4%
40-49	n=3895	10.8%	11.0%	10.8%	10.8%	10.0%		0.8%
50-59	n=2566	8.7%	8.4%	7.7%	8.0%	7.0%		0.3%
60-69	n=1681	5.3%	5.9%	6.0%	5.7%	5.0%		0.3%
70-79	n=1487	4.9%	6.0%	5.4%	5.6%	5.7%		-0.8%
80+	n=1153	6.4%	6.6%	6.8%	7.6%	5.4%		1.0%
All ages	**n=22494**	**10.3%**	**10.3%**	**9.6%**	**9.7%**	**8.8%**		**1.5%**
Normal Week		*10.0%*	*9.8%*	*9.2%*	*9.0%*	*8.7%*		*1.3%*

Discussion

The results here support previous conclusions from Chapter 4 confirming that the start of the week is viewed in a more negative light as Tuesday becomes the new Monday following a bank holiday. This echoes findings from Ariel (1990) who identified similar trends in the stock market following a bank holiday weekend. In light of these findings, an additional recommendation for reducing non-attendance might involve placing a special influence on reminders for appointments made for a Tuesday following a bank holiday weekend, or to allocate more of these appointments to another week. Other everyday time disruptions however, may also affect non-attendance and in the next analysis, I considered non-attendance during transitions into and out of daylight savings.

5.2 Missed appointments during transitions into and out of daylight savings

More that 1.5 billion men and women are exposed to the transitions involved as the clocks go forward one hour in the spring and backward by one hour in the autumn. These transitions can disrupt chronobiologic rhythms and influence the duration and quality of sleep, and this effect lasts several days after the shifts (Kantermann, Juda, Merrow & Roenneberg 2007; Lahti, Leppamaki, Lonnqvist & Partonen 2006). At the same time, it has been postulated that people in Western societies are chronically sleep deprived, since the average sleep duration has decreased from 9.0 to 7.5 hours during the 20th century (Spiegel, Leproult & Van Cauter 1999).

Janszky and Ljung (2008) examined the influence of these transitions on the incidence of acute myocardial infarction. They compared the incidence of acute myocardial infarction during each of the first seven days after the spring or autumn transition and the mean of the incidences on the corresponding weekdays 2 weeks before and 2 weeks after the day of interest. They found that the incidence of myocardial infarction was significantly increased for the first 3 weekdays after the transition to daylight saving time in the spring. In contrast, after the transition out of daylight saving time in the autumn, only the first weekday was affected significantly.This pattern was more pronounced in those under the age of 65 than for those 65 years or older.

Transitions into and out of daylight saving time (DST) have been associated with road traffic accidents (Coren 1996), workplace injuries (Barnes & Wagner 2009), ‘cyberloafing’ (Wagner, Barnes, Lim & Ferris 2012) and impairments in mood and cognition (Monk & Aplin 1980); all of which have been attributed to changes in sleep duration/quality and circadian misalignment. According to other experimental studies, this adverse effect includes the predominance of sympathetic activity and an increase in pro-inflammatory cytokine levels (Meier-Ewert, Ridker & Rifai 2004; Spiegel, Leproult and Van Cauter 1999).

Based on these previous findings, I predicted that non-attendance would increase during the forward clock change and decrease when the clocks went back an hour in the autumn.

Analysis

Taking the same data-set from Chapter 4, I assessed the percentage of missed appointments at hospital outpatient clinics in Scotland for individuals aged 18-64, during the two weeks before the clock change, the week of the clock change, and the two weeks after the clock change (for both transitions into and out of DST).

Results

During the forward clock change, a reliable increase in DNA rate was observed before (11.30%) and during (11.82%) the clock change [$\chi^2(1, N = 155996) = 9.15, p < 0.01$] (figure 5.1). No reliable change was observed between the week of change and two weeks following (11.88%) [$\chi^2(1, N = 140561) = .097, p = 0.7$] A reliable change was also observed between pre and post forward changes [$\chi^2(1, N = 195093) = 15.77, p = < 0.01$] suggesting that any increase in non-attendance may take longer to settle following a forward clock change.

Fig 5.1. Showing an increase in missed appointments following the spring-clock change.

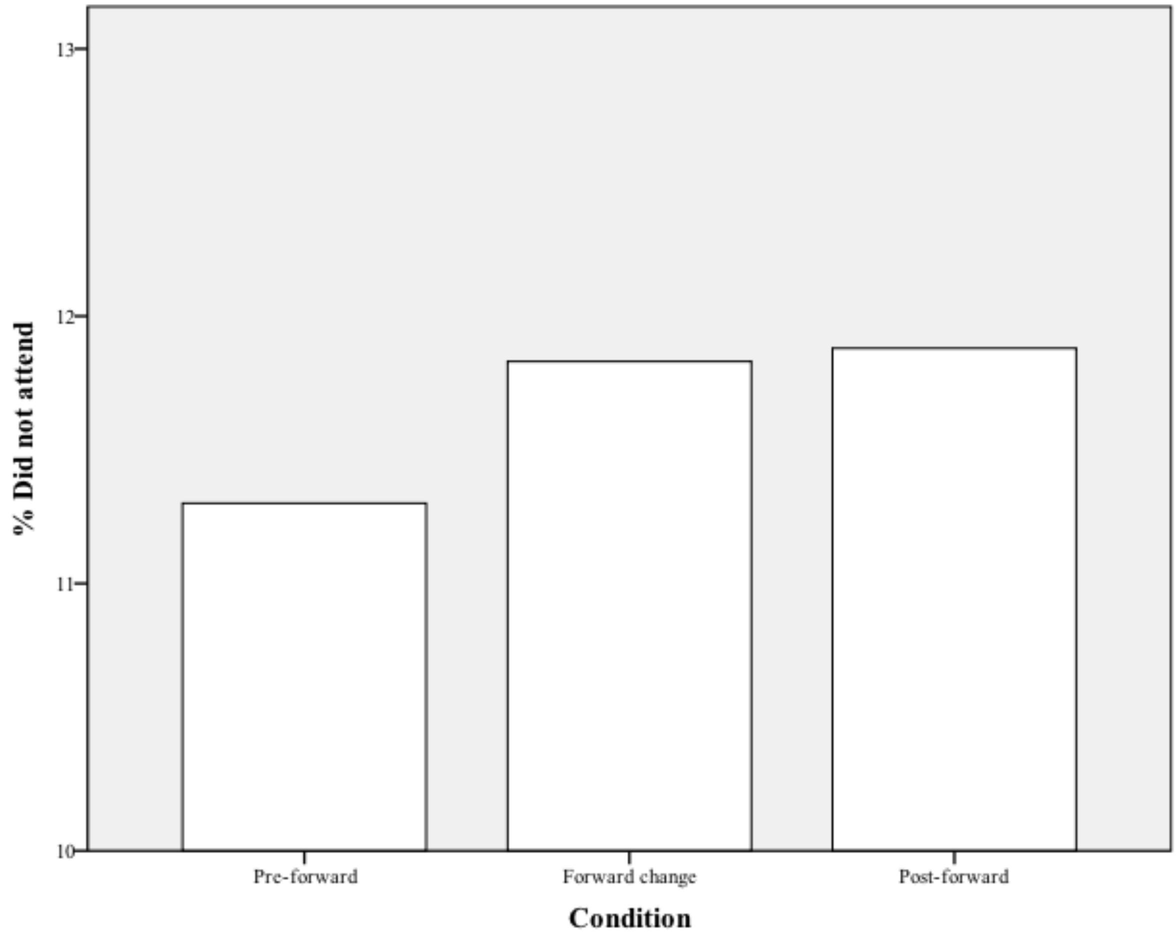
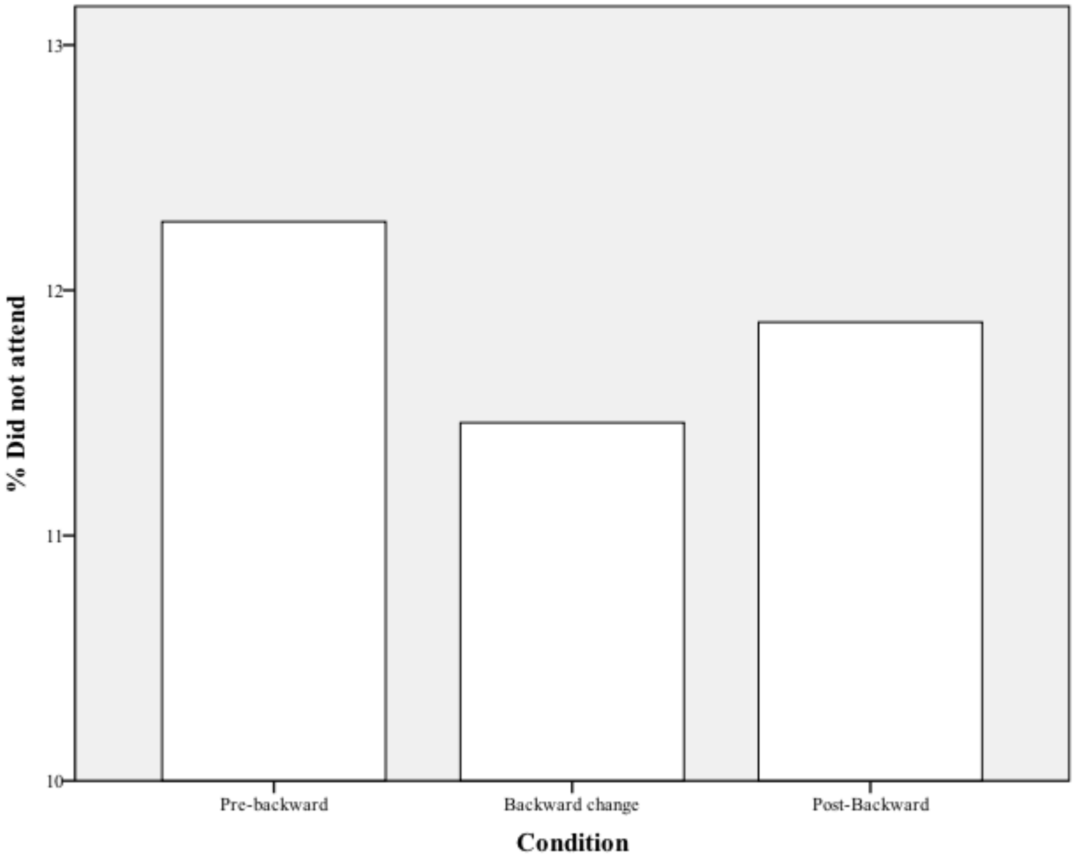


Fig 5.2. Showing a decrease in missed appointments following the autumn-clock change**.**



During the autumn (backward) clock change, a reliable decrease in DNA rate was observed before (12.28%) and during (11.46%) the clock change [$\chi^2(1, N = 162799) = 23.55, p < 0.01$] (figure 5.2). A reliable change was also observed between the week of change and two weeks following (11.88%) [$\chi^2(1, N = 171625) = 6.31, p = 0.012$] showing a increase in DNA. A significant change was also observed between pre and post backward changes [$\chi^2(1, N = 220100) = 8.43, p < 0.002$] suggesting a possible carry over effect from the week where the the clocks changed.

Discussion

Though preliminary, these modest alterations in the number of missed appointments may reflect changes related to DST. Specifically, the large decrease in missed appointments observed after the clock change in autumn, suggests that an extra hour of sleep may translate into improved attendance for scheduled hospital appointments. Such data would be consistent with published literature indicating that road traffic accidents (Coren 1996) and incidence of myocardial infarction (Janszky & Ljung 2008) both decrease after the autumn clock change.

The mechanisms through which changes into and out of DST may impact the complex cognitive and psychosocial factors involved in determining appointment attendance, remain unclear. Factors relating to improvements in mood and prospective memory performance are worthy of more focussed attention. Ongoing/future analyses would need to investigate gender differences and determine whether DST-related changes in missed appointments depend on time of day. Novel ways of assessing how DST may impact behaviour at a societal level could also be considered. In a final analysis, I consider appointments allocated for Friday the 13th, a date considered unlucky in Western society.

5.3 Friday the 13th

Superstitions affect behaviour in all cultures in all parts of the world in some form or another. Previous work however, has focused on supernatural beliefs in developing countries (Gouteux 1992). A subconscious perception exists that people in the West are too sophisticated to be influenced by such beliefs. However, research on the issue remains inconsistent and the purpose of this final analysis was to examine the relationship between non-attendance rates that occur on normal Fridays and Fridays that fall on the 13th. The origins of Friday the 13th as an unlucky day are twofold: Friday and the number 13.

> '*Friday*
>
> *Now Friday came, you old wives say,*
>
> *Of all the week's the unluckiest day*'

The roots of Friday as an unlucky day are predominately Christian, Good Friday being the day on which Christ was crucified. Superstitions around the number 13 are also Christian, mainly pertaining to the last supper when Christ dined with his 12 apostles. However, even before this, the Romans disliked the number 13 as they regarded it as a symbol of death, destruction and misfortune (Lorie 1992). O'Brien (1994) also points out that actuarial investigation reveals that the 13th of a month is more likely to be Friday than any other day. The Gregorian calendar has a cycle of 400 years, or exactly 20871 weeks. In such a period the 13th of the month arises 400x 12=4800 times; the number of times that it falls on each is as follows: Monday 685, Tuesday 685, Wednesday 687, Thursday 684, Friday 688, Saturday 684, Sunday 687.

Friday the 13th has previously been found to correlate with negative outcomes in some aspects of obsessive compulsive disorder (Veale 1995). More generally however, Scanlon, Luben, Scanlon & Singleon (1993) examined the relationship between health, behaviour and superstition. They found a significant reduction in vehicles on the southern section of the M25 on Friday the 13th compared with Friday the 6th over a period of 3 years. However, the number of shoppers were not significantly different on those two days over 3 years in nine supermarkets. On the other hand, admissions due to transport accidents were significantly increased on Friday the 13th over the previous 5 years.

They felt that there were four possible reasons for the findings: (i) chance: where further work on larger samples would confirm or refute their evidence; (ii) confounding: there was some hitherto unrecognised factor that may explain both driving patterns and accident rates; (iii) bias: those recording accident data may be more likely to record accidents on Friday the 13th; (iv) association: Friday the 13th is a more unlucky day.

A more recent study in 2004 using Finnish road accident data from 1989-2002 could not find evidence of more traffic accidents on Friday the 13th, but the authors admit that this itself does not imply a non-existent effect because no exposure-to-risk data are available. People who are anxious of a black-Friday may simply stay at home or avoid driving (Radun & Summala 2004).

In the final analysis of this Chapter, I consider whether a specific day that elicits a strong emotional response is likely to correlate with increased or reduced attendance. It is possible that such a novel date may elicit a reduction in non-attendance as people phone up and cancel rather than simply forget to attend. On the other hand, given its negative connotations, the opposite effect may be true as people make a conscious effort to avoid any medical appointment that might bring bad news.

Analysis

Using the same data set previously outlined, normal Fridays were compared with those specific Friday appointments, which fell on the 13th. This occurred five times between 2008 and 2010.

Results

Chi-square analysis to compare the frequency of attended versus non-attended appointments confirmed that the difference between normal Friday (9.95%) and Friday the 13th (7.75%) appointments was statistically robust, with male patients showing a reduced level of non-attendance for appointments which fell on Friday the 13th [$\chi^2(1, N = 269846) = 123.12$, $p < 0.01$] (table 5.3). However, this effect was not found to be statistically significant in female patients [$\chi^2(1, N = 368488) = 3.70$, $p = 0.054$].

Table 5.3. DNA rates in Study 5.3 Percentage non-attendance rates for each weekday are shown separately for male patients (top) and female patients (bottom) on normal Fridays and Fridays that fell on the 13th.

	DNA rate (Male)	Weekday effect				
			Friday 13th		normal friday	**Difference**
Age Band			n=633		n=261418	
0-9		n=62	7.6%	<	10.9%	**3.3%**
10-19		n=47	7.3%	<	13.0%	**5.7%**
20-29		n=118	15.6%	<	22.1%	**6.5%**
30-39		n=114	12.3%	<	18.6%	**6.3%**
40-49		n=112	9.4%	<	13.9%	**4.5%**
50-59		n=69	5.6%	<	9.4%	**3.8%**
60-69		n=43	3.3%	<	5.7%	**2.1%**
70-79		n=42	3.6%	<	4.6%	**1.0%**
80+		n=26	4.6%	<	5.0%	**0.4%**
All ages		n=633	7.3%	<	11.1%	**3.8%**

Age Band	DNA rate (Female)	Weekday effect	Friday 13th n=1024		normal friday n=356215	**Difference**
0-9		n=66	11.8%	>	10.7%	**-1.1%**
10-19		n=96	12.6%	>	11.8%	**-.08%**
20-29		n=218	13.1%	<	13.8%	**0.7%**
30-39		n=173	9.6%	<	10.9%	**1.3%**
40-49		n=159	8.7%	<	9.5%	**0.8%**
50-59		n=119	6.7%	<	7.4%	**0.7%**
60-69		n=75	4.6%	<	4.7%	**0.1%**
70-79		n=63	4.2%	<	4.7%	**0.5%**
80+		n=55	5.4%	<	5.8%	**0.4%**
All ages		n=1024	8.2%	<	8.7%	**0.5%**

Discussion

As expected, Friday the 13th may hold a special significance, however the trend is in the opposite direction from what might have been predicted based on previous research (Scanlon, Luben, Scanlon & Singleon 1993).

Chapter 3 demonstrated that Friday has a very positive representation in memory and shows the lowest rate of non-attendance across the week. However Friday the 13th shows a reduced level of non-attendance that exceeds a normal Friday. Given the emotional associations outlined in previous chapters it may simply be the case that Friday the 13th elicits an even stronger, positive emotional association that goes beyond the negative connotations associated with the number 13, however, this ignores other potential explanations and interactions.

Instead, these results are more supportive of recent work (Radun & Summala 2004). It may be the case that superstitious individuals who are allocated appointments on Friday the 13th simply cancel them, but data is not available to confirm that assumption. On the other hand, at least in male participants, the specific date may evoke an even stronger response in memory and is therefore more likely to be remembered. It is also possible that the potential emotional buffer normally provided by a Friday in addition to the fear of bad luck by not attending actually encourages attendance. This issues warrant further investigation.

Chapter Summary

In summary, these additional analysis provide some simple guidelines that may help further improve attendance and maximise efficiency

(1) During a bank holiday week, care should be taken when allocating appointments to the following Tuesday, particularly in male patients who are have high rates of non-attendance across a bank holiday week.

(2) Additional reminders should be sent to patients during a forward clock change and for the weeks following this change to improve attendance. More appointments should be allocated to the week following the autumn clock change where possible. Again, this positive effect may last several weeks.

(3) For male patients, more appointments should be allocated for a Friday falling on the 13th. As an added advantage, this specific date is statistically more likely to fall on the 13th of any given month (O'Brien 1994).

Together and in conjunction with findings documented in Chapter 4, interactions between weekday and other appointment factors could lead to additional savings. These recommendations would be cheap to implement and do not reply on specific patient data for example, their medical history or socioeconomic status. However, a clear future direction for this research would be to model non-attendance based on more specific individual and appointment factors. This is something which could easily be accomplished in Scotland where data linkage is more straightforward.

A 'whole systems' approach that takes into account the patient's journey through health care, and which takes into account other factors (e.g. multi-morbidity) is a prerequisite for the development and evaluation of effective, complex interventions in primary and secondary care. Even something as simple as 'time of day', may also have a measured impact on appointment specifics and the next Chapter aims to explore another socially derived cycle that has become an extension of both the weekly and sleep/wake cycle. The 9 to 5 working day also forms a key component of social and occupational organisation.

Chapter 6
Changes in personality and subjective well-being across the working day

Introduction

It is difficult to discuss social time scales for example, the weekly cycle without also considering an additional social cycle that sits alongside. The working day for many people runs from 9am until 5pm. However, basic human biological processes and functions oscillate in a rhythmic fashion. For example, circadian rhythms are particularly important in everyday life. These are controlled by an inherited master clock residing in the paired suprachiasmatic nuclei (SCN) of the hypothalamus (Duguay & Cermakian 2009).

In other words, people have a built-in day, which tends to be around 24 hours. While indoor lighting has been shown to affect circadian rhythms, subsequent studies have demonstrated that the range of this 24 hour cycle was no more than 24 hours plus or minus 11 minutes (Czeisler et al. 1999). While the last decade has seen a move towards research that has started to link these biological markers with behaviour and under normal conditions however, these basic rhythms also regulate various physiological events that include the cell cycle, body temperature, metabolism, feeding and the most studied of all from a psychological point of view, the sleep-wake cycle.

The importance of these rhythms on health and well-being has also been studied intensively as regular disruption can have a detrimental impact on the human immune and cardiovascular system and in some cases lead to Seasonal Affective Disorder (SAD). This can be particularity problematic in specific populations who undergo regular circadian disruption for example, shift workers (Lange, Dimitrov & Born 2010; Smolensky, Hermida, Castriotta & Portaluppi 2007).

The impact of time-of-day effects and of circadian rhythms on cognitive performance in humans have been studied for decades. For example, day-night patterns in blood pressure are closely tied to the 24 hour sleep-wake cycle. In typical people, blood pressure declines to its lowest levels during night-time sleep, rises abruptly with morning awaking, and attains near peak or peak values during the first hours of waking (Smolensky, Hermida, Castriotta & Portaluppi 2007). In turn, heart attacks are much more likely to take place in the morning whereas conditions relating to premature or out of sync heart beats are more common during the day (Portaluppi, Tiseo, Smolensky, Hermida, Ayala & Fabbian 2012).

There has in turn been a renewed interest in this topic in light of advances in understanding genetic and molecular events that underly these complex processes and recent reviews from the likes of Gerstner & Yin (2010) have considered how circadian rhythms interact with memory formation. This builds on previous work considering how the demands of a task and the load placed on working memory can play a large role in determining the time of day at which it is best performed (Folkard, Wever & Wildgruber 1983).

Time of day effects have also previously been examined across a range of cognitive and behavioural measures (Gupta 1991; Weith & Zacks 2012). For example, circadian or daily rhythms in other basic cognitive functions have been shown to impact on alertness of arousal, activity, and physical performance (e.g. Horne & Ostberg 1976; Hrushesky, Langevin, Kim & Wood 1994). For example, world records are more likely to be broken in the afternoon between 3pm and 6pm and the lungs function more efficiently, muscles are more flexible and receptiveness to pain is lower (Chtourou & Souissi 2012).

Steptoe, Siegrist, Kirschbaum & Marmot (2004) measured cortisol levels along with blood pressure over the working day (9-5). As expected, cortisol levels decreased across the working day and blood pressure increased in men and women. However, these were found to interact with work commitment and socioeconomic position in men as blood pressure was higher in lower-status men who were overcommitted to their work.

From a cognitive perspective, Weith and Zacks (2012) illustrated an effect of time of day on creative thinking. They found that for insight problems, that is, problems that require participants to reinterpret the problem and approach it from a different perspective, are best tackled when a participant tackles them at their non-optimal time of day. On the other hand time of day effects using more traditional measures of intelligence show the opposite effect, but results have been mixed (Goldstein, Hahn, Hasher, Wiprzycka & Zelazo 2007; Gupa 1991; Song & Stough 2000). In addition, children who suffer from Attention Deficit Hyperactivity Disorder (ADHD) generally show an increase in hyperactive behaviour in the afternoon.

Antrop, Roeyers & De Baecke (2005) filmed 14 children who suffered from ADHD along with 14 controls during a whole school day.

There is however, a surprising lack of research exploring how specific changes in mood or personality might change across the working day in the normal population, which for many individuals is driven by a 9-5 working pattern. This is, in part, due to the debate surrounding the fixed nature of personality, mood, and how this can predict future behaviour. It could be argued that this working cycle is part of a temporal subset of circadian effects and this is how the occupational literature tends to approach the subject. However, while such a 9 to 5 routine is socially constructed, this chapter does not attempt to separate the two. However, it is highly likely that the two interact.

Introducing personality: Is it fixed?

Humans differ from each other in both their physical characteristics and their psychological make-up. The major dimensions of personality by which people differ however, have only emerged in the last few decades (Matthews, Deary & Whiteman 2009). By about 1990, psychologists were converging on a consensus that there might be only five principal personality traits, generally referred to as the Big Five, or the Five Factor model. A brief sketch of each of the traits in the Five-Factor model are documented in table 6.1. The names used here are the most common, but slight variations are used in different measures:

Table 6.1. Facets of the Five-Factor Model Personality Traits.

Trait	Facets
Neuroticism	Anxiety, angry hostility, depression, self-consciousness, impulsiveness, vulnerability
Extraversion	Warmth, gregariousness, assertiveness, activity, excitement seeking, positive emotions
Openness to experience	Fantasy, aesthetics, feelings, actions, ideas, values
Agreeableness	Trust, straightforwardness, altruism, compliance, modesty, tender mindedness
Conscientiousness	Competence, order, dutifulness, achievement striving, self-discipline, deliberation

While this brief sketch does not cover the richness of each trait, they do describe general tendencies in people's behaviours, feelings, attitudes, and thinking. Each of these traits also has a normal distribution in the normal population and allows individuals to be compared and contrasted. More recently however, individual differences research has also started to link levels of these traits to other health outcomes. For example, personality is the strongest and most consistent cross-sectional predictor of subjective-well being (Boyce, Wood & Powdthavee 2012, Ferrer-i-Carbonell and Frijters 2004).

As a result of this new development, personality has now become a public-policy issue further fuelled by the debate surrounding how much it can change over time. The extent to which it does or does not change is a central question for fields interested in both the quality of life and the fundamental argument that personality can reliably be measured using self-report measures. Soto, John, Gosling and Potter (2012) examined how personality traits vary between childhood and adolescence and also found evidence to support the view that it is not exclusively biological in origin. However, any change in adolescence is addressed as part of the five-factor theory which states:

'*Traits develop through childhood and reach mature form in adulthood'* (McCrae & Costa 1999, p. 145).

This predicted stability is said to last throughout middle age, until retirement, where personality could change again as a result of being disrupted by cognitive decline (Lautenschlager & Forstl 2007). In addition, from emerging adulthood through middle age, conscientiousness and agreeableness show positive age trends, neuroticism shows a negative trend, and extraversion and openness to experience show flat trends (Deary, Weiss & Batty 2010). This goes against the traditional view that the Five-Factor personality traits are '*insulated from the direct effects of the environment'* (McCrae & Costa 1999, p144).

Srivastave, John, Gosling and Potter (2003) compared big-five scores over 130,000 individuals between the age of 21-60. Neuroticism appeared to decline amongst women, but not men. Other patterns of change varied considerably suggesting that the Big Five are likely to be influenced by several other developmental factors not limited to adolescence (Roberts, Walton

& Bogg 2005). Boyce, Wood & Powdthavee (2012) have also shown several within-subject personality changes in 8625 individuals across a four year period. These measures were taken as part of the Household, Income and Labour Dynamics in Australia (HILDA) survey, where participants were presented with 36 descriptive words and asked '*how well do the following words describe you*'. Participants could respond on a 1 to 7 scale. The results suggest that personality does change and this change is comparable to other characteristics such as income, unemployment and marital status.

The fixed personality assumption remains problematic. Firstly, it makes personality measurements almost useless to applied economists and public policy-makers. Even if personality is predictive, for example, of labour force status and occupational behaviour, but is unchanging and fixed, it is not a useful target for macro- or micro- level intervention. Second, the assumption of much standardised microeconometric analysis is reliant upon personality being fixed and unchanging. For example, the relationship between income and subjective well-being, or the influence of wages on labour supply, are commonly investigated using a fixed effects regression analysis. This may need to change. Currently, within economics such fixed effects analysis are assumed to remove the effect of *non-changing* personality, an asumption that has been brought into question as personality has been found to meaningfully change over time (Lewis 2001).

Recent advances in social media have allowed individual changes to be explored on a minute by minute basis. Golder & Macy (2011) used Twitter's data access protocol and collected messages from nearly 2.5 million individuals across the day. They found that individuals tend to wake-up in a good mood, which deteriorates as the day progresses. This is consistent with the effects of sleep patterns and circadian rhythm. As personality is directly related to subjective-well being, it is not unreasonable to assume that reverse correlation may show that personality would also change accordingly.

Surprisingly, time of day effects in personality measurement have never been considered, but previous Chapters already show potential individual changes that may take place across the working-week. A social/celestial time cycle may exhibit an even stronger effect and it is reasonable to assume that this might affect personality scores across an average 9-5 working day. This research was also partially motivated by witnessing changes observed between tutorial classes across the day and this is where I chose to begin this investigation. Colleagues often report that tutorial groups in the afternoon are both louder and more argumentative, which in many cases makes them easier to teach. While previous research has considered personality change across several years, in this Chapter I set out to demonstrate that meaningful changes in personality can also occur over the course of a socially derived cycle - the working day. While incorporating a number of correlational and experimental designs, like previous Chapters, early studies take an exploratory approach.

Study 6.1 Changes in personality between morning and afternoon tutorial groups

Given that the premise for this research was partly motivated by the casual observation of tutorial students, it made sense to start by looking for any personality differences between these individuals in their respective tutorial groups. I predicted that extraversion would show an increase towards the end of the day.

Method

Design and Measures

At the start of the academic year, students who enrolled on a level 1 psychology course were allocated to either a 9am, 2pm or 4pm tutorial group were approached and asked to complete the following measures at the start of their tutorial class:

Ten Item Personality Measure (TIPI): The TIPI is a 10-item measure of the Big Five or (Five-Factor Model) dimensions. The instrument has demonstrated adequate levels in terms of (a) test-retest reliability, (b) patterns of predicted external correlates, and (c) convergence between self and observer ratings (Gosling, Rentfrow & Swann 2003).

Morning Evening Questionaire (MEQ): Originally developed by Horne and Ostberg in 1977, it has been cited over 1500 times. It consists of 19 multiple-choice questions, with each question having four response options. Responses are combined to form a composite score which indicates the degree to which the respondent favours morning or evening. Higher scores indicate an evening preference.

Participants

22 students (86% female) studying psychology at Glasgow University completed the TIPI and the MEQ. 7 people were tested at 9am, 3 at 2pm and 12 at 4pm. They were each paid £2 for their participation.

Procedure

At the beginning of each designated tutorial, participants were given the opportunity to take part in a short piece of psychological research. Those who agreed were asked to provide some brief demographic information and completed the TIPI and MEQ. They were also asked to identify an ideal time to attend their psychology tutorial and give a brief reason for choosing this time.

Results

A significant correlation was observed between extraversion and time of day tested (table 6.2 & figure 6.1). A significant correlation was also observed between a reduction in openness and time tested (figure 6.2). Only conscientiousness showed a significant correlation with an individual's ideal tutorial time [r = -.46] and MEQ score [r = .42] (table 6.3).

Table 6.2 Showing correlations between TIPI dimensions and time of assessment.

	E	A	C	ES	OE
Time Tested	.44*	.25	-.21	.27	-.62**

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Table 6.3. Showing correlations between TIPI dimensions and ideal tutorial time.

	E	A	C	ES	OE
Ideal Time	.15	-.07	-.46*	-.25	-.01

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Table 6.4 Showing correlations between TIPI dimensions and MEQ score.

	E	A	C	ES	OE
MEQ	.00	.06	.42	.08	-.06

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Fig 6.1. Scatter plot showing a significant correlation between extraversion and time tested.

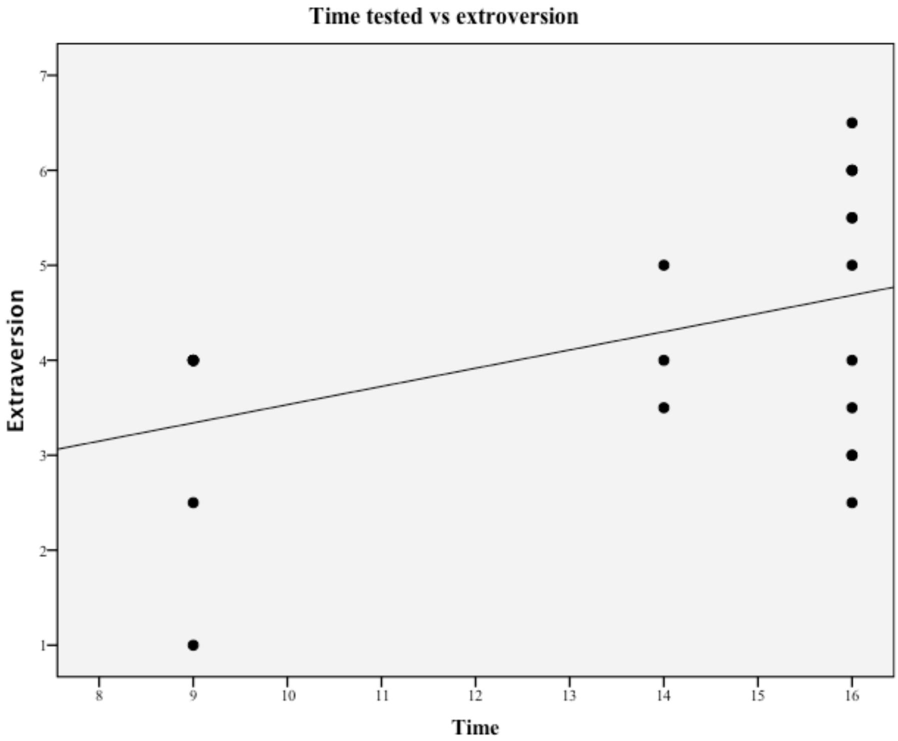


Fig 6.2. Scatter plot showing significant correlation between openness and time tested.

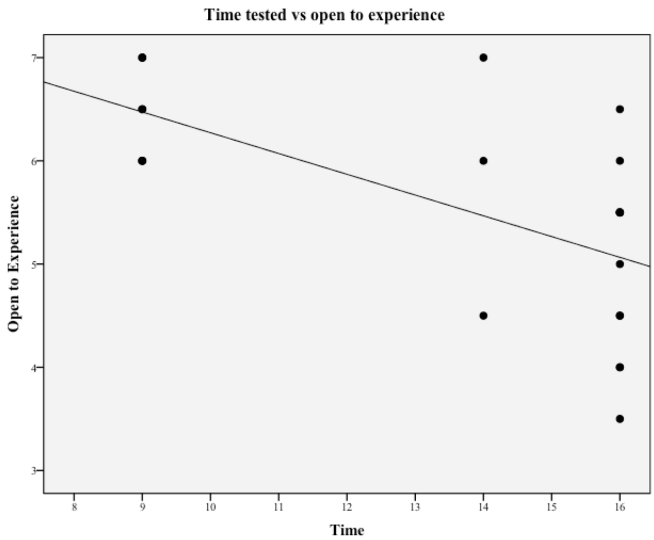
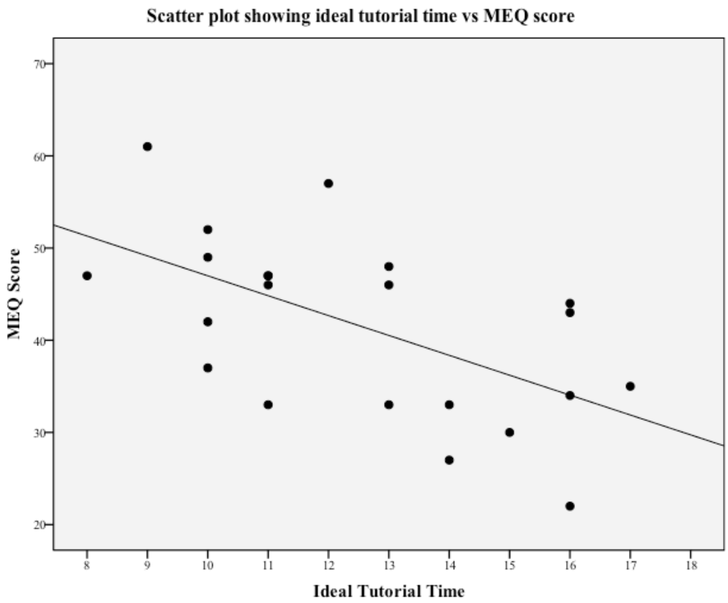


Fig 6.3. Showing significant correlation between MEQ and ideal tutorial time.



To ensure that ideal times were representative of an individual's MEQ score, I confirmed that these were significantly correlated (figure 6.3) [$r(20) = -.58$, $p = .005$]

Discussion

These preliminary results suggest that extraversion and openness to experiences may be related to the time of day participants were tested. With the exception of conscientiousness, the Big Five do not appear to be affected by an ideal time or a preferred bias towards morning or evening. I next sought to replicate this result in a larger sample using a more complex measure of personality. In addition, I increased the number of testing times. Participants were taking part in a separate experiment between 11am and 4pm and were also recruited to take part in Study 6.2.

Study 6.2 The effect of time of day on self-reported extraversion

The study sought to replicate Study 6.1 using a larger sample and a broader range of testing times. I again predicted that extraversion would show a similar increase across the day.

Method

Design and Measures

In this study, participants arranged with the experimenter to arrive at the lab at a time between the hours of 11am and 4pm. On arrival, they completed the MEQ and a 100 item version of The International Personality Item Pool (Goldberg 2006). The IPIP scales have good internal consistency and relate strongly to major dimensions of personality assessed by two leading industry questionnaires (NEO-FFI and the EPQ-R) (Gow, Whiteman, Pattie and Deary 2005).

Participants

32 students (40.63% male) studying at The University of Glasgow took part in a short correlational study. Their ages ranged from 19-27 and they were each paid £3 for their participation.

Procedure

After being welcomed into the lab, participants completed a standard 100-item version of the IPIP and the MEQ. They were then debriefed, paid and thanked for their time.

Results

Scores for the Big-Five domains were computed from the IPIP. These consist of extraversion, agreeableness, conscientiousness, emotional stability and intellect.

In line with Study 4.1, a significant correlation was observed between extraversion and time tested [r = .49] (tables 6.5 & 6.6), but not with any of the other 4 dimensions of personality. Self-reported extraversion appears to increase towards the end of the working day and peak at around 4pm (figure 6.4).

Table 6.5. Showing correlations between IPIP dimensions and time tested.

	E	A	C	ES	I
Time Tested	.49**	.13	.11	.13	.13

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Table 6.6. Showing correlations between MEQ score and IPIP dimensions.

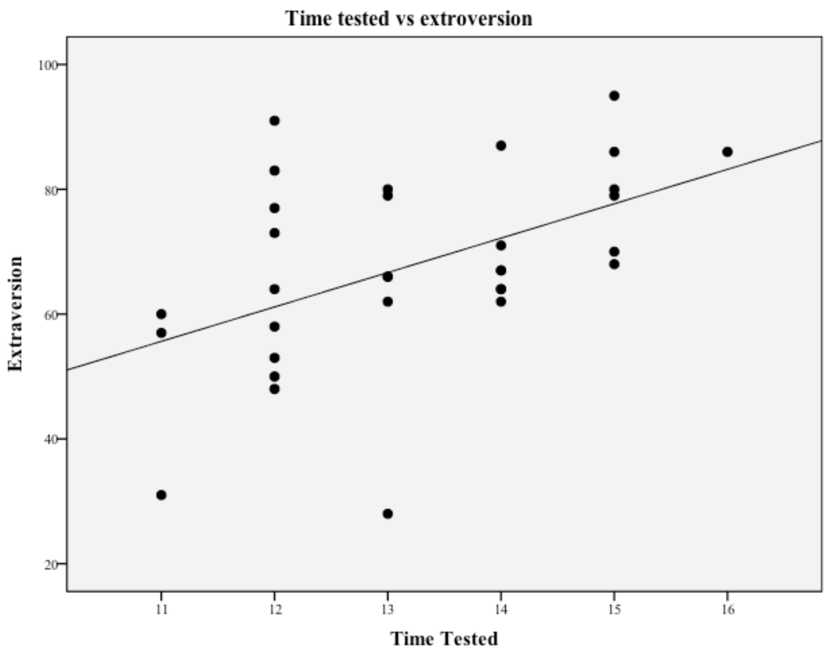
	E	A	C	ES	I
MEQ Score	-.24	.05	.19	.16	-.37

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

As observed in Study 6.1, individuals' MEQ scores do not correlate with levels of extraversion. However, those with low (evening) scores show a significant reduction in intellect score.

Fig 6.4. Scatter plot showing a significant correlation between extraversion and time tested.



A linear regression was conducted to evaluate whether time tested was necessary to predict extraversion. Approximately 24.2% of the variance in extraversion could be accounted for by the time they were tested. Thus the regression equation for predicting extraversion was:

[Predicted extraversion = (5.513 x time tested) - 5.005]

Discussion

The results from Studies 6.1 and 6.2 demonstrate a consistent relationship between extraversion and the time of day tested across two separate measures of personality. These results appear to be unrelated to an ideal or bias towards a specific time of day. However, these results are based on a student population who often work and sleep with some amount of irregularity (Van Dongen, Rogers & Dinges 2003). To ensure that these results are likely to be consistent in the general population, I next set out to look for a similar trends in a large online sample.

Study 6.3 Exploring personality changes across the day in a large online sample (N=489)

In Study 6.3, I looked for similar trends in a large online dataset using TIPI personality scores and time stamps. The TIPI was chosen in this instance because it was essential that the measure could be administered and understood quickly. While sacrificing some detail in the measurement of each dimension, a more detailed (albeit slightly more accurate) measure would have almost certainly resulted in a large percentage of participants returning incomplete questionnaires or providing inaccurate responses.

Method

Design and Measures

Participants completed the Ten Item Personality Inventory (TIPI) in addition to several other measures administered as part of a large online data collection exercise (see Appendix A).

Participants

489 people (51.17% male) took part in an online study across several months in 2011, between the hours of 7am and 7pm. Their ages ranged from 13-85.

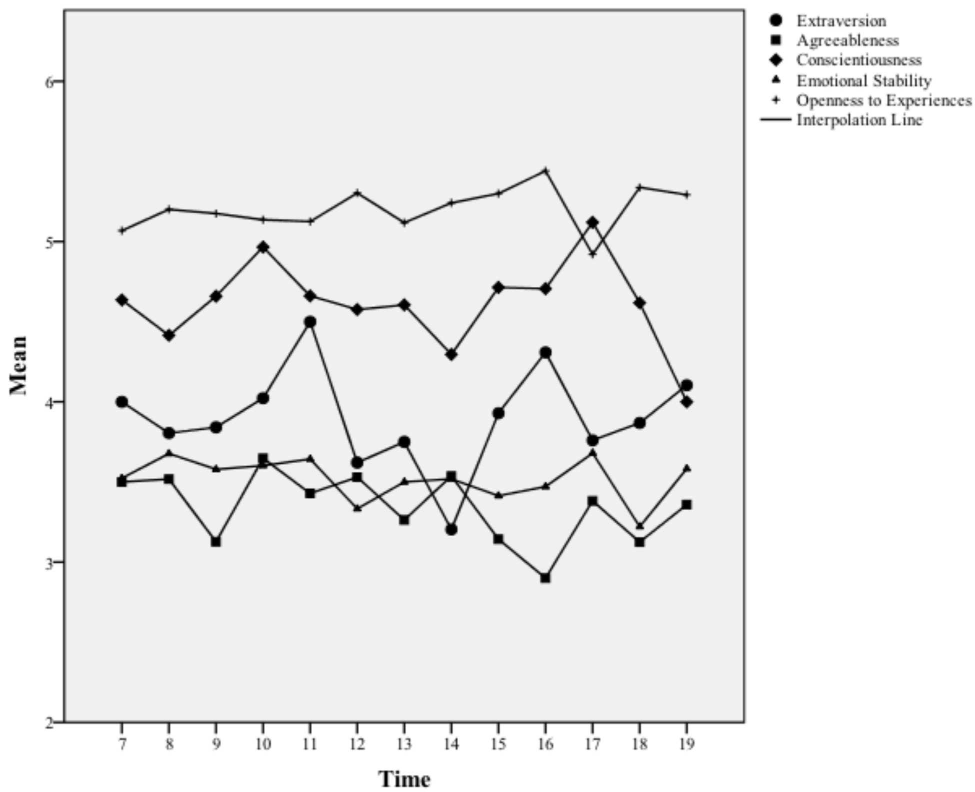
Procedure

See Chapter 1 and/or Appendix A for the full procedure involved as part of this study.

Results

The line graph below (figure 6.5) shows fluctuations of the Big Five personality dimensions between men and women from responses collected between 7am and 7pm. The number of participants completing the TIPI each hour ranged from 22 to 82.

Fig 6.5. Graphs showing daily fluctuations from 7am to 7pm in TIPI personality dimensions.



A series of one-way ANOVAs failed to show any significant differences in Extraversion [$F(12, 476) = 1.22$, $p = .27$], Agreeableness [$F(12, 476) = 1.12$, $p = .31$], Conscientiousness

[F(12, 476) = 1.23, p = .26], Emotional Stability [F(12, 476) = .31, p = .987], or Openness to Experience [F(12, 476) = .39, p = .97] scores between 7am and 7pm.

However, extraversion shows the largest variation across the day and in line with my earlier findings appears to peak late afternoon. While some dimensions show little variation across the day, extraversion and emotional stability have the largest standard deviations (1.57 and 1.47) suggesting that they may be less stable across the day. However, these are also comparable with normative data provided by the authors (1.45 and 1.42 respectively) (Gosling, Rentfrow & Swann 2003).

Discussion

Extraversion shows both the largest variation by hour and coincides to some extent with similar trends already observed in smaller samples of students. However, as with all studies documented so far in this Chapter, the design employed is between and not within-subject. Some of the findings (or lack of) could simply be the result of more extraverted individuals responding at specific times of the day. I next sought to address this concern in a within subjects design.

Study 6.4 Changes in extraversion and emotional stability across the day within-subjects

The differences observed thus far all involve between and not within-subject comparisons. In the following study, I attempted to replicate the trend observed in Studies 6.1 and 6.2 using a small, within-subjects sample where the same individuals were tested at two points during the day when extraversion was predicted to be low (9am) or high (4pm).

Method

Design and Measures

The International Personality Item Pool (IPIP) can be administered as a 50 or 100 item scale. I modified a 100 item version IPIP by splitting it in half to create two versions (A and B). Each version contained ten items for each of the five factors. These two halves were randomly administered to participants at either 9am or 4pm and again at the alternate time. A quarter of participants were tested at 9am first and completed version A of the IPIP before completing version B at 4pm. Another quarter were firstly tested at 9am with version B, then 4pm with version A. A third quarter were tested at 4pm then 9am with version A then B. A final quarter received version B then A at 4pm then 9am. This would control for and allow me to consider any order effects. A self-reported measure of tiredness was also requested where participants were asked at both testing times to report how tired they felt on a 10 point likert scale (with 10 being very tired)

Participants

12 female students studying at The University of Glasgow were each paid £2 to participate. Their mean age was 20.75 years. I deliberately chose to test a female only sample because the results from previous studies suggested that the extraversion effect would be stronger in female participants.

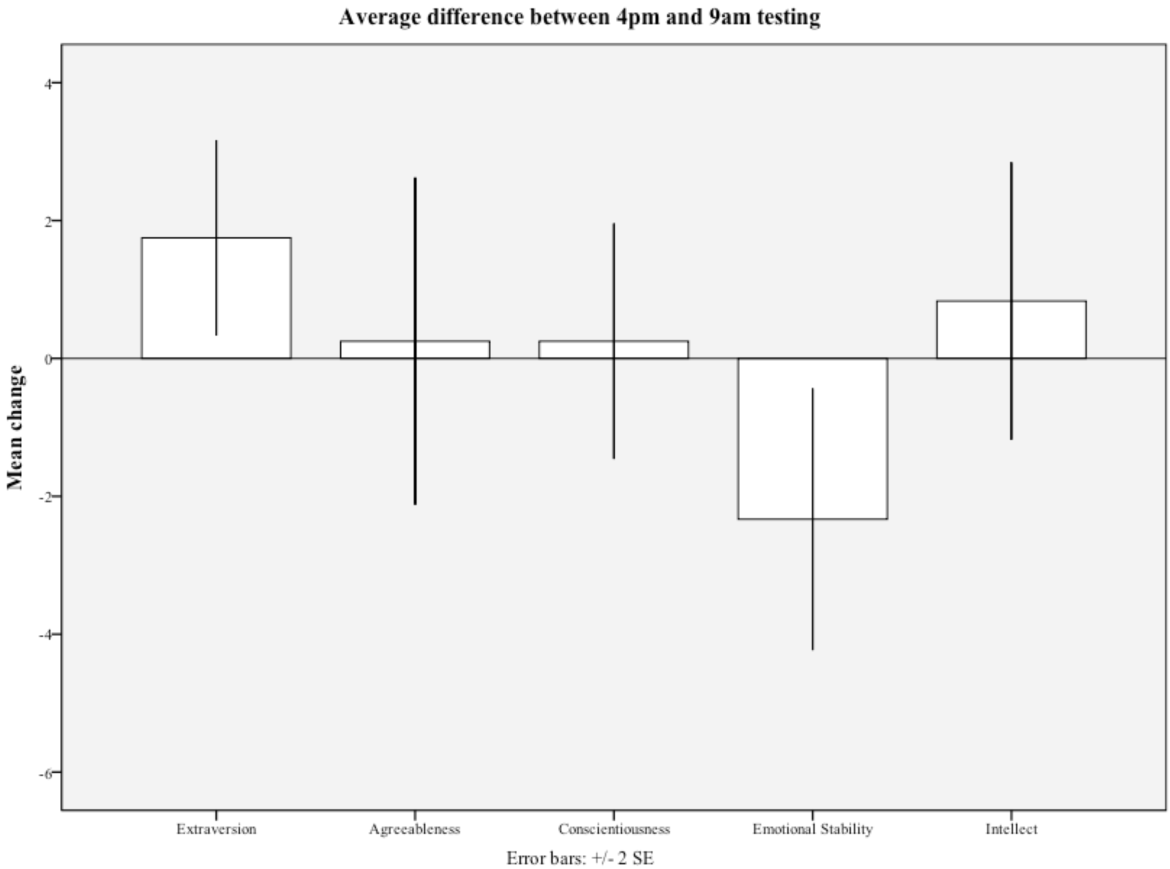
Procedure

Participants were invited into the lab to complete a 50 item version of the IPIP. They were then randomly allocated to arrive at 9am or 4pm. After completion, participants were then instructed to return at the alternative time at which point they completed a second 50-item version of the IPIP. They were then debriefed, paid and thanked for their time.

Results

Average changes across all five dimensions between 4pm and 9am were calculated (figure 6.6).

Fig 6.6. Bar graph showing average changes (and standard deviations) that occur in IPIP scores between testing at 4pm and 9am.



A series of paired sample t-tests revealed significant differences between mean extraversion at 9am (*M* = 32.91, *SD* = 6.23), 4pm (*M* =34.67, *SD* = 5.50) [*t*(11) = 2.470, *p* = .031] and Emotional Stability 9am (*M* = 33.08, *SD* = 6.58) 4pm (*M* = 30.75, *SD* = 6.80) [*t*(11) = -2.461, *p* = .032]. No significant differences were found between Agreeableness [*t*(11) = .210, *p* = .837], Conscientiousness [*t*(11) = .293, *p* = .775] or Intellect [*t*(11) = .828, *p* = .425].

A paired sample t-test found no significant difference in tiredness scores between 9am (*M* = 3.83, *SD* = 2.08) and 4pm (*M* = 3.67, *SD* = 1.50), [*t*(11) = -.236, *p* = .818].

As predicted, extraversion shows a significant increase between 9am and 4pm. This correlates with a reduction in Emotional Stability. A significant correlation between the rate of change in extraversion and emotional stability was also observed [*r*(10) = .564, *p* = .028] (one tailed).

Fig 6.7. Bar graphs showing a consistent pattern of changes across the order of time tested order of IPIP version administered.

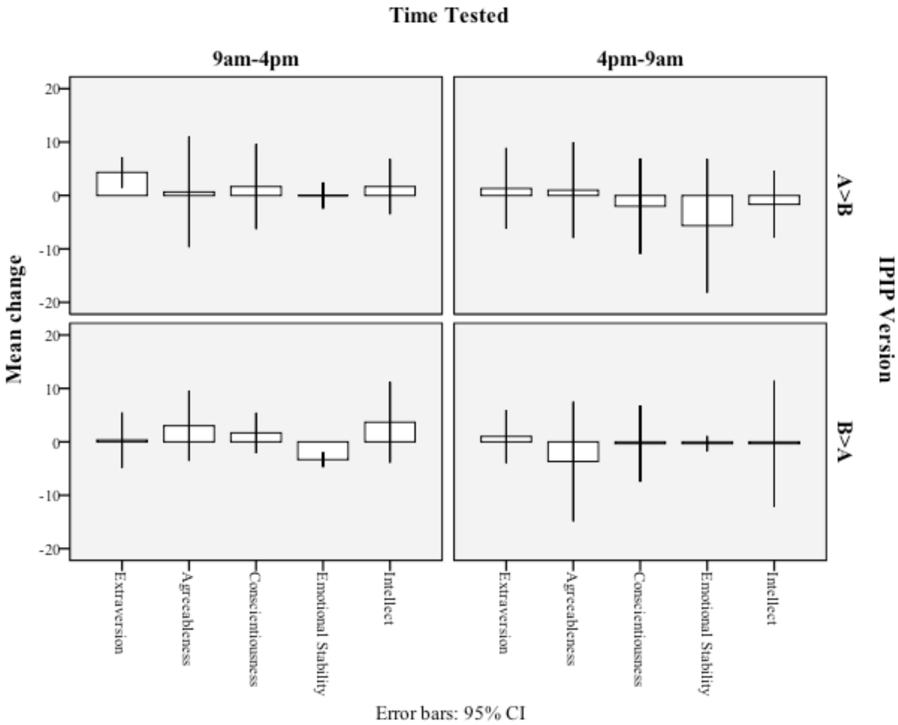


Figure 6.7 illustrates no main effect of test order was observed in changes of Extraversion [$F(1,8) = 2.97$, $p = .123$.], Agreeableness [$F(1,8) = 2.09$, $p = .609$], Conscientiousness [$F(1,8) = .245$, $p = .634$], Emotional Stability [$F(1,8) = .444$, $p = .524$.] or Intellect [$F(1,8) =.787$, $p = .401$].

Discussion

Despite some unexpected changes in Emotional Stability across the day, these results again demonstrate the same change in extraversion between morning and late afternoon as previously observed in studies 6.1 and 6.2. However, as outlined at the start of this Chapter, personality tends to predict other important individual differences from life-expectancy to levels of creativity (Aguilar-Alonso 1996). In a final study, I sought to try and link these changes to another measure over the same time period that has also gained an increasing amount of attention in the current research literature - happiness.

Study 6.5 Current and retrospective happiness across the day in a large online sample (N=489)

The results documented so far raise further questions surrounding what additional self-report measures may also be affected by the time of day they are administered. For example, personality is generally regarded as the most important predictor when it comes to well-being, particularly extraversion (Deary, Weiss & Batty 2010). Therefore, any increase in self-reported levels of extraversion should also be reflected in self-reported levels of happiness or indeed any other measure of mood.

At the same time, there has been increasing interest recently in using wider measures to monitor well-being and evaluate government policy and this includes measures related to society and the environment (ONS 2012). One important component of national well-being is the subjective well-being of individuals, which is measured by finding out how people think about their own lives.

Method

Design and Measures

The office of National Statistics have recently published preliminary results from the first annual Subjective Well-being Annual Survey (APS) dataset, which took various measures from 165,000 adults aged 16 or over and covers the UK (ONS 2012). Between, April 2011 and March 2012, four subjective well-being questions were included in the constituted survey of the Integrated Household Survey (IHS):

-Overall, how satisfied are you with your life nowadays?

-Overall, to what extent do you feel the things you do in your life are worthwhile?

-Overall, how happy did you feel yesterday?

-Overall, how anxious did you feel yesterday?

All were answered on a scale of 0 to 10, where 0 is 'not at all' and 10 is 'completely'

In an online study, I chose to examine one of these questions along with an additional question relating to current happiness on the actual day tested. Participants received these questions in a random order along with other measures including the TIPI discussed earlier (see Appendix A). The two questions were presented several minutes apart from each other:

-'*Overall, how happy are you today'*

-'*Overall, how happy were you yesterday*'

Participants

489 participants completed an online study between the hours of 7am and 7pm. Their ages ranged from 13-88. This analysis utilises the same data from Study 6.3.

Procedure

See Appendix A.

Results

In line with previous research, extraversion and emotional stability show the strongest relationship with retrospective and current happiness. However, the correlation with Emotional Stability appears to go in the opposite direction expected, as increased self-reported levels of happiness is usually associated with an increase in Emotional Stability (table 6.7).

Table 6.7. Showing correlations between personality dimensions and two happiness questions.

	E	A	C	ES	OE
Happy Today	.218**	-.138**	.065	-.234**	.104*
Happy Yesterday	.210**	-.126**	.074	-.258**	.116*

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Stepwise regression was chosen to try and predict happiness today and happiness yesterday due to the large nature of the data set and the number of significant correlations between the dependent and independent variables. It would not be feasible using hierarchical regression alone to fit all possible models.

Predicting Happiness Today from Personality

A stepwise multiple regression was conducted to evaluate what aspects of personality were necessary to predict happiness today. At step one of the analysis, Emotional Stability was entered into the regression equation and was significantly related to happiness today [$F(1,487) = 28.17$, $p < .001$]. Extraversion was then entered into the equation at step 2 of the analysis [$F(1,486) = 23.70$, $p < .001$] and Agreeableness at step 3 [$F(3,485) = 17.64$, $p < .001$]. Conscientiousness [$t = 1.44$, $p = .152$] and Openness to Experiences [$t = .880$, $p = .379$] were not entered into step 4 of the analysis. The multiple regression correlation coefficients were -.251, .221 and -.156 indicating approximately 9.8% of the variance in happiness today scores could be accounted for from Emotional Stability, Agreeableness and Conscientiousness.

Predicting Happiness Yesterday from Personality

A second stepwise multiple regression was conducted to evaluate what aspects of personality were necessary to predict happiness yesterday. At step one of the analysis, Emotional Stability was entered into the regression equation and was significantly related to happiness today [$F(1,487) = 34.72$, $p < .001$]. Extraversion was then entered into the equation at step 2 of the analysis [$F(1,486) = 25.98$, $p < .001$]. Agreeableness [$t = -1.94$, $p = .053$], Conscientiousness

[t = 1.83, p = .068] and Openness to Experiences [t = 1.24, p = .217] were not entered into step 3 of the analysis. The multiple regression correlation coefficients were -.352, and .251 indicating approximately 9.7% of the variance in happiness yesterday scores could be accounted for from Emotional Stability, Agreeableness and Conscientiousness.

A strong correlation was observed between happiness felt the previous day and happiness felt on the day tested [r (488) = .54, p < .0001], but this relationship is not consistent across the day when subtracting the two measures of happiness (figures 6.8 & 6.9).

Fig 6.8. Line graph showing fluctuations in happiness measures between 7am and 7pm.

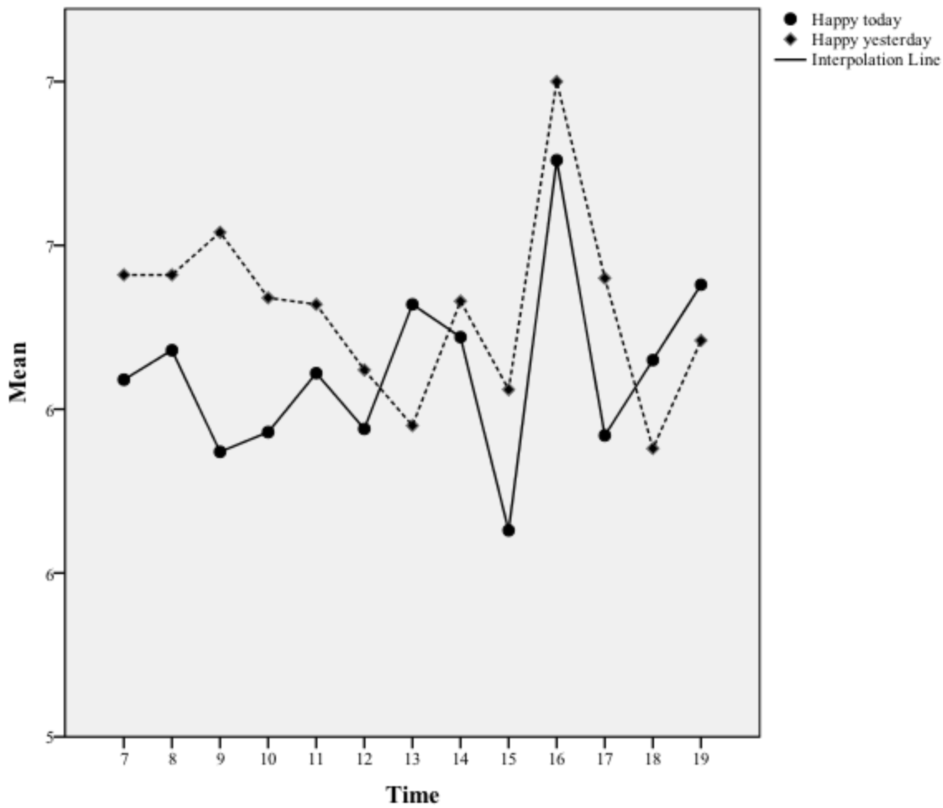
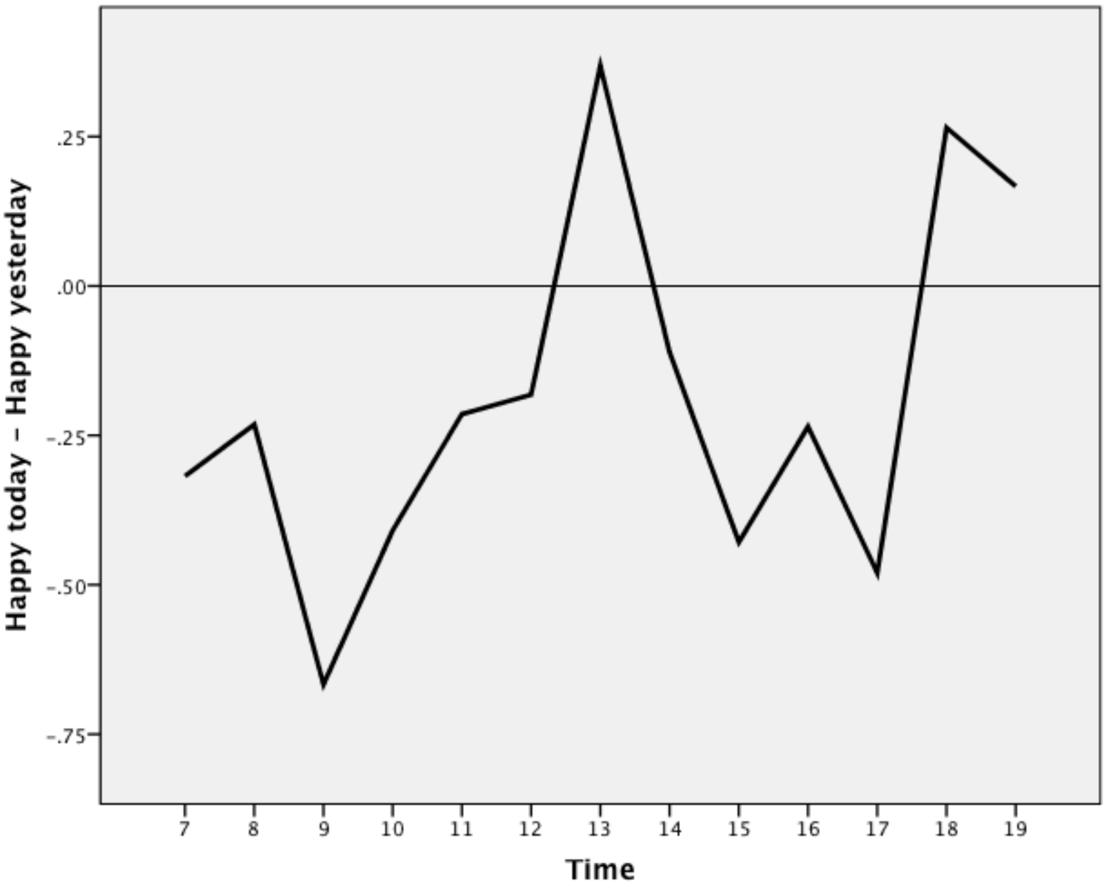


Fig 6.9. Line graph showing differences between happiness today and happiness yesterday.



Discussion

While personality can be used to predict happiness, these results suggest that like personality a simple mood measure also fluctuates considerably across the day. Such between-subject measures however, do not account for any additional within subject changes. Interestingly, it appears that people rate their previous day as happier than the current day in the morning, but are then more likely to align and cross over with present day happiness later in the day. These measures become more similar between 11 and 12, but re-align later in the evening.

Self-reported happiness also appears to peak at 4pm, which chimes with the increase in extra-version illustrated in the previous study. Personality is often used to predict happiness, as demonstrated in this data set, but if it isn't a fixed construct, then it may become problematic. On the other hand, if personality changes across the day, then other interventions may be able to alter it directly that will in turn improve mood.

Given these preliminary results, future governments may want to measure personality using a more complex measure in addition to happiness. If large samples could be collected online, then it might be possible to see how the time of day in addition to personality can help predict an individual's happiness in the future. This was not possible here due to a comparatively small sample size and the use of a short personality and mood measure. An additional weakness concerns the sample itself because it is impossible to tell if participants were actually at their place of work when their response was recorded. In addition, an individual's job satisfaction may also interact with such ratings of mood or personality. This could be the focus of future research.

Chapter Summary

There is a growing body of evidence to suggest that some facets of personality are not fixed (Boyce, Wood & Powdthavee 2012). However, while previous research has demonstrated changes that take place over multiple years, the results here suggest that self-report measures are likely to reveal significant changes over a period of several hours. Unlike previous findings, I have demonstrated this change in both between and within-subject samples and across two independent measures of personality. This change also appears to be related to a simple measure of subjective well-being.

There are broad analytical implications for the measurement of personaltiy in research, public policy and occupational settings. Personality psychology would gain a lot by further investigating how and when personality is susceptible to rapid change across shorter time scales. The consistent change in extraversion documented here may simply be driven by the fact that people spend more time interacting with others across the day and as the number of those interactions increases, a self-reported measure of extraversion is likely to trigger recent memories in relation to those social exchanges. Alternatively, given that extraversion appears to peak at around 4pm, this may correlate with other physiological changes that occur at the same time. For example, body temperature tends to increase towards late afternoon, where more world records in track and field are also broken (Atkinson & Reilly 1996; Golder & Macy 2011). Research examining the stressful hours of work has demonstrated similar trends (Colligan & Tepas 1986; Kunz-Ebrecht, Kirschbaum & Steptoe 2004).

In summary, previous research examining other daily patterns in individuals' physiology, cognition and behaviour are consistent with my findings. These findings also support the notion that personality can be viewed as a quality of life variable. Measures of well-being are often regarded as important indicators of quality of life (e.g. Diener, Diener & Diener 2009; Ferrer-i-Carbonell & Frijters 2004). Changes in personality between 9am and 4pm may also say something about fluctuating mood across the day. The decrease in emotional stability witnessed as part of a small within-subjects comparison suggests that mood may become more unstable as the day progresses (Golder & Macy 2011). Increases in extraversion may indicate a greater desire for social interaction and reflect a willingness to work together to form mutually beneficial solutions for example. There may be public policy and clinical implications for these findings as people may be more susceptible to certain health campaigns at different times of the day, which could be more efficiently targeted. That said, some groups may be more vulnerable to a time of day effect than others (Diaz-Morales 2007).

While I have highlighted the potential nature of personality change that can take place over several hours, there are several limitations to this research. The purpose of this research was to highlight that personality does change, against a prevailing view that it does not, and show that this change is meaningful. However, it is not possible to say what the exact casual mechanism is behind any of these changes. By first showing that changes in personality do exist, future research may wish to gather evidence to support my predictions as to why these changes are occurring. For example, conversation levels in a typical open-plan office throughout the day could be monitored. I would also predict that these would become louder and last longer towards 4pm. Such a result may confirm whether the results documented here are simply a weakness of the measurements used, or a measurable and rapid change in personality brought on as people move through their working day. It is also a priority for future research to disentangle whether increased well-being can come about due to a change in environment, physiology or personality. It should also be noted that just because people may be responding differently in different states across the day, this does not necessarily mean that personality is unstable. As mentioned at the outset of this chapter, a key object of future research would be to increase the resolution of measurement and consider the interaction between self-report, state, trait and circadian effects on any 9 to 5 change in personality.

A further concern is that this research relies on self-report measures and it may simply be the case that my results demonstrate an additional problem with current constructs used to measure personality (Kagan 2001). Deeper insights into this domain may only result if psychologists move away from self-report instruments to measure personality. Like this study, most of the work cited within the personality literature uses questionnaires to assess personality categories or dimensions. However, different personality types are also likely to emerge if the thousands of people who filled out those questionnaires had been filmed for 24 hours over a 6 month period in different contexts and scientists factor analysed those observations. Alternatively, specific times of the day may simply lead to a more accurate judgement of ones own and others personality (Funder 2012).

Advocates of the popular personality constructs assume that a person's semantic judgements about their behaviours, beliefs, and moods are the most valid bases for inferring personality types. On the other hand, no cognitive psychologist would record participants' careful descriptions of their perceptions, memories, and ways of solving problems to infer the basic cognitive competencies. Self-report measures may have several serious problems. Most personality categories describe relatively superficial evaluative dispositions like society, conscientiousness, nervousness, and openness to ideas. Each of the main traits are regarded as good or bad (Paunonen & Ashton 2001). This may become even more problematic when testing psychology students who are likely to be aware of the factors which each item is assessing.

To conclude, the time of day an individual's personality is measured may interact with several other mood related factors, but future research will need to establish the root causes of these time of day effects for example, are they driven by social working patterns or biological sleep patterns (i.e. the number of hours since an individual woke up) (Golder & Macy 2011).

While I have considered weekly and daily working cycles, there remain other aspects of everyday time that may rely on an interaction between these everyday units of time. That is, the ability to move through weeks, days and hours in order to arrive on time for different meetings, events and appointments. Punctuality is an inescapable part of self-organisation that can also be considered a core part of everyday time processing. In the next Chapter, I explore how punctuality might be predicted from appointment specifics, personality and time orientation.

Chapter 7

Developing a predictive measure of punctuality

Introduction

Across everyday time scales, people have to contend with arriving at events at the right time. In an accelerated life, the ability to manage time becomes increasingly important and is highly valued in Western cultures (Back, Schmukle & Egloff 2006). Being on time is necessary to develop and maintain satisfying relationships with others, to structure one's life, and be successful on the job (Levine & Bartlett 1984). Meeting with others at a specific time is thus a critical situation in daily social life as well as an essential part of everyday time management. Being late on the other hand, costs the British economy £9 billion pounds a year (Rogelberg, Scott, Agypt, Williams, Kello, McCausland & Olien 2013).

Aside from weekday and the time an appointment is made (Chapters 4, 5 and 6), there are likely to be many other individual and situational factors that influence the time people arrive at a specific appointment. Despite this, most people can quickly identify those who they know who are almost always late, others who are always waiting, and some who are always just in time.

In daily life, there are even cases where people adapt to and adjust to someone's assumed lack of punctuality: for example, making an appointment for 7pm because it is already known that the person will not arrive until 8pm. Individuals appear to have consistent punctuality styles; some are typically early and others are consistently late, regardless of the occasion (Richard & Slane 1990). However, as an individual difference measure, punctuality has also been shown to correlate with anxiety, depression and sleep disturbances (Iverson & Deery 2001; Spiegelhalder, Regen, Kyle, Endres, Nissen, Feige & Riemann 2011).

It is surprising, given the importance of punctuality, that it is not a more well-established area of psychological research in its own right. A lack of punctuality can be both emotionally and financially expensive. Being late for an important meeting for example, can give the wrong first impression. Similarly, a late credit card payment can lead to financial hardship in the long run (Navarro-Martinez, Salisbury, Lemon, Stewart, Matthews & Harris 2011). Despite these negatives, a large number of people who live in cultures where punctuality is highly valued still consistently struggle to arrive on time.

Previous research into punctuality has typically focused on either cultural differences regarding what it means to be 'on time' to different groups, or personality differences that act as a marker for punctual behaviour (Blau 1994; White, Valk & Dialmy 2011). Who is prone to be late or early is likely to be reflected in an individual's personality as it has in the past been used to predict a variety of social behaviours and attitudes (Paunonen & Ashton 2001; Paunonen 2003). The Five-Factor model of personality is a common and replicable taxonomy of personality (McCrae & John 1992), however, only a handful of studies to date have explored potential correlates (Back, Schmukle & Egloff 2006). Other large-scale studies from Dishon-Berkovits & Koslowsky (2002) attempted to describe the punctual employee and found that personality was of little importance. They concluded that punctuality is more intrinsically linked to age, gender and work situation.

The aim of this experimental Chapter was therefore to understand the influence of firstly personality, but to also consider the effects of other individual difference measures that may also correlate with someone's punctuality. For example, increased levels of future time orientation have been associated with a decreased likelihood of engaging in HIV transmission risk behaviours as well as smoking, alcohol and substance abuse (Boyd & Zimbardo 2005; Keough, Zimbardo & Boyd 1999; Petry 2003; Wills, Sandy, & Yaeger 2001). General explanations tend to relate these to a cognitive structure that people access when making decisions about short-term and long-term actions and goals. Surprisingly and despite the well established theoretical relationship between personality and punctuality (Zimbardo & Boyd 1999), no one has yet considered how these measures could be combined and termed as an individual's 'time personality'.

This Chapter also considers appointment specifics along with individual differences in an attempt to help predict punctual behaviour. Based on previous work by Back et al. (2006), I predicted that personality, specifically self-reported levels of conscientiousness and agreeableness would be the strongest predictors of punctuality. However, appointment specifics are also likely to affect punctuality. For example, a more conveniently timed appointment may lead to improved punctuality. A deeper understanding of how personality and appointment specifics interact could lead to several applied recommendations. For example, elements of personality may only correlate with a regular (e.g. a weekly lecture), but not an irregular (e.g. medical) appointment. This would therefore allow for a more efficient reminder system if specific individuals were more likely to be at risk of late attendance.

However, before embarking on this, an exploratory study sought to examine whether individuals who believe they are punctual, are also likely show similar personality correlates found by Back et al. (2006).

7.1 Personality correlates between 'on time' and 'off time' individuals

People are generally quick to identify themselves as someone who is regularly on-time or consistently late. Similarly, there are those who arrive early for everything. People who live in cultures where punctuality is highly valued usually learn that if they do not want to be late for an appointment, then they have to prepare and set out for it in time. This also involves understanding how to adjust to other people's schedules, even if this does not suit their immediate desires or impulses (Shaw 1994).

Relying on a simple self-report measure of punctuality has previously been shown to correlate highly with actual punctuality. Arguably, asking individuals a single question may also give a better measure that avoids the issue of other situational influences (Richard & Slane 1989). Despite these other situational influences, individuals tend to show a reliable tendency to be consistently on time or late - and are able to identify others' punctuality behaviour from previous experience.

Previous work from Back et al. (2006) found links between conscientiousness and agreeableness and I expect to replicate those findings in this first study.

Method

Design and Measures

As part of a larger online experiment (see Appendix A), participants were asked:

'*Do you regularly arrive on time for events and appointments?*'

Participants provided a yes or no response and also completed the TIPI as part of this experiment. The Ten-Item Personality Inventory (TIPI) was developed by Gosling, Rentfrow and Swann (2003) to meet the need for a very brief measure of the Big-Five personality dimensions (extraversion, agreeableness, conscientiousness, emotional stability and openness to experience). The TIPI has been shown to reach adequate levels of (a) convergence with widely used Big-Five measure in self, observer and peer reports, (b) test-retest reliability, (c) patterns of predicted external correlates, and (d) convergence between self and observer ratings.

Participants

637 participants answered the set question and completed the TIPI. 51.2% were male. Each individual was required to allocate themselves to an age band (under 18(N =12), 18-24(N = 175), 25-34(N = 174), 35-54, (N = 230) and 55+ (N = 31). About half of these participants were based in the UK with the remainder coming from Europe and the US. However in total, over 40 countries are represented. Participants were not paid for their time. Multiple responses were prevented by using an I.P logger.

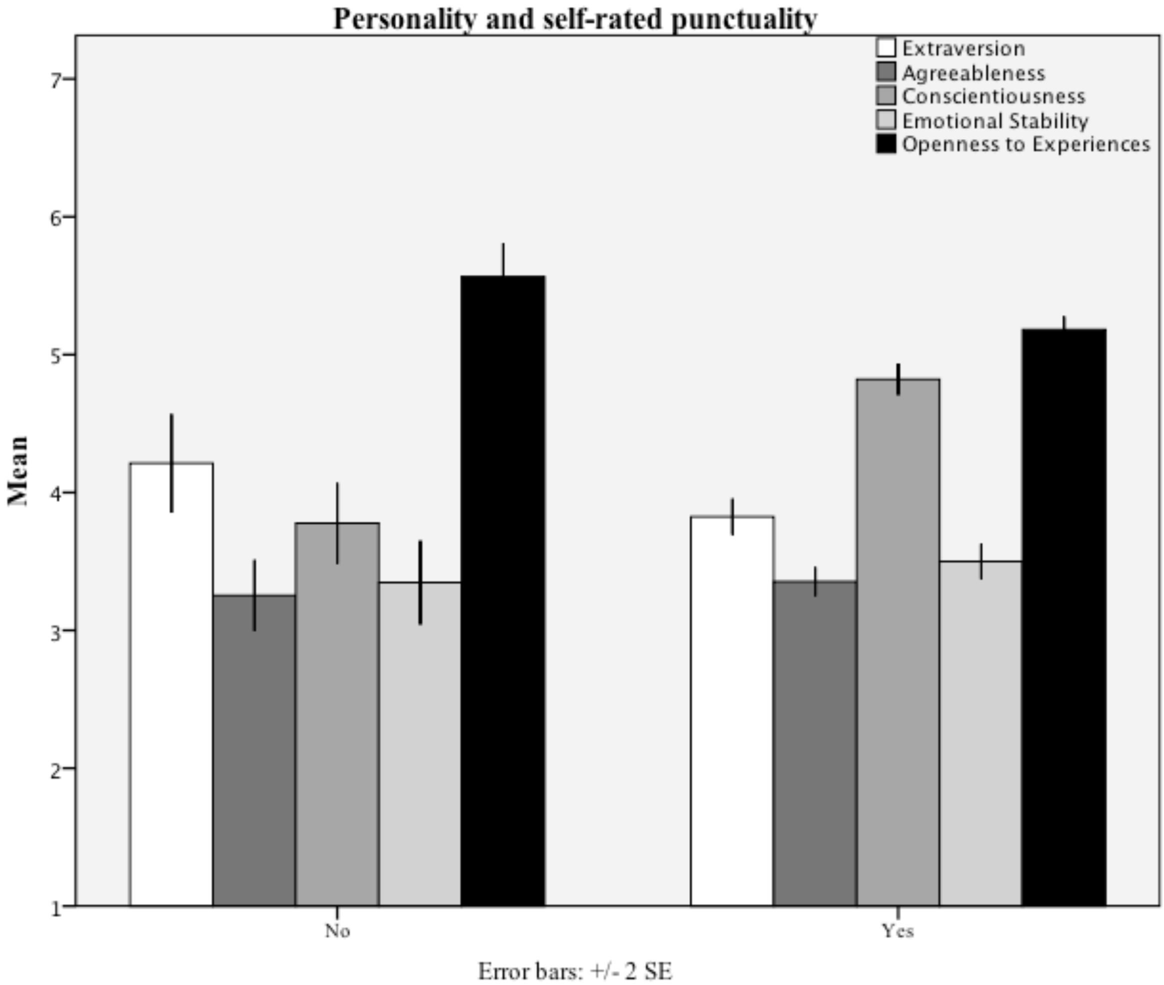
Procedure

See Appendix A for a complete procedure.

<u>Results</u>

Mean personality scores were computed separately for individuals who responded yes (N = 552) or no (N = 85) to the question posed: ('*Do you regularly arrive on time for events and appointments?*')

Fig. 7.1. Showing mean Big-Five personality scores (and 95% confidence intervals) showing personality differences between individuals who identified themselves as being likely to arrive 'on time' for appointments.



Independent sample t-tests revealed significant differences between Extraversion [p = .036], Conscientiousness [p <.0001], and Openess to Experiences [p = .004]. No significant differences were observed between Agreeableness [p = .48] and Emotional Stability [p = .38].

Table. 7.1. Showing results from independent sample t-tests comparing Big-Five scores between individuals who consider themselves to be punctual (or not).

	t	p	Mean Difference
Extraversion	2.15	**.03**	-.01
Agreeableness	-.66	.51	-.02
Conscientiousness	-6.61	**.00**	.04
Emotional Stability	-.83	.41	.01
Openess to Experiences	2.95	**.00**	.02

Discussion

While limited in scope, these results support some of the findings from previous research which examined correlations between actual punctuality and personality (Back, Schmukle & Egloff 2006). As expected, the largest differences were observed in levels of conscientiousness. However, differences were also observed in other traits as self-reported punctual individuals also reported significantly higher levels of openness and extraversion. My next step was to examine how these personality traits along with other individual difference measures in different appointment types may also correlate with actual punctuality in a regular appointment.

7.2 Predicting punctuality for a regular appointment

In the past, punctuality has often been reported as a component of various personality profiles however, limited attention has been given to how an individual's overall time personality can be measured in a single measure. For example, out of the 2,413 items available as part of the International Personality Item Pool, only two relate to punctuality. These include, '*Am often late for work*' and '*Am often late*'. Similarly, the Zimbardo Time Perspective Inventory includes only a few items that directly relate to being on time for example, '*If things don't get done on time, I don't worry about it*', '*it upsets me to be late for appointments*' and '*I meet my obligations to friends and authorities on time*'. Other measures of impulsivity also include a few items on planning that may also correlate with punctual behaviour (Patton, Stanford & Barratt 1995).

The question remains as to whether these various facets predict real-world punctuality on their own, or can this prediction be improved in conjunction with other measures related to the timing of the appointment or event itself.

To date, no research has combined measurements of personality and ideal time preference to examine their combined or individual effect on punctuality. This is surprising given the small correlations between personality and actual punctuality suggesting that other individual difference measures may be more predictive. On the other hand, small correlations are perhaps not surprising given that many other situational factors can affect punctuality. In the following study, I chose to use tutorial students who had no previous classes before a weekly, regular tutorial meeting. Previous research suggests that people have a tendency to fall into one of three categories - constantly early, on time or constantly late (Mosakowski & Earley 2000).

Method

Design and Measures

Time of arrival was recorded as the time-lag in minutes between the appointed time of the tutorial and the time of each participant's arrival (negative scores indicate early, positive scores late arrival). Participants completed The Morning Evening Questionnaire (MEQ), The Zimbardo Time Perspective Inventory (ZTPI) and the TIPI personality inventory (see Study 6.1) immediately following their tutorial. In addition, participants were also asked to provide their ideal day and time for a psychology tutorial along with the reasons for their current time selection. Finally, participants were asked if they wished to continue studying psychology in the following academic year.

Morning Evening Questionnaire (MEQ): Originally developed by Horne and Ostberg in 1976, it has been cited over 1500 times. It consists of 19 multiple-choice questions, with each question having four response options. Responses are combined to form a composite score which indicates the degree to which the respondent favours morning verses evening. Higher scores indicate an evening preference.

The Zimbardo Time Perspective Inventory: The ZTPI is a 56-item self-reported questionnaire that assesses a person’s perception of how considerations of the past, present, and future influence their thoughts and motivate their behaviour (Zimbardo & Boyd 1999). The items in the ZTPI were derived from statements about subjective experiences with time collected in interviews and focus groups, modified after initial testing, and subjected to repeated factor analysis. Factor analysis produced five distinct subscales of time perspective (future, present-hedonistic, present-fatalistic, past-negative, and past-positive), which were confirmed in tests of subsequent samples. Cronbach's alpha coefficients for the subscales have been reported to range from 0.74 to 0.82, and test-retest reliability has been reported to be from .70 to .80 (Zimbardo & Boyd 1999). The subscales have shown convergent validity with measures of mood, self-esteem, novelty-seeking, and conscientiousness (Zimbardo & Boyd 1999). In contrast to other psychometric measures that assess only either future or present orientation, or that conceptualise time perspective as a single dimension (i.e. a person is either present-oriented or future-oriented), the ZTPI considers time perspective as a multi-dimensional construct. In this view, although some individuals may dominantly use a single time perspective in most situations, individuals may also be "temporally balanced" and draw on more than one time perspective as situations and demands dictate (Boyd & Zimbardo 2005).

Participants

25 participants studying psychology at Glasgow University were offered the chance to complete a series of short individual difference measures after their tutorial. The time and day of their tutorial was allocated at the start of term. 24% were male and their ages ranged from 18-31.

Procedure

Students arriving at their tutorial on Tuesday 16:00 (13), Wednesday 14:00 (4) or Thursday 9:00 (8) were required to write their university number next to the register on arrival. Unknown to participants, this was time stamped by the experimenter. At the end of an hour long tutorial, students were offered the chance to participate in some research. After signing a consent form, participants completed the TIPI, the MEQ and some basic additional information. They were then debriefed as to the nature of the study, thanked for their time and received one course credit.

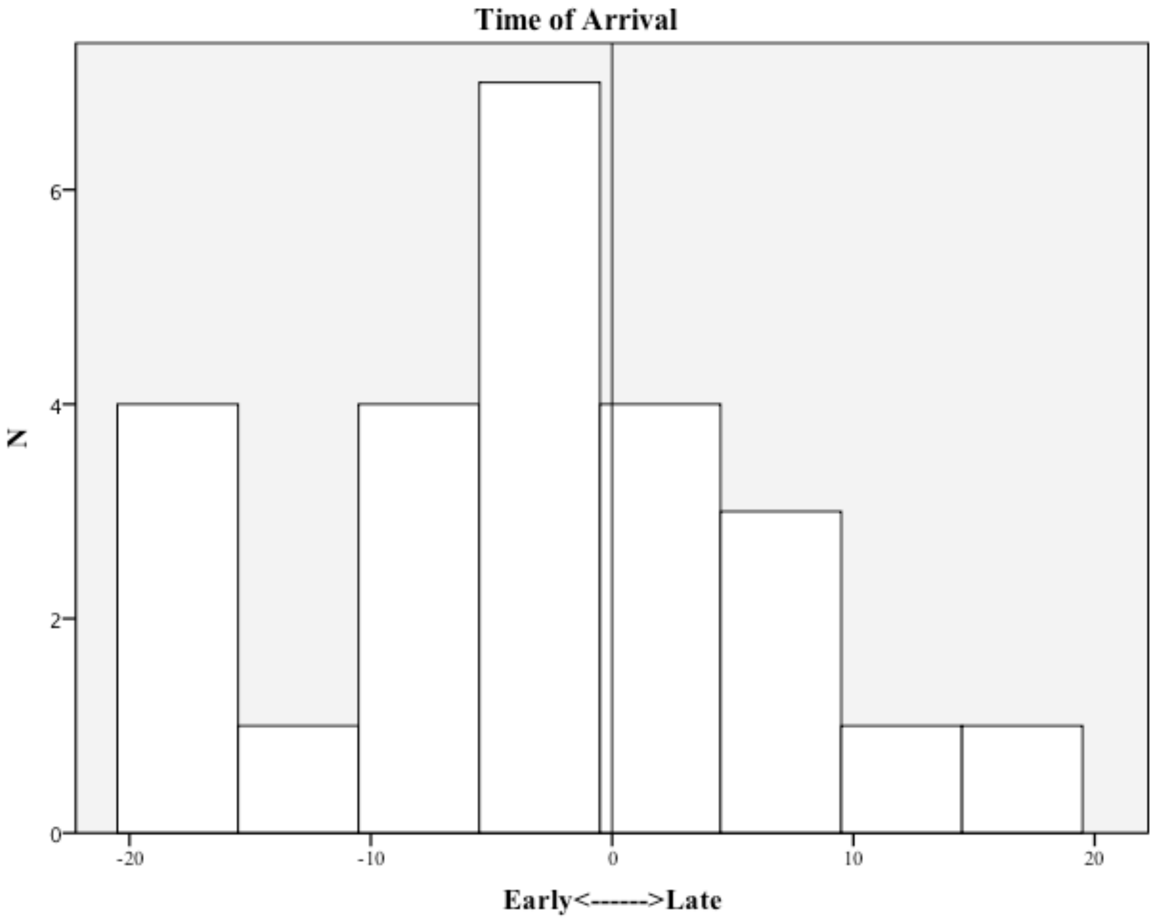
Results

The distribution of punctuality scores can be seen in figure 7.2. They ranged from 18 min too early to 15 min too late. On average, participants arrived 3.04 min before the appointed time (SD = 8.78). This difference from zero was not significant, [t (24) = -1.731, p = .096]. Thus, the sample contained a mix of individuals who were early and late. Additionally, a Kolmogorov-Smirnov test revealed that the scores for time of arrival were normally distributed [Z = .096, *ns*]. Sixteen participants were early, one individual was exactly on time, and 8 were late. Earliness was computed by setting all positive scores in time of arrival to zero and by multiplying the other scores by -1. In the same manner, lateness was computed by setting all negative scores in time of arrival to zero.

Of the 25 participants who had their punctuality recorded. Three opted not to take part in the research and withdrew.

I examined the influence of personality and ideal tutorial time on all these three behavioural indicators of punctuality (figure 7.2). I also calculated how far away students' actual tutorial time was away from their ideal time and day.

Fig. 7.2. Distribution of participants time of arrival in minutes. Negative scores indicate an arrival before, positive scores indicate an arrival after the appointed time.



Correlations were computed between personality, MEQ score, ideal tutorial time and punctuality (table 6.3 & figures 7.3-7.4).

Table. 6.3. Showing a correlation matrix between arrival time, earliness, lateness and individual difference metrics.

	Arrival Time	Earliness	Lateness
E	-.22	-.26	-.07
A	.04	.07	-.02
C	-.14	.01	-.29
ES	-.16	-.01	-.34
OE	.49*	.42*	.41
PN	-.07	-.04	-.09
PP	.17	.32	-.12
PH	.28	.25	.22
PF	-.01	-.03	.03
F	.04	.15	-.16
MEQ	-.11	-.16	.01
Ideal Time	.39	.3	.38
Ideal-Actual Time	.54**	.50*	.41
Ideal Day	.35	.38	.19
Ideal-Actual Day	.4	.37	.31

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Interestingly, the strongest correlation between punctuality arises from the difference between a student's ideal tutorial time and the actual time they have been allocated. Openness to Experience however is also significant with higher levels correlating with an earlier arrival time. No significant correlations were found between a participant's time perspective and arrival time.

Fig. 7.3. Scatter graph showing a significant positive correlation between punctuality and distance between ideal and actual tutorial time.

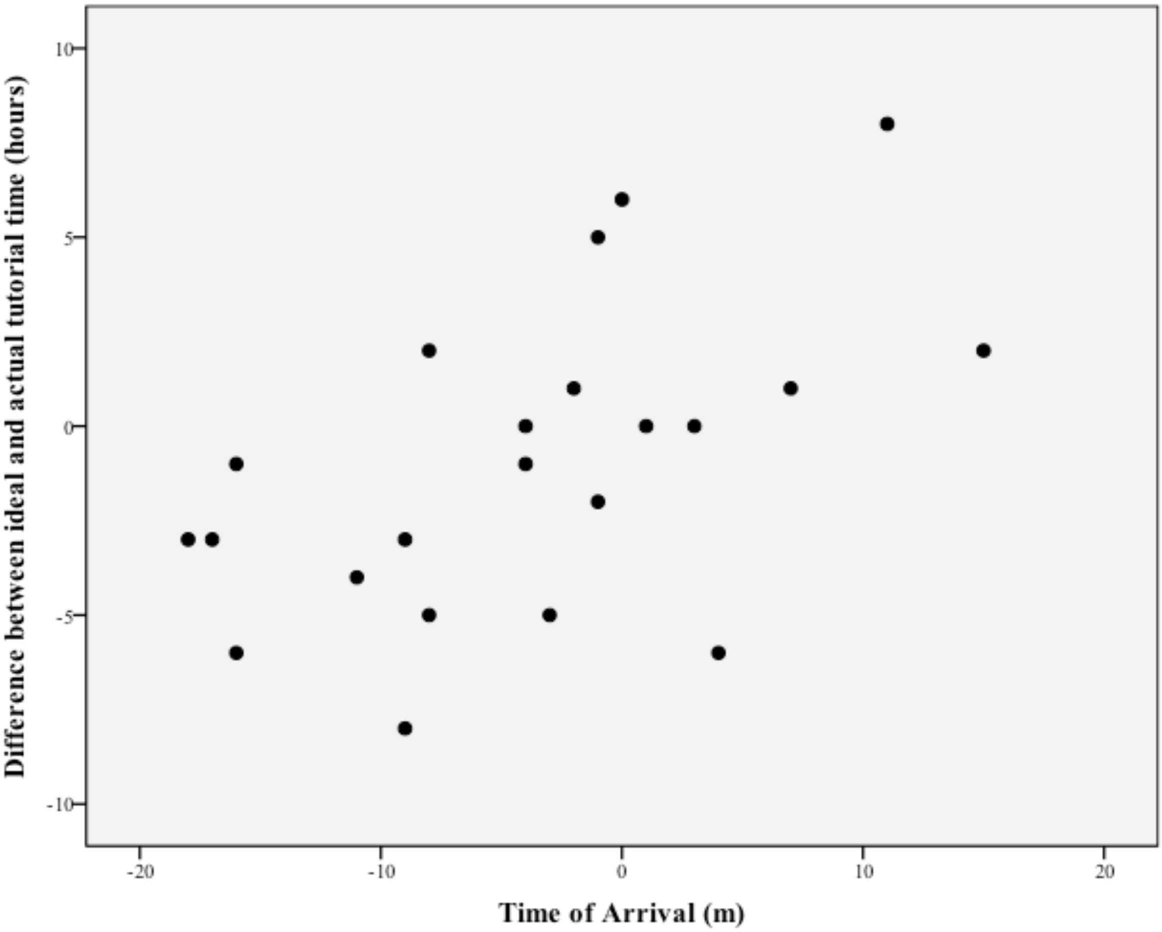
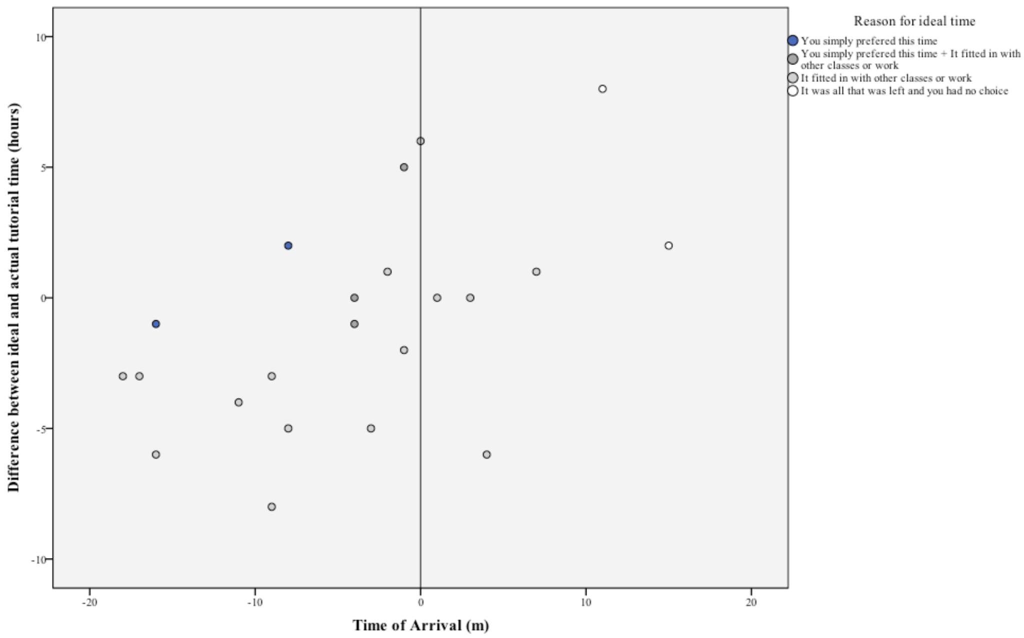


Fig. 7.4. Scatter graph showing a consistent relationship between punctuality and distance between ideal and actual tutorial time, irrespective of reason given for ideal time selection.



A stepwise multiple regression was conducted to evaluate whether both Openness to Experience and the difference between ideal and actual time attended were necessary to predict punctuality. At step one of the analysis ideal-actual time was entered into the regression equation and was significantly related to punctuality [$F(1,20) = 8.32$, $p = .009$]. The multiple regression correlation coefficient was .542, indicating approximately 29.4% of the variance of student punctuality could be accounted for by how far away students ideal tutorial time was from their actual time. Openness to experience was not entered into the equation at step 2 of the analysis [$t = 1.42$, $p = .172$]. Thus the regression equation for predicting punctuality was:

[Predicted punctuality = (1.19 x ideal-actual time) - 2.72]

Discussion

The present study investigated the influence of personality and time based dispositions on an important real-life criterion: punctual arrival at a regular meeting, in this case a tutorial class. With the exception of openness, I was unable to find any reliable correlates for predicting punctuality in this small sample. What appeared to be a much stronger predictor was the distance between a student's preference towards their ideal time and actual time when attending a regular meeting. Furthermore, the reason for this ideal time appears to be irrelevant for the existence of this effect. In summary, students whose ideal time was before their actual tutorial time arrived earlier. Those whose actual tutorial time was after their ideal time arrived late. This suggests that it might be fruitful to encourage students who are allocated a tutorial time well after a preferred ideal should be provided with additional tutorial reminders that may reduce lateness. Alternatively, it might be fruitful to test if students who are consistently provided with tutorial times a few hours before their ideal time (assuming there are no timetable clashes) consistently arrive early. Finally, future research could explore university data to examine the choice each student had when they originally selected a tutorial time. One might predict that those who had fewer choices would also consistently arrive late.

Whether the results reported here would hold true for different types of regular appointments remains untested however, in a final study I sought to establish if a more elaborate measure of personality could predict punctuality in a non-regular, one-off experimental appointment.

7.3 Big-Five personality factors do not predict punctuality when attending psychological experiments

Previous work from Back et al. (2006) observed a positive correlation between conscientiousness, agreeableness and improved punctuality. This is consistent with the idea that those who are high in conscientiousness are predisposed to be organised, while agreeableness assumes courtesy and altruistic tendencies. However, research has struggled to come to a definitive conclusion as to whether Big-Five factors really are a reliable metric when it comes to predicting punctuality. Large-scale studies from Dishon-Berkovits & Koslowsky (2002) attempted to describe the punctual employee and found that personality was of little importance. They concluded that punctuality is more intrinsically linked to age, gender and work situation.

The aim of the present study was to replicate the findings of Back and colleagues. I expected to find similar positive correlations between conscientiousness, agreeableness and arrival time. A focused attempt was also made to match their original method as closely as possible by recruiting a sample that contained a similar balance of men and women who were of a similar age. However, two key differences between their original study and this replication are worth noting.

The original study used a 60-item version of the NEO-FFI to assess personality. In the following replication however, I chose to use the 100-item International Personality Item Pool Item (IPIP). The reasoning behind this was two-fold. Firstly, the IPIP provides a more in-depth measure of the Big-Five using 100 items instead of 60. Each personality factor is therefore allocated 25 items instead of 12. Secondly, a freely available measure of personality like the IPIP will allow the results documented here to be replicated again with limited expense.

In addition, the order of presentation was reversed so that participants completed the personality measure after their arrival. Back et al. (2006) instructed participants to complete questionnaires at home before measuring their arrival time at a later date. In this replication however, all participants completed the personality questionnaire in one sitting. However, they remained unaware of the study's true purpose until after they had completed this measure.

In all other respects, the method and analysis outlined here are identical to that of Back et al. (2006).

Method

Measures and Procedure

This study was part of a larger project where participants were recruited to take part in an additional experimental study. Participants were appointed a time to come into the lab via email a week in advance of attending. They were reminded to be punctual so as to prevent a backlog of people arriving at the same time. All participants had attended the lab on at least one previous occasion. This ensured that they did not become lost before meeting with the experimenter.

Time of arrival was recorded as the time-lag in minutes between the appointed time of the experiment and the time of each participant's arrival (negative scores indicate early, positive scores indicate late arrival). Earliness was computed by setting all positive scores in time of arrival to zero and by multiplying the other scores by -1. In the same manner, lateness was computed by setting all negative scores in time of arrival to zero.

After arriving, each participant completed a 100-item version of the International Personality Item Pool for the measurement of the Big Five Broad Domains. The IPIP scales have good internal consistency and relate strongly to major dimensions of personality assessed by two leading industry questionnaires (NEO-FFI (used by Back et al (2006)) and the EPQ-R) (Gow, Whiteman, Pattie and Deary 2005). In the following analysis, I examined the influence of personality on all three behavioural indicators of punctuality: time of arrival, earliness, and lateness.

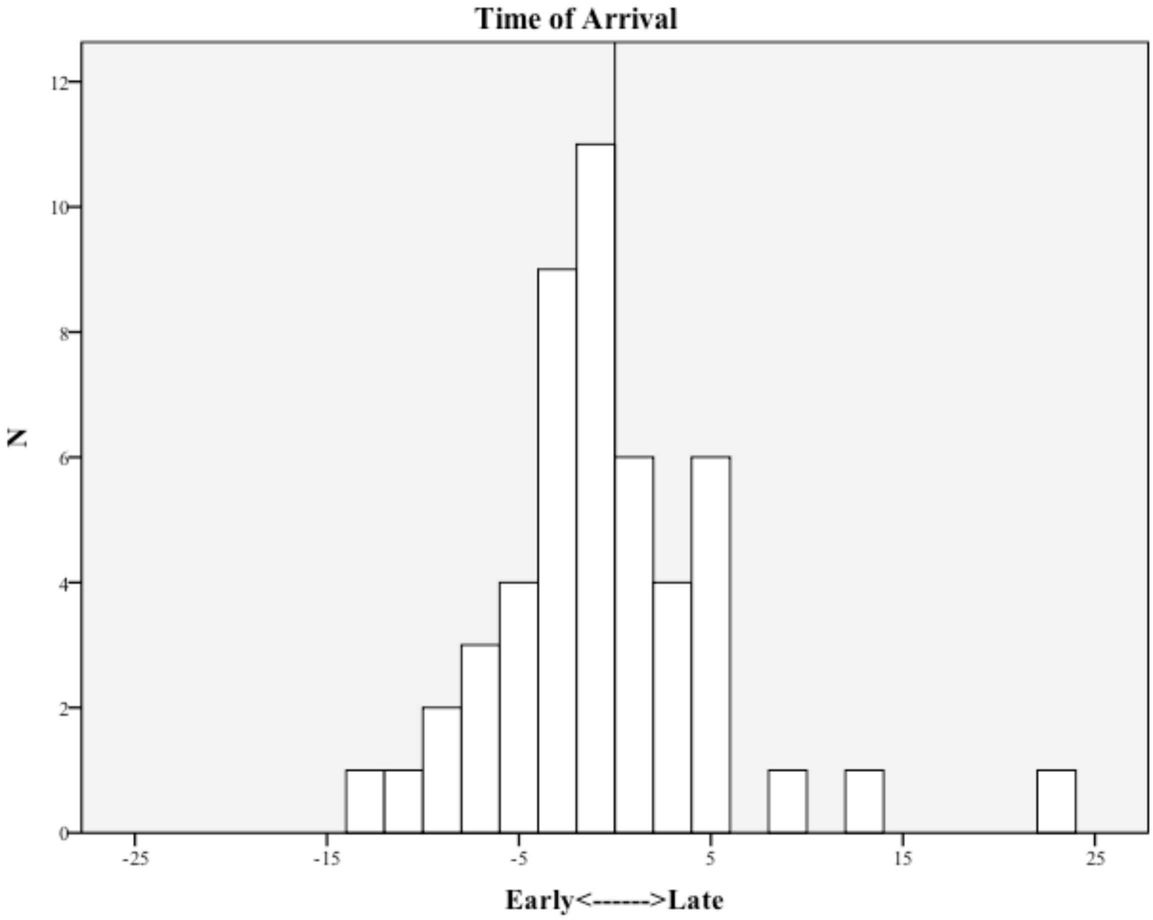
Participants

Fifty students (33 women, 17 men) studying at The University of Glasgow participated in a short study in exchange for research participation credit or monetary compensation. Their average age was 22.42 years (*SD* = 5.38).

Results

Arrival times ranged from 13 min too early to 23 min too late. On average, participants arrived 1.06 min before the appointed time (*SD* = 5.97). This difference from zero was not significant, [$t(49) = -1.26$, $p = .216$]. Thus, the sample contained a mix of individuals who were early and late. Additionally, a Kolmogorov-Smirnov test revealed that the scores for time of arrival were normally distributed [$Z = .116$, *ns*]. Thirty-one participants were early, three individuals were exactly on time, and 16 were late (figure 7.5).

Fig. 7.5. Distribution of participants time of arrival in minutes. Negative scores indicate an arrival before, positive scores indicate an arrival after the appointed time.



Correlations between personality and the three punctuality indicators can be seen in table 7.4. No significant associations were found between age and punctuality or gender and punctuality [$p > .7$].

Table. 7.4. Correlations among personality measures and punctuality variables.

	E	A	C	ES	Arrival Time	Earliness	Lateness
E					-.01	.08	-.07
A	.33*				-.05	.04	-.09
C	.15	.17			-.05	-.06	-.02
ES	.27	.05	.27		.02	-.14	.14
I/O	.23	.02	.07	.21	-.07	-.15	.02

Note. N = 50. E, Extraversion A, Agreeableness; C, Conscientiousness; ES, Emotional Stability; I, Intellect. * $p < .05$ (two-tailed).

Discussion

Like Back and colleagues, the present study investigated the influence of personality on a real-life criterion - punctual arrival at a previously arranged psychological experiment. Unlike Back et al. however, no significant correlations were observed between improved punctuality and higher levels of self-reported conscientiousness or agreeableness. In this attempted replication, other individual or situational factors were more important when it came to determining a participant's arrival time. While personality does appear to be different in those who believe they are regularly ‘on time’ (e.g. Conte & Jacobs, 2003; Koslowsky, Sagie, Krausz, & Singer 1997), it was not a reliable metric for consistently predicting punctuality in this instance. Punctuality remains a very difficult real-life metric to predict for a one-off appointment.

The type of appointment, the way it is arranged and motivation to attend are also likely to affect punctuality (Conte & Jacobs 2003). For example, the appointment in this study has less cost associated with a lack of punctuality. A meeting with a Professor is likely to have a higher personal cost associated with lateness. In future, punctuality as a behavioural criterion should be assessed in different social situations. The aggregation of several indicators of punctuality may or may not enhance its predictability when correlated with personality (Back et al. 2006). In addition, the original study itself suggests that one may need to consider specific associations between sub-facets of personality and different indicators of punctuality. Combining the strategies of specificity and aggregation may reveal additional correlations and improve the prediction of punctuality.

While the personality measure employed here differed to that used by Back et al., it has been shown to correlate with the NEO-FFI, particularly in relation to conscientiousness and agreeableness (Gow et al. 2005). Future work may need to consider other individual difference metrics. Time orientation for example, may be a more useful criterion as measured by The Zimbardo Time Perspective Inventory (ZTPI) (Zimbardo & Boyd 1999). Therefore, one hypothesis may predict that those who are more punctual will also report higher levels of future orientation. Unfortunately, this was not found to be predictive of punctuality in Study 7.2. Alternatively, Foust, Elicker & Levy (2006) developed a scale of lateness attitude and found this was associated with the number of times someone arrived late for work however, they only considered lateness as arriving more than 8 minutes after the appointed time.

In summary, given the clear inconsistencies between personality and punctual behaviour, a meta-analysis at this stage would help control for between-study variation. However, punctuality research also needs to start broadening its horizons and move beyond a limited set of markers that may (or may not) correlate with those who consistently or occasionally fail to arrive on time.

Chapter Summary

While Chapter 6 demonstrated correlations between personality and time of assessment, this experimental Chapter has failed to establish any strong links between a simple measure of time management (punctuality) and personality or time orientation. While personality does appear to be different in those who believe they are likely to be punctual, it is not a reliable metric when it comes to predicting punctuality. Despite people being able to quickly identify themselves as punctual individuals (or not), it remains a difficult real-life metric to predict when it comes to a regular or one-off appointment both of which carried no penalties for being late. This is a strength as well as a weakness. While these types of appointments are similar to typical meetings and events people attend everyday, the type of appointment and the way it is arranged however, is likely to have a large impact on punctuality (James & Fleck 1986). The results from this Chapter suggest that the difference between actual and ideal time for a regular appointment is a superior predictor in a small sample of tutorial students. Future studies should consider this across larger-data sets.

Levels of punctuality in the wider-context of decision making are likely to go beyond just turning up on time (Spiegelhalder et al. 2011). It may also be a secondary measure of how an individual is likely to allocate time for other important decisions they make on a daily basis. As yet, no established cognitive model exists to help explain how decisions surrounding punctuality are processed. These may rely on similar cognitive functions that are engaged during other decision making tasks whereby late individuals consistently underestimate how long it will take to reach their intended destination. A lack of punctuality may therefore have more to do with differences in optimism and an underestimation of time than personality type (Lovallo & Kahneman 2003). An improved understanding of these processes in relation to lateness may lead to simple guidelines on how people can improve their punctuality - something which has also yet to be tackled in the current literature. If punctuality is simply an issue of bad planning, then it can easily be improved. Forcing a participant to unpack the steps required to reach a destination may improve any duration estimate of their total time spent traveling to a destination. They would in turn arrive closer to the original arranged time (Buehler, Griffin & Ross 1994).

Several extensions of the present studies may improve the prediction of punctual behaviour. As discussed, additional studies could consider lower-order facets of personality instead of just the broad dimensions. Lower-order facets have often been shown to be better predictors of behavioural outcomes than composite measures (Paunonen & Ashton 2001). For example, specific facets of conscientiousness, like dependability or self-reported punctuality, could be more important than others (e.g., orderliness). Other experiments may choose to explore how punctuality may correlate with prospective memory tasks. For example, Einstein, McDaiel, Richardson, Guynn & Cunfer (1995) found a deficit in older participants who performed poorly in a time-based task where they were asked to press a specific key on the keyboard after a ten minute period. To conclude, the present Chapter examined personality determinants of punctuality. In doing so, real-life indicators of punctual behaviour were analysed in two separate social situations. In a final experimental Chapter, I consider the effects of a regular exposure to a time cue (watch wearing) on both personality and punctuality.

Chapter 8

The effects of watch wearing on punctuality and personality

Introduction

This final experimental Chapter set out to consider if a potential interaction exists between individual differences, punctuality and choosing to expose oneself to a regular, everyday time cue. Several experiential studies have demonstrated how time cues can influence evaluative judgements by prompting attributions. Typically, cues involve a cognitive experience (e.g. violation of expectations) that leads to a process of sense making relying on theories about thinking, or metacognition. The imperfect nature of duration estimation means that time distortion is a common experience that prompts sense making. Therefore, the feeling of time being distorted based on time cues, often prompts people to seek an explanation (Sackett, Meyvis, Nelson, Converse & Sackett 2012). Sackett et al. (2012) ran a series of experiments that involved the manipulation of an external time cue (a modified digital clock) to create the illusion that time was moving slightly faster or slower in comparison to real time. When people believed that time has passed unexpectedly quickly, they rated tasks as more engaging, noises as less irritating, and songs as more enjoyable.

Additional evidence highlights an array of individual differences that may also interact with visual time cues. For instance, people with greater capacities for attention and engagement (Block & Zakay 1997), novelty (Danckert & Allman 2005), impulsivity (Van den Broek, Bradshaw & Szadadi 1992), and present-orientated hedonistic values that enable *flow* (Zimbardo & Boyd 1999; see Csikszentmihalyi 1998) all percieve time as passing more quickly than others. There are also distinct situational influences on temporal experience, ranging from the speeding effects of body temperature, alcohol and caffeine (Terry, Doumas, Desai &

Wing 2009; Wearden & Penton-Voak 1995) to the slowing effects of social rejection and exhausted cognitive energy (Twenge, Catanese & Baumeister 2003). However, while these factors shed some light on the psychological influences that govern time perception, they do not take into account the individual differences that may interact with the choices people make when choosing to be closer or further away from the actual time itself.

The issue of personality was previously introduced in Chapters 6 and 7 and some aspects of have been tentatively explored in relation to time perception. For example (Rammsayer & Rammstedt 2000) found no relationship between timing performance and personality scores between men and women. However, no research has yet considered correlates between regular real-time cue exposure (watch wearing) and personality.

People are exposed to time cues on a daily basis. From mobile phones to computer screens, the actual time is an almost inescapable visual cue in western culture and in today's time-poor society, the need to keep tabs on the passing minutes appears to be greater than ever. Despite the growth of portable digital products - phones, laptops, MP3 players - with time displays, the number of watch owners has remained static (Hoffman 2009; Mintel 2010).

A complementary strand of research has concerned itself with behavioural and personality differences based on an individual's appearance beyond physically fixed attributes (i.e. facial and vocal attractiveness) (Hughes, Dispenza & Gallup 2004; Kleisner, Priplatova, Frost & Flegr 2013; Willis & Todorov 2006). For example, tattoos have been associated with individual's who rate themselves as less conscientious and agreeable, but more extraverted (Swami 2012; Tate & Shelton 2008; Wohlrab, Stahl, Rammsayer & Kappeler 2007). Other less permanent features, such as the wearing of glasses, have been shown to correlate with lower levels of extraversion, and have been associated with intellectualism and goodness (Borkenau 1991; Hellstrom & Tekle 2006). Correlates have also been observed between the type of shoes and clothing an individual wears on a semi-regular basis with mixed results (Aaker 1997; Gillath, Bahns, Ge & Crandall 2012).

Although such studies of personality and individual differences appear to be flourishing, previous research has an over-reliance on college and university students, who may not be representative of the wider population, particularly in terms of their socio-demographics. To overcome this limitation and explore the effect of watch wearing in some depth, this final experimental Chapter sought to investigate whether there are differences in personality and punctuality between watch and non-watch wearers in small and large samples.

Based on the premise that conscientiousness is associated with time-keeping (Back, Schmukle & Egloff 2006) and organisation (Boyd & Zimbardo 2005), I predicted that watch wearers would identify themselves as being more conscientious in comparison to non-watch wearing counterparts. I also predicted that watch wearers would be more punctual than non-watch wearers. Testing these first two predictions was relatively straightforward using standard measures in a variety of settings. However, a final experiment sought to test the direction of the relationship, i.e. can wearing a watch change an individual's personality or is choosing to buy a watch simply motivated by a stronger desire to know the time and be more punctual? This randomised control experiment proved to be more challenging.

Study 8.1 Personality differences amongst watch wearers

The studies reported as part of Study 8.1 all take a similar approach where participants were asked to complete a short personality measure. They were also required to note whether they regularly wore a watch.

Study 8.1.1 Using the TIPI in an opportunistic sample

Method

Design and Stimuli

The Ten-Item Personality Inventory (TIPI) was developed by Golsing, Rentfrow and Swann (2003) to meet the need for a very brief measure of the Big-Five personality dimensions (extraversion, agreeableness, conscientiousness, emotional stability and openness to experience). The TIPI has been shown to reach adequate levels of (a) convergence with widely used Big-Five measure in self, observer and peer reports, (b) test-retest reliability, (c) patterns of predicted external correlates, and (d) convergence between self and observer ratings.

Participants

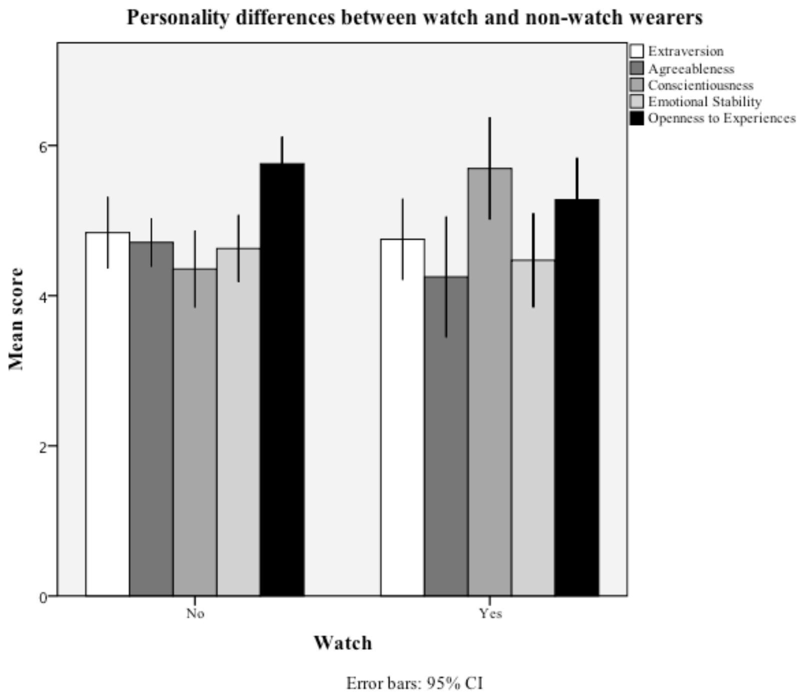
An opportunistic sample of 18 watch and 31 non-watch wearers were approached while visiting a psychology stand at Glasgow Science Centre.

Procedure

Individuals approaching a psychology stand were asked if they wished to take part in a short personality study. If verbal consent was obtained, participants were asked to fill out the TIPI. They were then asked whether or not they regularly wore a wristwatch. Participants were then thanked for their time after being debriefed as to the true nature of the study.

Results

Fig. 8.1. Mean (and 95% confidence intervals) from TIPI personality scores.



An independent sample t-test revealed a significant difference in mean conscientiousness scores between watch (M = 5.69, SD = 1.37) and non-watch wearers (M = 4.35, SD = 1.39) [$t(47) = -3.26$, $p = 0.002$] (figure 8.1).

Additional independent sample t-tests showed no significant differences between watch and non-watch wearers in mean Extraversion [$t(47) = 0.245$, $p = 0.808$], Agreeableness [$t(47) = 1.29$, $p = 0.202$], Emotional Stability [$t(47) = 0.428$, $p = 0.670$] or Openness to Experiences [$t(47) = 1.56$, $p = 0.125$] scores.

Dicsussion

As predicted, watch wearers reported higher levels of conscientiousness than non-watch wearers. I next attempted to replicate this finding in a lab based student sample and again as part of a large online data collection exercise (see Appendix A).

Study 8.1.2 Replication of 8.1.1 in a student sample

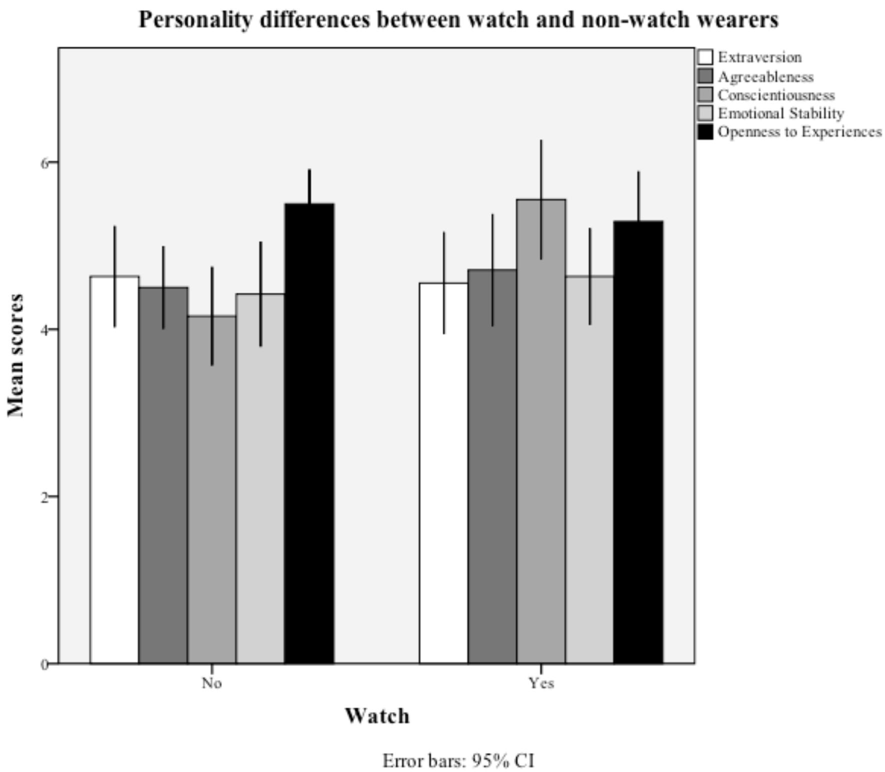
8.1.1 was replicated using an additional 19 watch wearers and 19 non-watch wearers.

Participants

Participants were recruited from students studying psychology at the University of Glasgow (73.7% female). Their ages ranged from 17-24.

<u>Results</u>

Fig. 8.2. Showing mean (and 95% confidence intervals) from TIPI personality scores.



An independent sample t-test revealed a significant difference in mean conscientiousness scores between watch (M = 5.55, SD = 1.48) and non-watch wearers (M = 4.15, SD = 1.22) [$t(36) = 3.16$, $p = 0.003$] (figure 8.2).

Additional independent sample t-tests showed no significant differences between watch and non-watch wearers in mean Extraversion [$t(36) = -0.193$, $p = 0.848$], Agreeableness [$t(36) = 0.531$, $p = 0.598$], Emotional Stability [$t(36) = 0.518$, $p = 0.608$] or Openness to Experiences [$t(36) = -0.603$, $p = 0.550$] scores.

Study 8.1.3 Replication of 8.1.1 in a large online sample

Method

Appendix A documents the complete procedure and method. In addition to completing the TIPI online, participants were also asked the following:

Do you regularly wear a watch?

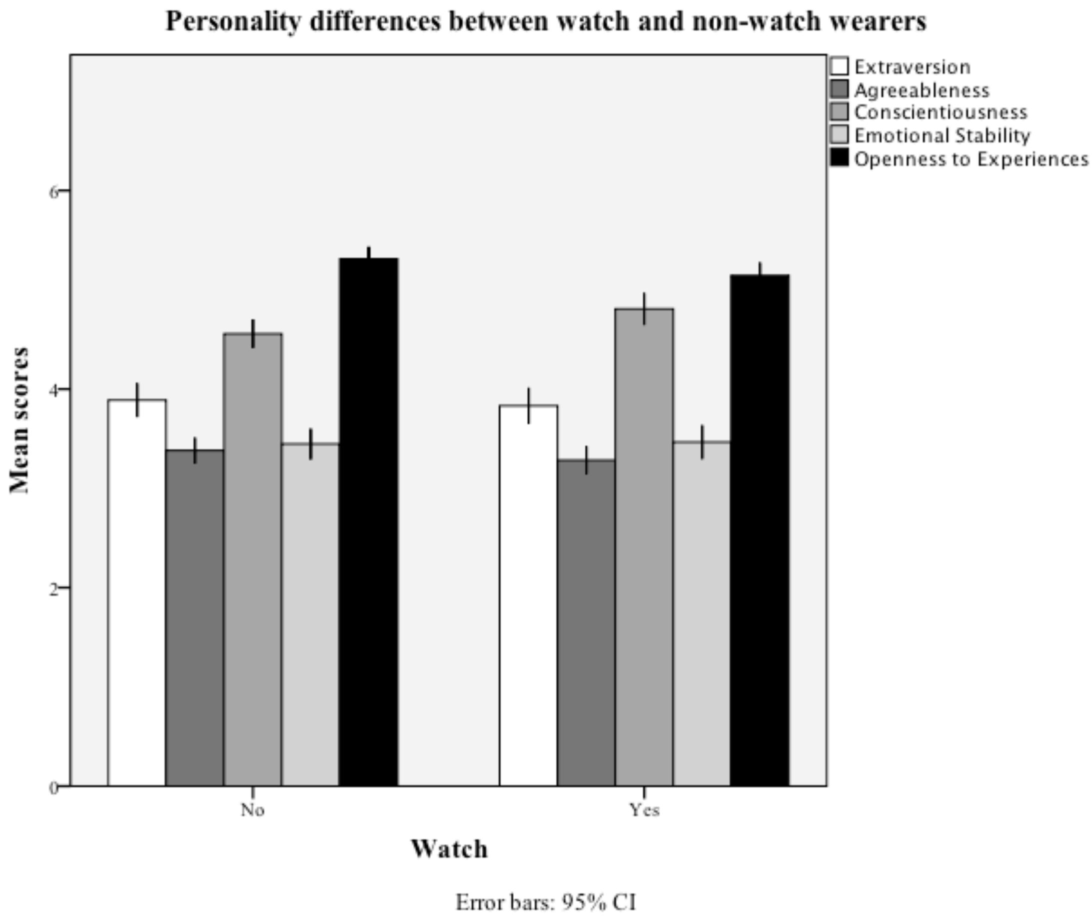
If you do wear a watch is it analogue or digital?

Participants

Participants were recruited via numerous email shots and twitter advertisements. In total 636 participants took part (48.57% female). 45.6% identified themselves as being regular watch wearers. 64.15% were located in the UK, with the rest based in Europe, the United States and Canada.

Results

Fig. 8.3. Showing mean (and 95% confidence intervals) from TIPI personality scores.



An independent sample t-test revealed significant differences in mean conscientiousness scores between watch (M = 4.81, SD = 1.39) and non-watch wearers (M = 4.56, SD = 1.37) [$t(634)$ = -2.27, p = 0.023] (figure 8.3).

Additional independent sample t-tests showed no significant differences between watch and non-watch wearers in mean Extraversion [$t(634) = 0.442$, $p = 0.659$], Agreeableness [$t(634) = 0.998$, $p = 0.319$], Emotional Stability [$t(634) = -0.161$, $p = 0.872$] scores. Despite watch wearers showing an apparent reduction in Openness to Experiences, this narrowly failed to reach significance [$t(634) = 1.862$, $p = 0.063$].

Discussion

Again, these are in line with my previous results. One limitation might be that participants may own a mobile phone, but not a traditional watch. However, 97.48% of online respondents also owned a mobile phone so this is unlikely to be a factor. While the effect here is reduced, the short nature of the personality measure chosen suggests that a larger effect would be observed if a more in-depth measure was used. In addition to other socio-demographic factors, the type of watch worn may also be important and a second analysis was conducted to compare personality types between those who own a digital or analogue model.

Study 8.1.4 Does the type of watch worn reveal additional personality differences?

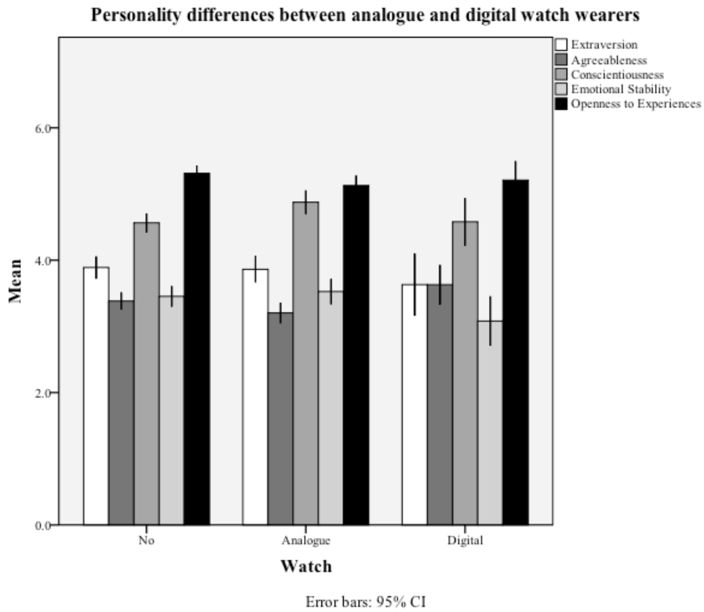
As part of Study 8.1.3, participants who identified themselves as regular watch wearers were also asked what type of watch they wore - digital or analogue. This analysis was purely exploratory however, any differences observed in conscientiousness between the two models may suggest that a specific type of watch may be driving the effect outlined previously.

Participants

Of the 371 participants who identified themselves as watch wearers, 302 wore an analogue and 69 a digital model.

Results

Fig. 8.4. Showing mean differences (and 95% confidence intervals) between non-watch wearers and those who wear a digital or analogue model.



An independent sample t-test revealed significant differences in mean Emotional Stability scores between analogue ($M = 3.53$, $SD = 1.52$) and digital watch wearers ($M = 3.04$, $SD = 1.43$) [$t(369) = 2.42$, $p = 0.016$] (figure 8.4).

Additional independent sample t-tests showed no significant differences between analogue and digital wearers in mean Extraversion [$t(369) = 1.52$, $p = 0.130$], Agreeableness [$t(369) = -1.88$, $p = 0.062$], Conscientiousness [$t(369) = 0.795$, $p = 0.427$] or Openness to Experiences [$t(369) = 0.166$, $p = 0.868$] scores.

Discussion

This series of exploratory studies lend strong support to the notion that people who choose to wear a watch also tend to rate themselves as more conscientious. This effect appears to exist irrespective of the type of watch worn or if a mobile phone is also present.

Conscientiousness has also been shown to correlate with improved punctuality* (Back, Schmukle & Egloff 2006) and so my next study sought to investigate if this everyday criterion is also related to watch wearing (see Chapter 6 for a short review on punctuality)

*Note: Studies in Chapter 7 failed to replicate this finding in actual punctual behaviour. However, higher levels of conscientiousness were observed in participants who felt the were '*regularly on time for appointments*'

8.2 Are watch wearers more punctual?

In an additional study, I examined whether those wearing a watch would be more punctual when arriving at a psychological experiment.

Method

Design and Stimuli

Participants arriving at the department of psychology for an unrelated experiment had their exact time of arrival recorded by the experimenter. It was also noted as to whether they were a regular watch wearer. A regular watch wearer was defined as someone who engages in wearing a watch regularly for at least a year.

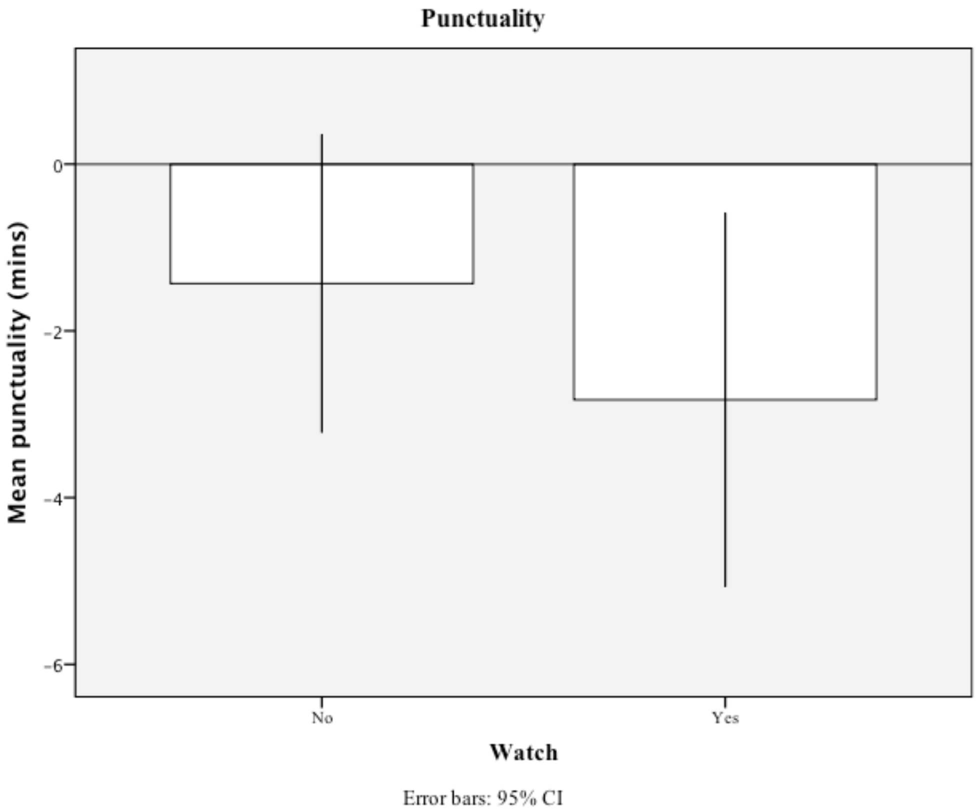
Participants

72 participants (38% male) who arrived to complete various experiments in the School of Psychology took part in this study. Their ages ranged from 17 to 34. All of these participants had previously visited the department on at least one previous occasion.

Results

Mean punctuality scores (minutes late or early) were calculated for watch and non-watch wearers. Scores which exceeded an early or late arrival time of +-15 minutes were removed from the analysis (N =5) to ensure that data was normally distributed. A total of 23 watch-wearers' and 44 non-watch wearers' arrival times were analysed (figure 8.5).

Fig. 8.5 Punctuality (and 95% confidence intervals) between watch and non-watch wearers.



While the general trend appears to support my original hypothesis, an independent sample t-test failed to show reliable difference in punctuality between watch wearing [M = -2.83, SD = 5.18] and non-watch wearing [M = -1.43 SD = 5.88] groups [$t(65) = .959$, $p = .341$].

Discussion

While suggestive, the results reported above failed to reach significance. On average however, watch wearers do appear to be more punctual. This study perhaps lacked statistical power. The large variability in arrival times makes it difficult to draw conclusions at this stage. An additional study in the near future may wish to recruit more participants.

In a final experimental study, I sought to determine the direction of the relationship between watch wearing and conscientiousness. Are those who choose to wear a watch already more conscientious, or can wearing a watch actually increase an individual's self-reported conscientiousness?

8.3 Assessing the direction of the relationship - can wearing a watch change an individual's personality or behaviour

Despite the growth of portable digital products - phones, laptops and MP3 players with time displays, the number of watch owners has remained static. Buying a watch may not simply be driven by a desire to know the time. In several comparisons, I have demonstrated that watch wearers show a significant increase in conscientiousness over their non-watch wearing counterparts.

In a final experiment, I set out to determine the direction of this relationship by recruiting individuals who had never worn a watch in their life. At the outset, participant's personality, and punctuality were re-assessed. They were then re-tested 4-weeks later. During this period, sixteen participants were required to wear a tamper-proof watch. A second group of 16 were instructed to wear a tamper-proof black wrist band in a placebo condition. A final group served as controls and received no treatment.

Method

Design

Participants' personality was assessed using the 100 item International Personality Item Pool (IPIP). They were then randomly allocated to a control, placebo or experimental condition. After 4 weeks, they returned to the lab and their personality was reassessed. Punctuality was also recorded on arrival at the first and second appointment.

Control: Participants were simply asked to return in one month with no intervention.

Placebo: Participants were provided with a tamper-proof black security wristband. Once sealed, this could only be removed by cutting the strap with a sharp knife (figure 8.6).

Experimental: Participants were provided with a Casio wristwatch (figure 8.7). A tamper proof seal was fitted around the buckle (figure 8.8).

Measures

Punctuality: This was measured from the time participants arrived at the lab. The Experimenter was already waiting and logged their time (+ or -) away from the arranged time of arrival.

IPIP personality pool (Goldberg 2006): A 100-item Big-5 questionnaire was derived from the International Personality Item Pool (IPIP, Goldberg, Johnson, Eber, Hogan, Ashton, Cloninger, & Gough, 2006). Used in a range of previous studies, the IPIP Big-5 measure has been shown to have good construct validity (Buchanan, Johnson, & Goldberg 2005) and to correlate highly with corresponding NEO-PI-R scores (International Personality Item Pool, 2011). The 100-item measure comprises 5 sets of 20 items measuring extraversion, neuroticism, conscientiousness, openness, and agreeableness. For each item, participants rate on a 5-point scale the extent to which the statement described the person whom they were rating. For example, the item “I am the life of the party” measures extraversion, whereas the item “I get stressed out easily” measures neuroticism.

Finally, participants provided with a watch were asked three additional questions on their return to the lab:

'*Would you like to keep the watch and continue wearing it on a regular basis?*'

'*How useful did you find wearing a watch on a scale of 1-10 with 10 being very useful*'

'*How many times a day did you check the watch to check the current time*'

Participants

Forty-eight participants took part, (68.8% female). Their ages ranged from 18 to 49. Participants were paid a total of £20 for their participation. £5 for the first testing session and a further £15 on their return 4 weeks later.

Procedure

Participants were welcomed into the lab where formal consent was obtained. After ensuring that they had not worn a watch in the last two years, they were asked to complete the pen and paper measures outlined above. They were then randomly allocated to either a control, placebo or experimental group. Participants arranged a convenient time to meet the Experimenter in exactly 4 weeks time and were re-tested on their return. They were then de-briefed.

Fig. 8.6. Placebo wrist band with security seal.

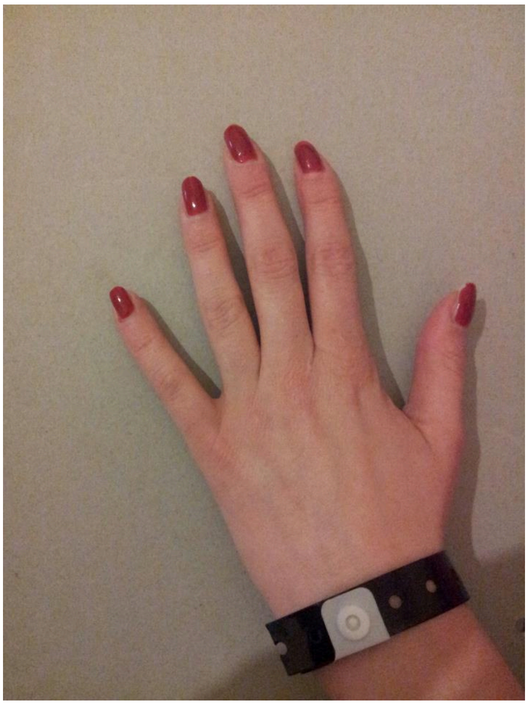


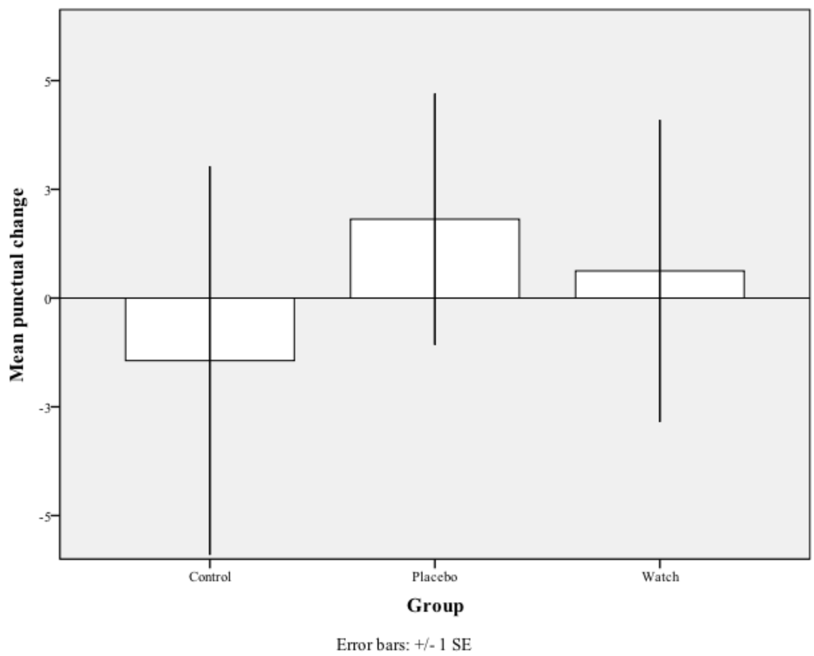
Fig. 8.7. Watch provided to participants allocated to the experimental group (Casio F-91W).

Fig. 8.8. Tamper proof seal attached to watch.

Results

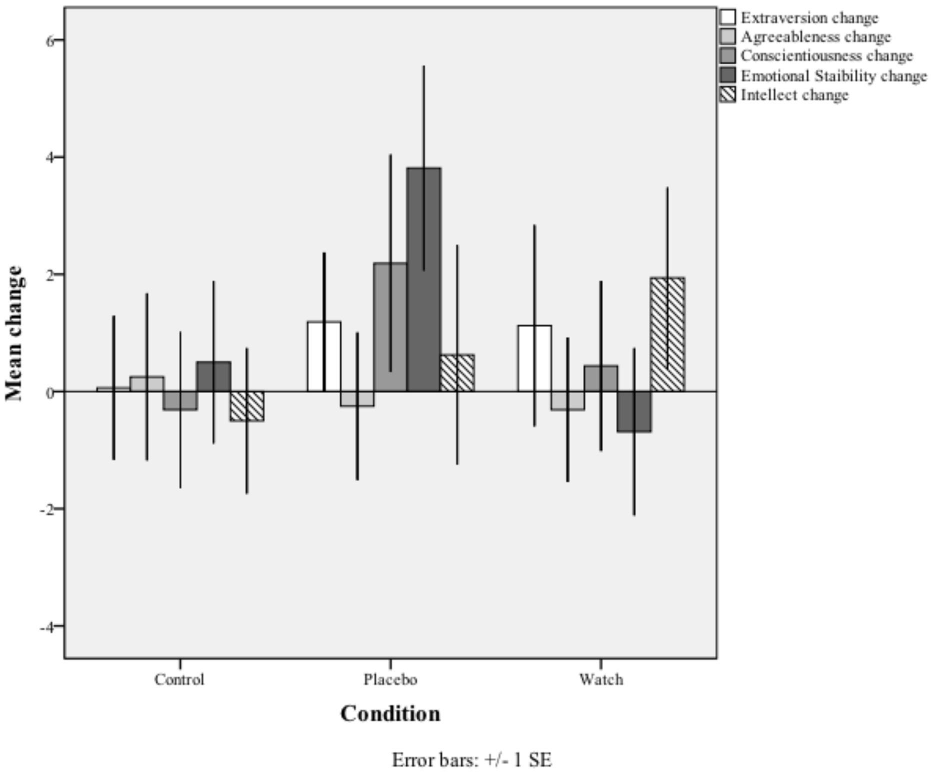
Changes between each participant's personality and punctuality were calculated. Mean changes were computed for each condition (figures 8.9 and 8.10).

Fig. 8.9. Mean change in punctuality (and standard deviations) before and after treatment.



A one-way between subjects ANOVA revealed no significant effect of group on punctuality change [$F(1,45) = .20$, $p = .82$].

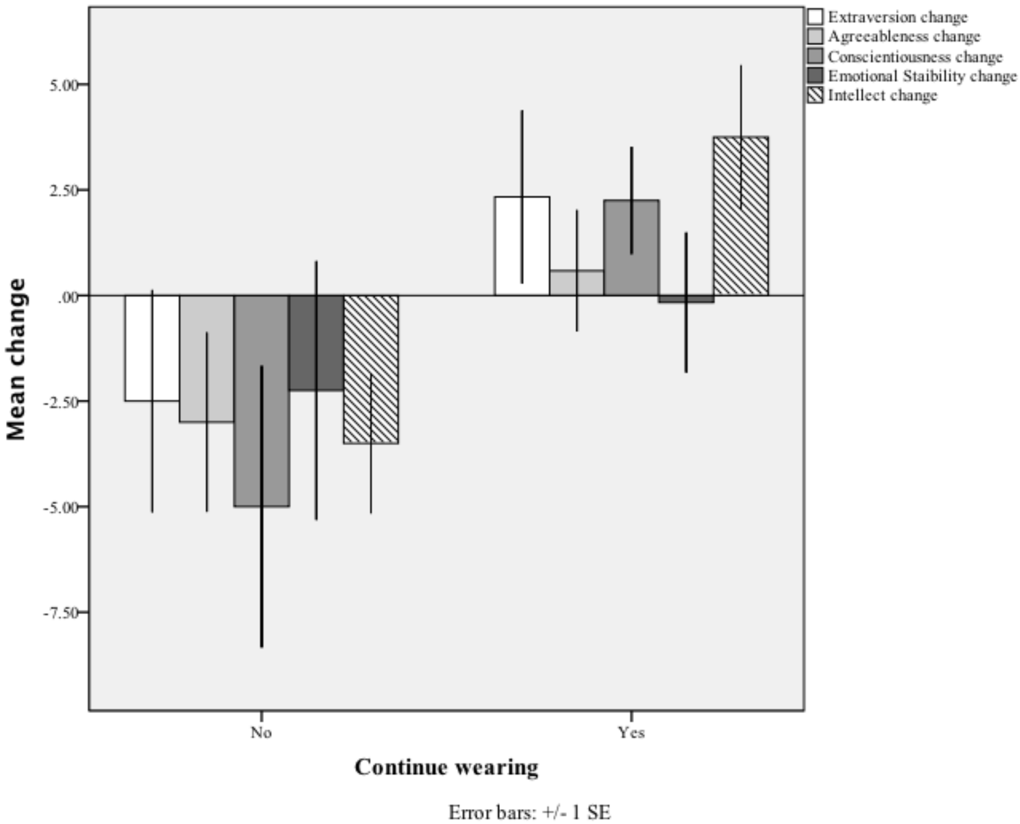
Fig. 8.10. Mean changes in self-reported personality dimensions (and standard deviations) before and after treatment.



*A series of between subject one-way ANOVAs failed to reveal any effect of treatment on changes in extraversion [$F(1,45) = .20$, $p = .81$], agreeableness [$F(1,45) = .06$, $p = .95$], conscientiousness [$F(1,45) = .68$, $p = .51$], emotional stability [$F(1,45) = 2.3$, $p = .11$] or intellect [$F(1,45) = .60$, $p = .55$].

*There remains considerable debate surrounding how to analyse data from a pretest-posttest design (Huck & McLean 1975). However, having also conducted a series of mixed ANOVAs using before and after scores as the within-subjects factor, these also failed to reach significance.

Fig. 8.11. Changes in self-reported personality based on whether an individual opted to continue wearing a watch after study completion.



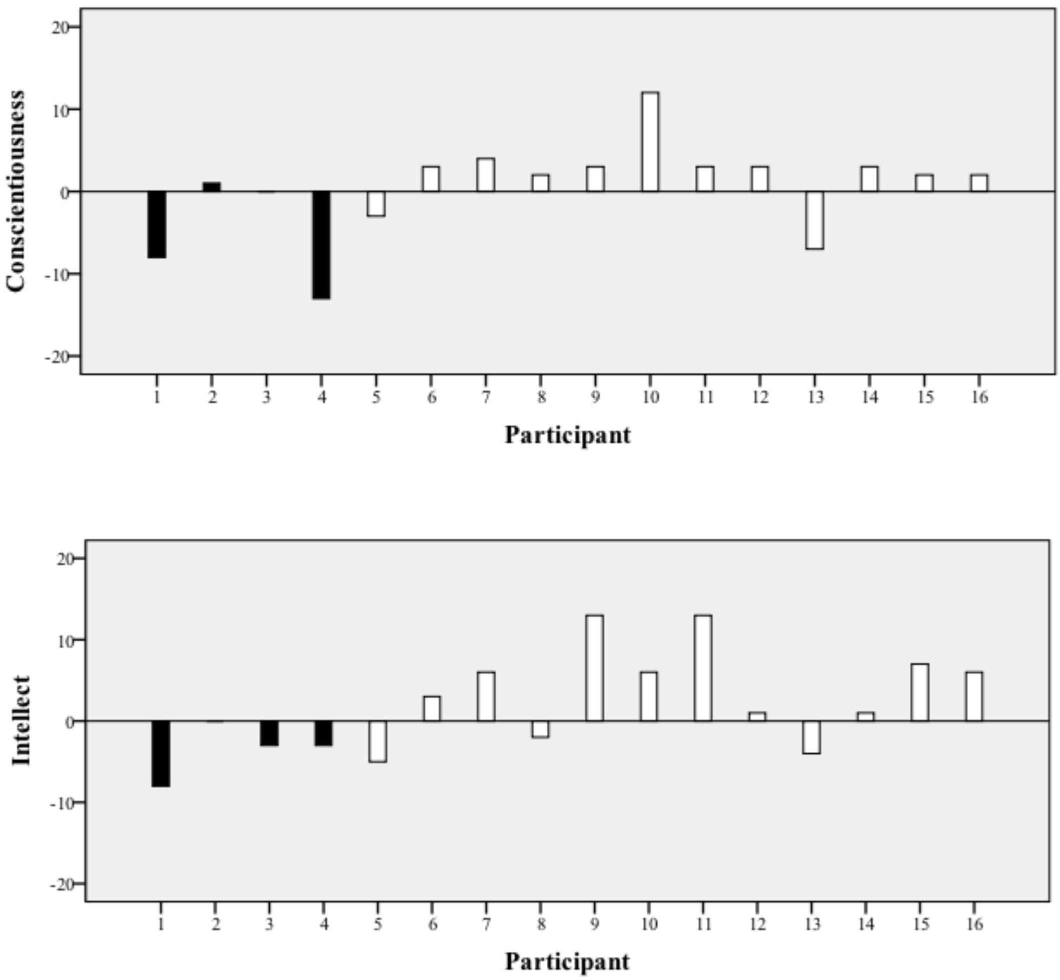
Participants in the watch condition (N=16) were split into those who did (N=12) or did not want (N=4) to continue wearing a watch post-experiment (figure 8.11).

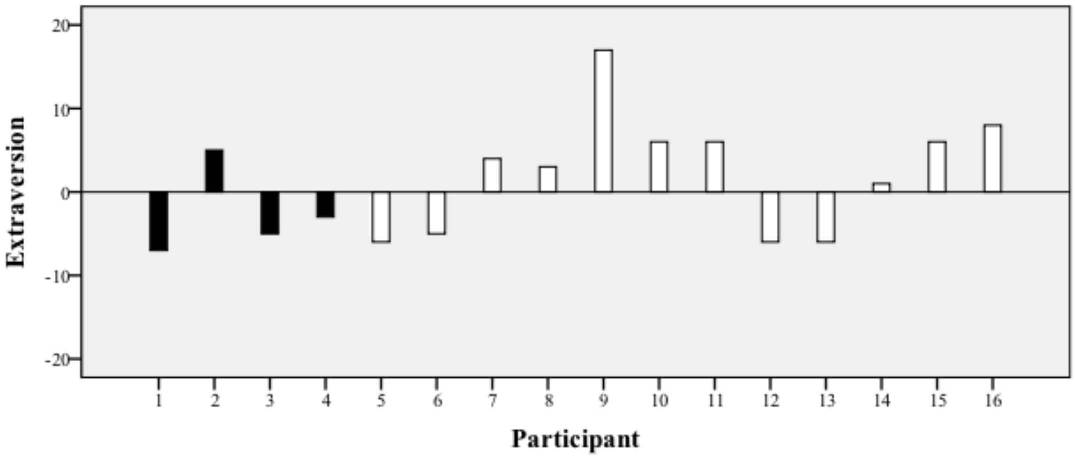
A series of independent sample t-tests revealed a significant increase in Conscientiousness between yes (*M =2.25 SD* = 4.41) and no (*M* = *-5 SD* = 6.68) groups [$t(14) = -2.52$, $p = .025$]. A significant difference was also observed as participants who answered yes (*M* = *3.75 SD* = 6.68) showed a significant increase in Intellect score over those who answered no (*M* = *-3.5 SD* = 3.32), [$t(14) = -2.31$, $p = .037$]. No significant differences were observed between

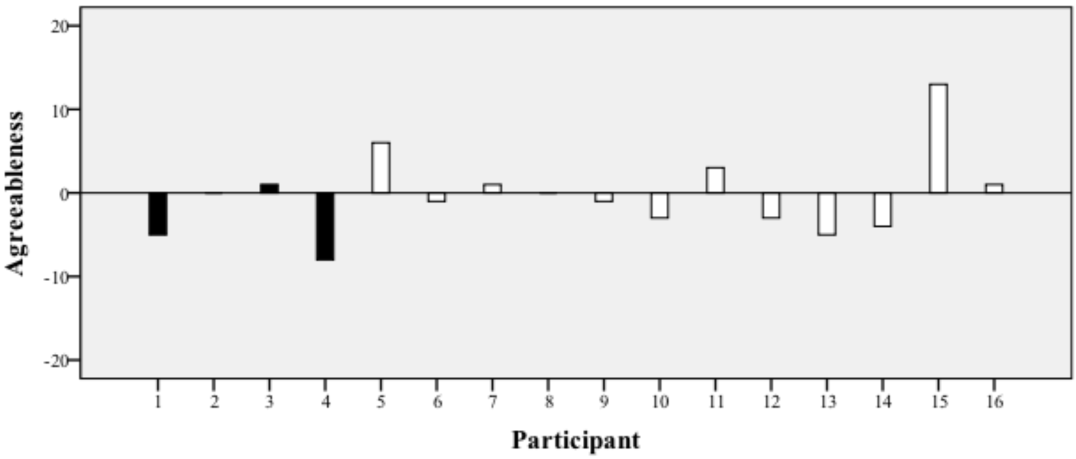
Extraversion [$t(14) = -1.24$, $p = .24$], Agreeableness [$t(14) = -1.28$, $p = .22$] or Emotional Stability [$t(14) = -.62$, $p = .55$].

Considering individual changes in the watch wearing condition, change varied considerably between individuals. For example, 11 out of 16 individuals in the experimental group showed an increase in conscientiousness (figure 8.12).

Fig. 8.12. Changes in personality at an individual level showing those in white who wanted to continue wearing a watch (those in black did not).




Extraversion
20
10
0
-10
-20
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Participant


Agreeableness
20
10
0
-10
-20
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Participant

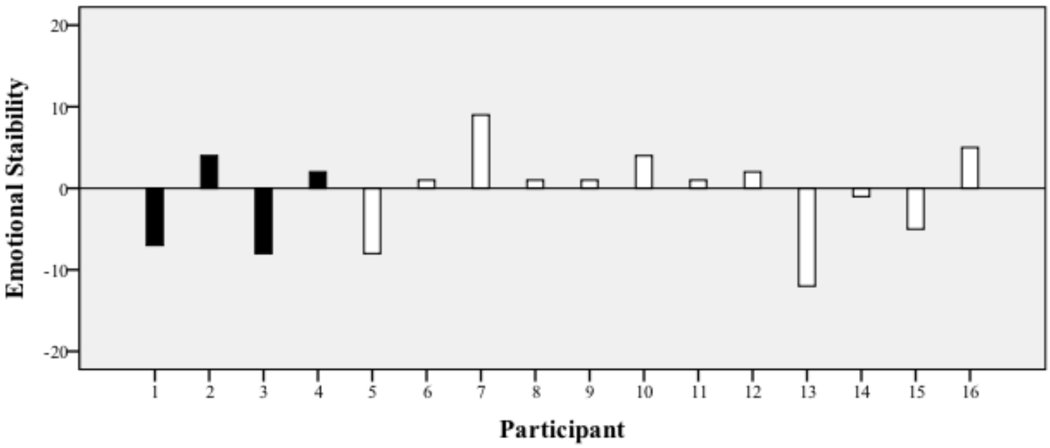
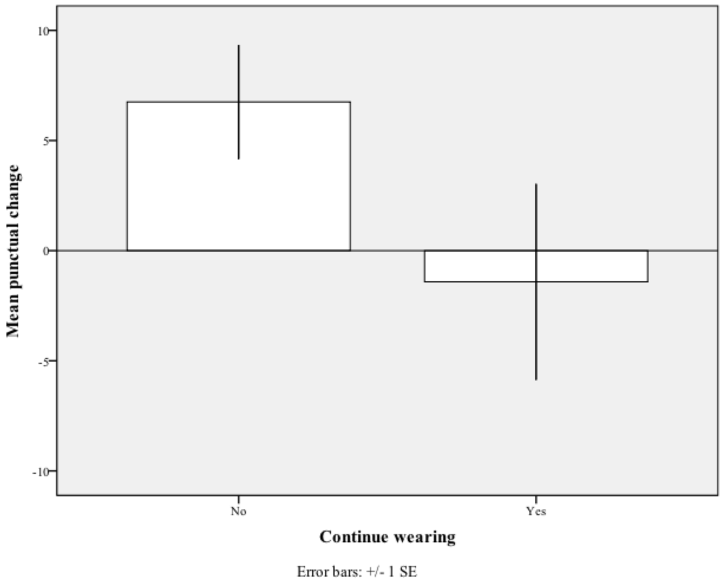

Emotional Staibility
20
10
0
-10
-20
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Participant

Fig. 8.13. Mean change in punctuality (and standard deviations) based on whether an individual opted to continue wearing a watch after completion of the study.



An independent sample t-test revealed no significant difference in punctuality between those who wanted to continue wearing a watch (*M* = -1.42, *SD* = 15.41) and those who no longer wished to do so (*M* = 6.75, *SD* = 5.12), [$t(14) = 1.02$, $p = .33$] (figure 8.13).

Discussion

For most individuals, wearing a watch appears to increase levels of self-reported conscientiousness and intellect. The only exceptions were those few individuals who actively disliked wearing the watch. For this minority of watch wearers, the positive effect on personality scores appears to be reversed. This reversal may be related to cognitive dissonance (Festinger 1949). Much as smokers tend to avoid reminders that smoking is bad for them, people who are not punctual may come to dislike a constant reminder of their poor punctuality (Blanton, Cooper, Skurnik & Aronson 2009). An interesting control study would be to explore what happens if participants were given something else that has nothing to do with timekeeping - e.g. a necklace. Future studies will also need to consider exactly what information a watch provides that may cause such a change in personality. The Casio watches used as part of this experiment for example, displayed the day and date in addition to the time. This is particularly important as personality differences have already been observed between individuals who wear a digital or analogue watch.

However, it may also be the case that individuals who actively seek out a watch already consider themselves to be more conscientiousness. While the wearing of a watch may be related to status and not a desire to know the time, this does not chime with the higher levels of conscientiousness and improved punctual behaviour observed across three separate samples. Like other research on first impressions, a watch may simply act as a social marker for an individual who sees themselves as more conscientious. Future research may wish to explore what other conscientious behaviours may also correlate with watch wearing or watch treatment as punctuality differences reported here suggest that the differences may go beyond self-reported personality. In addition, and given the differences observed in personality between watch types (analogue or digital), other experiments could examine the effect that watch wearing might have on first impressions and consider self-other ratings. I would predict that the presence of a watch would serve to help improve an individual's first impression in a specific social situation for example, at a job interview (Chapplin, Phillips, Brown, Clanton & Stein 2000; Dougherty, Turban & Callender 1994). Finally, watch wearing may also act as a marker for other individual difference metrics or predict performance on time estimation or production tasks. This would also be a logical avenue for future research particularly in terms of how the presence or absence of a time cue might relate to episodic future thinking or temporal discounting (Atance & O'Neill 2001; Jarvstad, Rushton, Warren, & Hahn 2012).

These results also raise additional questions surrounding the consistency and susceptibility of personality to change. The treatments in this study could be described as relatively small interventions and while the control group's personality remained very static, changes were observed in both the placebo and watch conditions. Exploring the watch group further, it may be the case that an individual has to possess specific qualities in order to benefit from such an intervention. While my sample size was too small to examine this issue in any depth, personality is typically founded on the notion that it remains fairly static over time. However, like the results reported in Chapter 5, personality may be more vulnerable to change over time than initially thought. This is also worthy of further investigation.

Chapter Summary

In summary, this final experimental Chapter suggests that there are small-to-moderate variations in select individual difference traits between individuals who do or do not wear a watch. Watch type may also play a role in moderating this effect. The possibility remains that there are particular constellations of personalities and individual differences that make it more likely that an individual will choose to wear a watch and expose themselves on a regular basis to other time management tools for example, email and reminder programs on their desktop computer (Sackett et al 2012).

Given the number of clocks that surround people on a daily basis, there is arguably no functional use for a watch in the 21st century and future qualitative research may want to consider the explicit reasons for watch wearing. On the other hand, people young and old continue to adorn their wrists with a timepiece. More recently, tech giant Apple has recently filed a patent with a view to developing a watch-like device that will link wirelessly with an iPhone and so it would appear that the wristwatch will continue to remain an important tool for the foreseeable future.

Choosing to wear a watch is related to increased levels of conscientiousness, which is likely to play a role in making the decision to regularly wear a watch in the first instance. This decision may be motivated by desire to know the time, become more organised and in turn become more conscientious. A sensible future direction for this research would be to explore the effect that watch wearing can have on both first impressions and also consider the correlations between self and other's perceptions. For example, conscientiousness alone is made up of many sub-facets of personality and one of these may play a more important role in watch wearing than others. How such a time cue could influence other evaluative judgements by prompting attributions remains unclear, but given that personality is predictive of many other behaviours, a watch is likely to act as a social marker for numerous other cognitive facets that go beyond time. It would be fruitful to examine how regular time cue exposure may affect other cognitive dimensions for example, time perception or future discounting.

From a theoretical perspective, this Chapter serves as a final example as to how the study of time can go beyond traditional research boundaries of the psychophysical and instead consider how an individual's choice or exposure to a time cue correlates with other individual difference metrics. From an applied perspective, these results may also be of particular interest to watch manufacturers who wish to selectively target individual future marketing campaigns.

Chapter 9
General Discussion and Future Directions

The introduction to this thesis argued that aspects of psychological time that go beyond minutes and seconds are often overlooked in the literature, but remain important. Specifically, I suggested that our knowledge of time would benefit by building on previous research that has considered 'higher level' cognitive functions, which go beyond more basic time perception processes. Historically, research into time perception has examined low level cognitive functions using short durations that have little application outside the laboratory (e.g. Tse et al. 2004). The issue has been complicated further by a lack of theoretical consistency and a failure to integrate time with other cognitive mechanisms.

However, while a considerable number of studies have explored time with regards to 'mental time travel' and chronesthesia e.g. (Tulving 2002), the mechanisms are neither fully understood and remains an abstract concept from an everyday perspective (e.g. Miles, Nind & Macrae 2010). Therefore, this thesis has offered novel approaches to psychological time as I have explored how social cycles and everyday timing constructs directly relate to social and occupational organisation. This builds on recent work by Zauberman, Kim, Malkoc and Bettman (2009) by showing that errors in everyday time may not be consistent with psychophysical principles.

Numerous laboratory experiments have integrated with large scale secondary data analysis as psychological time has been considered across socially derived cycles (Chapters 2, 3, 4, 5 and 6), punctuality (Chapter 7) and watch wearing (Chapter 8).

Chapters 2 and 3 examined the weekly cycle, which is a far more recent timing construct around which to organise behaviour. I first confirmed that weekday confusion is an almost universal timing error (Study 2.1). Confusions over the day of the week are surprisingly common and in an internet-based study (Study 2.2), I found that some weekdays are less confusable than others. In particular, Monday and Friday appear to be relatively distinct, compared with the days in between. Confusions were normally distributed around the actual day, such that the preceding day and the following day exerted the strongest influence. In Chapter 3, I investigated the mental representation of different weekdays (Study 3.1). Monday and Friday gave rise to significantly more semantic associations than the other weekdays, implying richer elaboration in memory. Moreover, semantic analysis of these associations revealed that they were affectively negative for Monday, positive for Friday, and neutral for the intervening days. Consistent with differential representation strengths, reaction times to name the current day in a surprise single-trial challenge were half as long for Monday and Friday as for the other days (Studies 3.3 & 3.4). The strength and valence of these representations predicted the observed pattern of confusability. I also found similar emotional associations after mining and analysing data from a popular microblogging website (Study 3.5).

Chapter 4 then explored the effect of weekday on missed appointments. In line with the emotional associations outlined in Chapter 3, non-attendance peaked on a Monday and declined monotonically towards Friday (Studies 4.1 & 4.2). From a policy perspective, I was able to make some simple recommendations as to how appointments could be allocated more efficiently across the week based on a patient's age. Chapter 5 explored this data in more depth and demonstrated how non-attendance is affected by bank holidays, transitions into and out of daylight savings time and appointments made for Friday the 13th (Studies 5.1, 5.2 & 5.3). Taken together, the results from Chapters 4 and 5 provide robust evidence for the existence of a weekday effect that flows in a consistent direction. However, understanding why this effect occurs in the first instance requires additional research.

Chapter 6 explored another everyday time cycle - the 9-5 working day and I considered how mood and personality fluctuates across the day in a variety of settings. (Studies 6.1-6.4). Self-reported levels of extraversion were found to increase towards the end of the working day, which was mirrored in patterns of self-reported prospective and retrospective happiness. These results are particularly topical given the UK Government's current directive to measure the nation's well-being (Study 6.5). More importantly, the issues raised in this Chapter challenge the traditional view that personality is stable across socially derived constructs of time. Future research could consider a measure of extraversion that does not rely on self-report alone for example, vocal amplitude or measuring the number of social interactions across the working day.

Chapter 7 then considered the relationship between personality and punctuality when attending a regular or irregular appointment with mixed results. While individuals who believe themselves to be on time show significant variations in personality (Study 7.1), these differences were not a reliable predictor for punctual behaviour in a variety of appointments (Studies 7.2 & 7.3). However, a participant's ideal time for a regular appointment may be a better predictor when it comes to determining future punctual behaviour. Punctuality as an everyday timing behaviour is understudied and the results documented here fail to replicate those of Back et al. (2006), suggesting that other factors play a stronger role when determining punctual or related self-organisational behaviours.

Finally, Chapter 8 considered an everyday time cue - the wristwatch, which consistently acted as a marker for higher levels of conscientiousness (Studies 8.1.1-8.1.3). Study 8.2 also suggested that watch wearers may also show improved levels of punctuality, but this failed to reach significance. A final randomised control trial revealed that wearing a watch may increase levels of conscientiousness in some individuals, possibly because it makes them more time aware and in turn more organised (Study 8.3). These results are also topical as several watch manufactures have been trying hard to make the long-awaited smartwatch 'revolution' happen. Ideally, future research could explore behavioural changes in conscientiousness that do not rely on self-report however, these results suggest that watch wearing may also improve a trait previously known to correlate with conscientiousness: punctuality (Back et al. 2006).

One general limitation of this thesis relates to the general issue of statistical power, that is, the probability that any test will reject the null hypothesis when the null hypothesis is false (i.e. the probability of not committing a Type II error). As power increases, the chances of a Type II error occurring decrease. This probability is referred to as the false negative rate. Therefore, power is equal to 1- false negative rate (also termed sensitivity).

It is often the case that psychologists conducting empirical studies have limited resources and limited access to participants to consider statistical power in advance. At the same time, Cohen (1962, 1990) and others have often argued that researchers should always conduct a power analysis in advance. The American Psychological Association Publication Manual (APA 2001) also encourages researchers to provide evidence that the statistical power of a test is adequate. The benefits of this pre-analysis are twofold according to Algina & Olejnik (2003). Firstly, sample-size selection is made on a rational bias and secondly, the researcher is specifying the size of an effect that is expected or going to make a strong contribution to the literature.

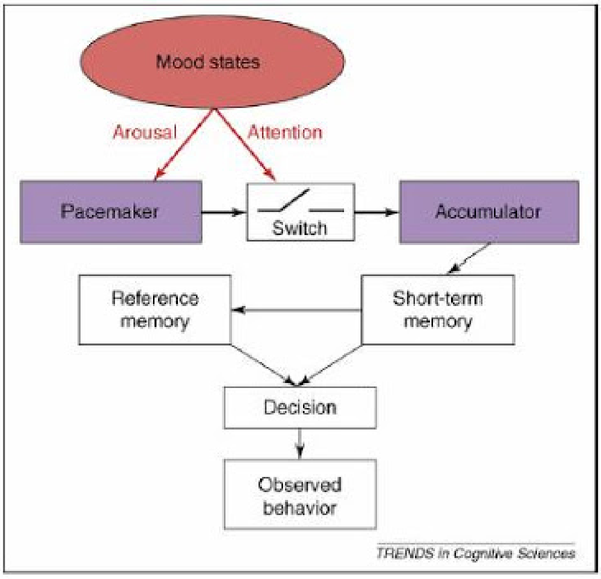
Sample sizes were often opportunistic and ranged from over 1000 participants (Study 2.2) to only 12 (Study 6.4). This may influence the interpretation of some results. For example, in Study 7.3. I predicted that conscientiousness would correlate with arrival time, that is, higher levels of conscientiousness would be associated with improved punctuality. A post-hoc power calculation reveals that the power of this study was only .097. In contrast, the power of an identical correlation in the original study by Back et al. (2006) was .70 as they tested a larger sample. In addition and going beyond differences in specific correlations, it is also possible to explicitly test whether my point estimates are different from those in the original paper. For example, my -.09 correlation for Agreeableness and lateness versus their .28 correlation - the 95% CI for the difference of .19 includes zero. Taken together, there might not be compelling evidence that my results actually differ from the original paper.

Considering a second example from Chapter 8, I was also unable to demonstrate directly that wearing a watch could increase levels of self-reported levels of conscientiousness. However, again this study was underpowered with a total sample size of 48 with power of only .16. To obtain a typical power of .6 with an identical, albeit small effect size (.18), I would require a total sample of 207, or 69 participants in each group. However, as previously discussed - given the longitudinal nature of this experiment however, the results documented in this thesis should be considered as pilot evidence for additional experimentation. Nevertheless, future work using small samples like these will incorporate a power analysis in advance of data collection and not post-hoc.

Despite this limitation, many of the results reported as part of this thesis help to push the study of psychological time in new directions. Historically, time processing research was displaced from its initial centrality in the psychological sciences and, for some decades, consigned to the back drawers of the discipline. However, the number of people in psychology and the greater neurosciences today working on time has perhaps never been greater (Hancock & Block 2012). On the other hand, how psychology should consider time still remains open to debate, but these results suggest that its definition in popular textbooks needs to push beyond perception in the traditional sense and ebrace the latest wave of reearch that considers time in a broader context (Zauberman, Kim, Malkoc & Bettman 2009). Given that most cognitive psychologists subscribe to the view that time has a large impact on how we behave in a day-to-day context, it is surprising that the literature is weighted towards aspects of time that do not fit in with this remit. This is particularly surprising given that very early work suggested the opposite approach (James 1890). However, in light of recent research into 'mental time travel', the results contained in this thesis hint at potential mechanisms that may underlie such a phenomena. In addition, this work raises additional questions surrounding how constructs of time may be linked. For example, people more readily identify with everyday units and experiences of time as they project themselves backwards and forwards through the week, but how this may interact with other established areas of psychological time for example, mental time travel, delay discounting or the planning fallacy remains unclear.

However, the timing errors outlined here in conjunction with the issue of individual differences cannot be accounted for using traditional models of time perception (figure 9.1). For example, weekday confusion cannot be explained using the current pacemaker model. The same is also true for behavioural changes that occur across these social cycles. On the other hand, some timing errors outlined in earlier Chapters still involve the conversion of temporal experience into linguistic units (e.g. weekdays). However, unlike minutes and seconds, these are units of time that people use everyday and for real-world time management. How these units relate directly to short and long term planning, which often involve a temporal component that escape traditional temporal units, remains unclear. However, events that unfold across the day tend to be organised as a mental list, which people often describe in terms of events that come before and after. This simple act of everyday organisation has more in common with the days of the week than minutes and seconds.

Fig. 9.1. Model of time perception based on pacemaker/accumulator model.



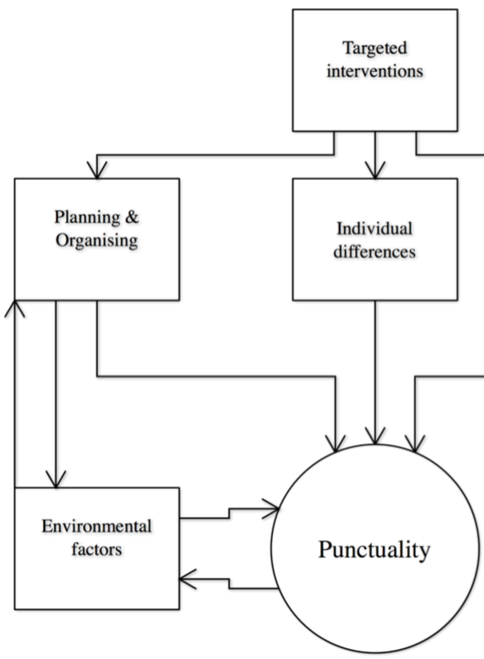
Errors in punctuality for example, may be better explained using a prospective memory context (Esinstein, McDaniel, Richardson, Guynn & Cufer 1995), which can be seen as a forerunner to 'mental time travel' research outlined previously. Principally, errors of weekday and a lack of punctuality may relate to specific cognitive impairments or variations in prospective, but not retrospective memory. In some instances, missed appointments may be a function of failed prospective memory and 'mental time travel' in combination. For example, previous research has identified a deficit of both prospective memory and 'mental time travel' in older adults (Addis, Wong, & Schacter 2008; Einstein & McDaniel 1990), but like weekday errors, these cognitive impairments may be more widespread in the general population (Zimbardo & Boyd 1999).

The results from this thesis therefore raise a number of persistent issues in the psychology of time that remain crucial. Time can and should be considered alongside other well established areas of cognitive and social psychology, but perhaps the most important issue concerns individual differences. For some researchers, individual differences are viewed as an unmitigated nuisance because they dilute the strong nomothetic trends that they are actively seeking. For others, these differences are the source of their whole life's study (Cronbach 1957). What remains clear is that when you ask a group of people for an estimate of even a short duration, you get a remarkably large distribution, especially when this is compared with a number of other forms of psychophysical assessment (Doob 1971; Rammsayer 1997). Similarly, when you ask people to arrive on time for an appointment, you also get a similarly large distribution (Chapter 7). On the other hand, some everyday units of time may negate the issue of individual differences altogether as weekday mismatching appears to be an almost universal trend (Chapters 2 & 3).

However, for most aspects of psychological time, the exact sources of large individual differences remain unspecified. Although the characteristics identified by several recent meta-analysis account for some of this variation in psychophysical experiments, there remain additional sources of variation that have yet to be identified, particularly for research that goes beyond psychophysical constructs. It is encouraging to see that such efforts have begun to burgeon in the past decade (Hancock 2011; Rammsayer 2002; Zimbardo & Boyd 2008), but potential resolutions are to be had by refining the methods of measurement so that the tested person is not expressing his or her estimate in terms of necessarily learned temporal units (i.e. having to express their estimates in terms of semantic labels such as seconds), but instead can express these using a more readily accessible, everyday time construct i.e. days, weeks, months and years (Zauberman, Kim, Malkoc & Bettman 2009).

Future research incorporating applied and theoretical strands could attempt to correlate specific, individual failings in prospective memory, mental time travel and time management with individual differences. As discussed previously, punctuality is a vastly under-researched area of time, that may be linked to how an individual plans ahead. Alternatively, it may simply be the result of poor time estimation alone. A model centred around predicting punctuality looks comparatively different to traditional models that focus on time perception in the milliseconds range, but remains highly testable (figure 9.2).

Fig. 9.2. A simple model of testable factors that are likely to influence punctuality.



Understanding how different timing systems are linked or separated should also be a priority for future research. For example, estimating a 5 second interval, knowing how much time to leave so that you arrive on time for a meeting and knowing what day of the week it is are separate judgments, but all involve a complex understanding of time. How these domains may be linked remains unknown. Given the large individual variance in time estimation between participants, there may be selective deficits regarding different aspects of psychological time. However, the ability to estimate a short duration may not correlate with an ability to estimate other physical attributes for example, judgements of speed and distance. Given that one of the dominant examples used to argue the importance of time is that these decisions are somehow connected (e.g. Espinosa-Fernández, Miro, Cano & Buela-Casal 2003), this may only operate at a low automatic level, but fail to replicate in a conscious or prospective paradigm. How these effects might be moderated by the exposure to time cues or an individual's propensity to use time cues is prime ground for additional cross-cultural studies where time is considered to be more or less important.

Missed appointment and punctuality research could be explored simultaneously by building a website that would incorporate an interactive demonstration, allowing visitors to make or break virtual appointments. They would then be invited to choose one of several available time slots over the next few weeks when they could return to the website (a virtual appointment). If the user returns to the website at their appointed time, they would receive an iTunes voucher. If they miss their appointment, they would be directed to information on the website about the psychological causes and economic effects of missed appointments. By recording the pattern of missed appointments on each day of the week, in conjunction with their punctuality, I would be able to build up a detailed picture of the distribution of errors, and individual differences that govern the strength of such an effect. The website could be optimised to operate on smart phones as well as computers, so that users could access the website as flexibly as possible.

Such a research project may reveal that punctuality is similar to other decision making models in that late individuals are overoptimistic when it comes to estimating how long a task will actually take (Lovallo & Kahneman 2003). This may have more to do with differences in optimism and the ability to adopt cognitive strategies involving heuristics rather than factors currently proposed, such as personality and time orientation. An improved understanding of these processes in relation to lateness or appointment scheduling may lead to simple guidelines on how people can improve their punctuality - something which has also yet to be tackled in the current literature. If punctuality is simply an issue of bad planning, then guidance can be provided. For example, requiring an individual to unpack the steps required to reach a destination may improve their duration estimate of the their total time likely to be spent traveling to a destination. They would in turn arrive closer to the original arranged time. On the other hand, if it is simply an issue of appointment specifics, guidance can be provided to those who set the appointments. Future experiments would ideally explore how individual differences, cognitive strategies and appointment specifics interact to produce a confirmatory structural equation model.

Another general way to extend this research would be to explore what causes the changes in behaviour and cognition across the social cycles previously identified (i.e. weekly and working day). One line of enquiry could explore the effect of weekday patterns on shift workers, or those who do not work a traditional 5-day working week, and consider how changes in the weekly cycle may link directly patterns of learned behaviour across days where work ends and begins. A similar strategy could explore mood or personality changes in those who do not work traditional 9-5 hours.

More importantly, previous research has established that changes in cognition can affect whether an individual chooses to engage or avoid a risky behaviour, but this has largely focused on characteristics of the situation and to what extent it engages the decision maker. Experimental tasks have also offered little in the way of providing guidance to help influence or modify behaviours outside the lab (Figner & Weber 2011). Consuming unhealthy food on a daily basis for example, carries an increased risk of developing health problems in the future, but while most people are aware of this risk, they ignore nudge strategies that encourage healthier alternatives. It is often assumed that if people have more information about diet and nutrition they will then begin to make better choices for themselves. However, current interventions still require an individual to act on the advice at that moment in time (Raynew & Lang 2011) and I would be interested to know how cycles of behaviour, personality and mood change interact with the risky choices that people make everyday? Understanding how these weekly and hourly changes interact with decision making and risk taking may lead to improvements in timing when it comes to targeting future nudge strategies particularly when it comes to understanding when people are more susceptible to falling off self-regulated changes in lifestyle. Being able to predict and map these changes in individual behaviour may also reveal when people are better equipped to make other important decisions that involve an element of risk, like financial decisions or selfless acts like recycling and charity donation. This idea is particularly edifying, as more research is essential to help understand the wide differences between peoples' and societies health and mortality experiences.

Additional lab based experiments may also allow for the development of stimuli that would prime weekday effects already outlined for example, 'that Friday feeling' and present participants with a number of decision making tasks that involve selecting a potentially risky (unhealthy) or low risk (healthy) payment option to measure the strength of these priming effects. There may also be an interaction in relation to the actual day an experiment is run. Other experiments would involve splitting current personality tests in half to allow a within-subject comparison of individual differences that occur across the week and how these can also be influenced with appropriate priming material. A large cohort of subjects could also take part in additional online based experiments to further explore the relationship between daily, weekly and monthly activities that also correlate with everyday risky decisions.

That said, the next prominent challenge for time in the short term concerns the demands of integration as potentially important discoveries coming from neuroscience tend to again demonstrate an over-reliance on low-level processes (e.g., Eagleman et al. 2005; Harrington, Haaland & Knight 1998). An additional question is how these insights at the level of neurophysiology express themselves in various behavioural outcomes. It is often the case that behavioural data are explained through reference to associated, underlying neural structures and functions. Such linkages often pass the level of necessity, and some reach the criterion of sufficiency, although few have been confirmed as exclusive relationships (Gibbon & Malapani 2002). Understanding and elucidating these polymorphic, isomorphic, and homeomorphic linkages between differing levels of description may be the most vital challenge for neuropsychology if it is to make a meaningful contribution. However, this challenge is not confined to timing and time perception.

In summary, this thesis demonstrates that time as a psychological concept is not limited to traditional paradigms, but can be fruitfully applied to various areas of cognitive, social and occupational psychology. It establishes several new facts about social timescales and our individual relationship with time that have both theoretical and applied significance. In doing so, it takes some steps towards uniting time across social and cognitive research, which have often dealt with time independently. It also identifies specific directions for future research.

The psychology of time is on the upswing, but this momentum will only be maintained if research can balance itself between future exploration (i.e. broadening its horizons) and theoretical coherence (Block & Zakay 2001; Grondin 2010). The ultimate goal being to convince academics and policy makers alike that, given half a chance, the psychology of time has a lot more to offer.

Appendix A
Overview of online data collection strategies

At various points throughout this thesis, I refer to two data-sets that were obtained from two large online samples. This appendix contains a more detailed breakdown of what data was collected and the methods employed. In both cases, a cookie logger prevented multiple response to ensure participants could only respond once.

A.1 Timeslip Collection (results are documented in Chapter 2)

Timeslip (University of Glasgow)

Data was collected over a two week period in May of 2009. A full list of questions and options are below:

1. People sometimes have the feeling that they are on the wrong day of the week.

For example, it might "feel like" Friday when in fact it is Wednesday.

What day of the week does today "feel like" to you?

People sometimes have the feeling that they are on the wrong day of the week. For example, it might "feel like" Friday when in fact it is Wednesday. What day of the week does today "feel like" to you?

Monday

Tuesday

Wednesday

Thursday

Friday

Saturday

Sunday

2. How tired are you now?

Extremely tired

Very tired

Moderately tired

Slightly tired

Not tired at all

3. How often do you daydream?

Hardly ever

Occasionally

Moderately

Quite often

Very often

4. Sex?

Male

Female

5. Age?

<20

21-30

31-40

41-50

51-60

61-70

>70

6. Where are you located just now?

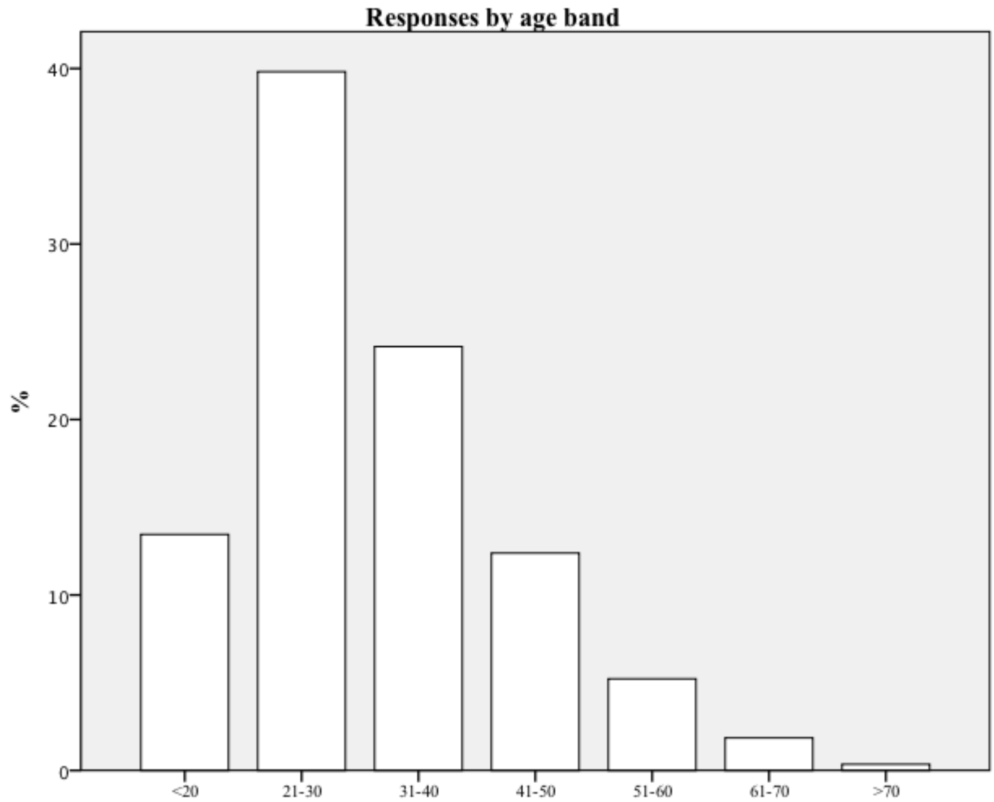
UK

Other

<u>Additional demographic information on the sample:</u>

A total of 1,130 people (figure A.1) completed part in this survey. 52.2% were female. 62.7% were located in the UK, with rest based in Europe, the United Sates and Canada.

Fig. A.1. Percentages of participants by age range.



A.2 Large Online Data Collection (results are documented in Chapters 3, 6, 7 and 8)

This second data collection set out to answer a number of questions to help both compliment and guide future experimental work. Data was collected between April and September 2011. The full list of questions and options are below:

On the consent page, a photo of a face was presented (figure A.2).

1. What sound can you hear?

A train

A dog barking

Water running

A car

note: this question ensured that participants web browser was able to accommodate embedded sound objects. participants who responded with anything other than 'A dog barking' were prevented from going any further.

2. People sometimes have the feeling that they are on the wrong day of the week. For example, it might "feel like" Friday when in fact it is Wednesday. What day of the week does today "feel like" to you?

Monday

Tuesday

Wednesday

Thursday

Friday

Saturday

Sunday

3. Here are a number of personality traits that may or may not apply to you. Please write a number next to each statement to indicate the extent to which you agree or disagree with that statement. You should rate the extent to which the pair of traits applies to you, even if one characteristic applies more strongly than the other:

1= Disagree strongly

2= Disagree moderately

3= Disagree a little

4= Neither agree nor disagree

5= Agree a little

6= Agree moderately

7=Agree strongly

Extraverted, enthusiastic. __

Critical, quarrelsome. __

Dependable, self-disciplined. __

Anxious, easily upset. __

Open to new experiences, complex. __

Reserved, quiet. __

Sympathetic, warm. __

Disorganised, careless __

Calm, emotionally stable. __

Conventional, uncreative. __

After spending 8 seconds on this page, participants heard a 100Hz 5 or 7 second tone. This was embedded and hidden in the page.

4. On the preceding screen, an audio tone was played over the speakers

Did you hear this tone

yes

no

If yes, how long do you think it lasted to the nearest second?

You are now going to hear a second tone. Afterwards you will be again be asked to estimate its duration in seconds.

Tone 2 (5 or 7 seconds in duration)

6. Did you hear this tone?

Yes

No

7. How long do you think this second tone lasted to the nearest second?

Sleep

8. How long did it take you to fall asleep last night?

0-15 minutes

16-30 minutes

31-45 minutes

46-60 minutes

61+ minutes

9. How long were you awake during the night, after you fell asleep initially?

0-15 minutes

16-30 minutes

31-45 minutes

46-60 minutes

61+ minutes

10. Roughly, how long did you sleep for in total last night?

0 - 10+ hours

Happy today

11. Overall, how happy are you today?

0 - not at all - 10 - not at all

Risk

12. How much would you be willing to pay for a lottery ticket that gave you a 1 in 100 chance of winning £100?

10p

20p

50p

£1

£2

£5

£10

Productivity

13. How productive do you expect to be or have you been today (with 100% being your absolute maximum level of productivity)?

0-100%

Work

14. Read the following statement:

'I am enthusiastic about my job'

How often do you feel this way about your job?

Never - never

Almost Never - a few times a year or less

Rarely - once a month or less

Sometimes - a few times a month

Often - once a week

Very Often - a few times a week

Always - every day

Demographics

Could you please provide us with some basic information about yourself.

15. Are you male or female?

Male

Female

16. Age?

10-100

17. Do you regularly wear a watch?

Yes

No

18. If you do wear a watch is it analogue or digital?

Analogue

Digital

19. Do you own a mobile phone?

Yes

No

20. Do you regularly arrive on time for events and appointments?

Yes

No

21. Do you keep a diary (including computer calendar programmes)?

Yes

No

22. Do you work a conventional Monday to Friday dayshift?

Yes

No

23. If no, please provide some brief details of your current working habits/hours.

24. Are you musically trained or actively engaged in musical performance?

Yes

No

25. If yes, for how many years?

<1year to 10 years>

26. Which statement best describes how you feel?

What happens to me is my own doing

Sometimes I feel that I don't have enough control over the direction my life is taking

Face Selection (figure A.2)

27. At the start of this survey a face was shown on screen. could you please identify this face from the line-up below

28. How confident or unsure are you about your last answer

very confident

confident

neither confident or unsure

unsure

very unsure

Happy yesterday

29. Overall, how happy were you yesterday?

0 - not at all to 10 - not at all

30. To what extent have you enjoyed taking part in this survey?

0 - I didn't enjoy it at all to 10 - I enjoyed it a lot

31. What is the actual day today?

Monday

Tuesday

Wednesday

Thursday

Friday

Saturday

Sunday

32. Finally, how many minutes do you think it has taken you to complete this survey?

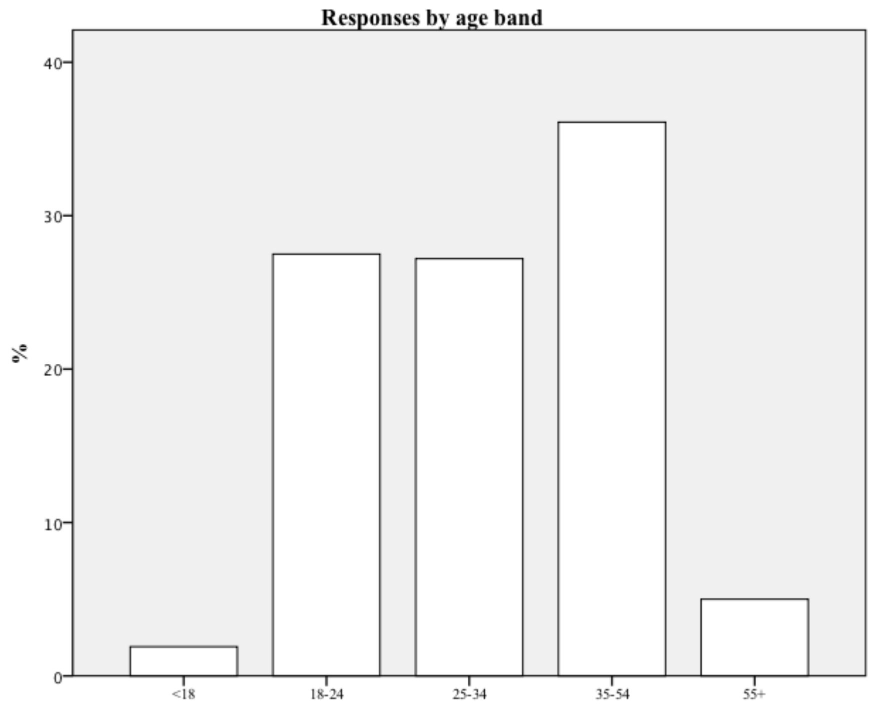
With compatible web-browsers, this survey also collected information on the time spent on each page in addition to the total time taken to complete the whole study.

Additional demographic information on the sample:

A total of 643 people took part in this study (figure B.3). 47.2% were female. Not all web-browsers supported the various measures that could be taken. 526 of those 643 returned a full cohort of answers.

Fig. A.2. Showing the face presented at the point of consent along with a different photo of the same face and another face.

Fig. A.3. Percentages of participants by age range.



A short note regarding online limitations

Results documented across this thesis that include data collected online however, should be viewed in the context of several limitations. When tasks are conducted online, I am not able to exert the same level of experimental control over each participant. That is, I could not control for variability in background noise and their external environment. However, the aim was to sample as many people as possible in their natural-occurring environments. I also expect that recruitment of such a large N minimised any potential biases as we avoided a 100% student sample. Finally, I did not ascertain participant's mental health, neurological or medication status – factors known to influence time perception (see Chapter 1).

Appendix B

R code from Study 3.5

Mining Script

```
#load libraries

library(RJSONIO)

library(twitteR)

library(plyr)

library(ggplot2)

library(rjson)

library(audio)


#mine tweets using twitteR library

monday.tweets=searchTwitter('Monday', n=500)

tuesday.tweets=searchTwitter('Tuesday', n=500)

wednesday.tweets=searchTwitter('Wednesday', n=500)

thursday.tweets=searchTwitter('Thursday', n=500)

friday.tweets=searchTwitter('Friday', n=500)

saturday.tweets=searchTwitter('Saturday', n=500)

sunday.tweets=searchTwitter('Sunday', n=500)


wait(5)
```

#sort into a workable format and print examples

```
monday.text=laply(monday.tweets, function(t) t$getText())

tuesday.text=laply(tuesday.tweets, function(t) t$getText())

wednesday.text=laply(wednesday.tweets, function(t) t$getText())

thursday.text=laply(thursday.tweets, function(t) t$getText())

friday.text=laply(friday.tweets, function(t) t$getText())

saturday.text=laply(saturday.tweets, function(t) t$getText())

sunday.text=laply(sunday.tweets, function(t) t$getText())

wait(5)
```

#showing the the first five tweets using plyr function

```
head(monday.text,5)

head(tuesday.text,5)

head(wednesday.text,5)

head(thursday.text,5)

head(friday.text,5)

head(saturday.text,5)

head(sunday.text,5)

wait(5)
```

```
#load word lists taken from Hu and Liu (2004 )

pos.words=scan('positive-words.txt', what='character', comment.char=';')

neg.words=scan('negative-words.txt', what='character', comment.char=';')


#compute scores for each day

monday.scores = score.sentiment(monday.text, pos.words, neg.words, .progress='text')

tuesday.scores = score.sentiment(tuesday.text, pos.words, neg.words, .progress='text')

wednesday.scores = score.sentiment(wednesday.text, pos.words, neg.words, .progress='text')

thursday.scores = score.sentiment(thursday.text, pos.words, neg.words, .progress='text')

friday.scores = score.sentiment(friday.text, pos.words, neg.words, .progress='text')

saturday.scores = score.sentiment(saturday.text, pos.words, neg.words, .progress='text')

sunday.scores = score.sentiment(sunday.text, pos.words, neg.words, .progress='text')
```

```
#rename data

monday.scores$monday='Monday'

monday.scores$code='Mon'

tuesday.scores$tuesday='Tuesday'

tuesday.scores$code='Tue'

wednesday.scores$wednesday='Wednesday'

wednesday.scores$code='Wed'

thursday.scores$thursday='Thursday'

thursday.scores$code='Thu'

friday.scores$friday='Friday'

friday.scores$code='Fri'

saturday.scores$saturday='Saturday'

saturday.scores$code='Sat'

sunday.scores$sunday='Sunday'

sunday.scores$code='Sun'
```

```
#rename for storage

monday = monday.scores$score

tuesday =tuesday.scores$score

wednesday =wednesday.scores$score

thursday =thursday.scores$score

friday =friday.scores$score

saturday =saturday.scores$score

sunday =sunday.scores$score


#calcualte means

Mon_mean = mean(monday)

Tue_mean = mean(tuesday)

Wed_mean = mean(wednesday)

Thu_mean = mean(thursday)

Fri_mean = mean(friday)

Sat_mean = mean(saturday)

Sun_mean = mean(sunday)
```

Score Sentiment Function

```
score.sentiment = function(sentences, pos.words, neg.words, .progress='none')
{   require(plyr)
    require(stringr)

            # taking a vector of sentences. plyr will handle a list
            # or a vector as an "l" for us
            # we want a simple array ("a") of scores back, so we use
            # "l" + "a" + "ply" = "laply":
    scores = laply(sentences, function(sentence, pos.words, neg.words) {

# clean up sentences with R's regex-driven global substitute, gsub():
        sentence = gsub('[[:punct:]]', '', sentence)
        sentence = gsub('[[:cntrl:]]', '', sentence)
        sentence = gsub('\\d+', '', sentence)

# and convert to lower case:
sentence = iconv(sentence, 'UTF-8', 'ASCII')
sentence = tolower(sentence)
```

split into words. str_split is in the stringr package

```
word.list = str_split(sentence, '\\s+')
```

sometimes a list() is one level of hierarchy too much

```
words = unlist(word.list)
```

compare our words to the dictionaries of positive & negative terms

```
pos.matches = match(words, pos.words)

neg.matches = match(words, neg.words)
```

match() returns the position of the matched term or NA

we just want a TRUE/FALSE:

```
pos.matches = !is.na(pos.matches)

neg.matches = !is.na(neg.matches)
```

```
# and conveniently enough, TRUE/FALSE will be treated as 1/0 by sum():
        score = sum(pos.matches) - sum(neg.matches)
        return(score)
    }, pos.words, neg.words, .progress=.progress )
    scores.df = data.frame(score=scores, text=sentences)
    return(scores.df)}
```

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