The Time of Our Lives: An investigation into the effects of technological advances on temporal experience.

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Abstract

Previous research (Blatchley et al., 2007) investigating the relationship between timing accuracy and computer use highlighted a potential difference between individuals with high and low levels of computer usage. In order to further investigate this phenomenon the current research has built on research in the area of human time perception, modernity and technology acceptance and use. In order to quantify the level of information communication technology use in participants the Everyday Technology Use Questionnaire was developed. Five studies were then conducted in order to investigate the effects which use of these types of technologies may be having on subjective timing. The initial two studies conducted found that when split by technology use, participants gave significantly different responses on both interval production and duration estimation tasks overall. In order to further investigate evidence for a difference in the subjective timing of both groups two further studies were conducted. These examined the performance of participants on timing tasks when the number of available options and integration of sensory modalities were manipulated by the researcher. A final study was conducted exploring the behavioural priming effects of technology use. It was found that integrating the modalities of the stimulus that the participants engaged with, and also priming participants to think about advanced technologies or time management, elicited responses suggestive of an increase in the pace of subjective time.

Declaration of Originality

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Declaration: I hereby declare that this thesis is the result of my own original research and does not contain the work of any other individual. All sources that have been consulted have been identified and acknowledged in the appropriate way.

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"...there are other choices, if you want them.

You don't have to toe the line and just float with the flotsam.

You can build your time better when you find a passion,

The Internet and Public Services give free education.

So it really ain't a case of rich or poor,

It's a case of self-motivation and nothing more,

Like Billy says, whether you have or you have not wealth,

The system might fail you, but don't fail yourself"

Meads, D. P. (2010). Get Better

[Recorded by dan le sac Vs. Scroobius Pip].

On *The Logic of Chance*. London: Sunday Best

Chapter One

Overview and Summary

The aim of this work is to investigate possible effects of daily information communication technology use on our experience of the passage of time. Although the area of human time perception has received much attention, there are still questions that are far from a definitive answer. Previous research in the area has tended to look at the effects of stimuli in isolation on our experience of duration, and our ability to accurately perceive duration (for example Brown, 1995; Pariyadath & Eagleman, 2007; Wearden, Edwards, Fakhri, & Percival, 1998), however there has been relatively little research looking at the effects of more encompassing stimuli such as modern society or technology on our ability to perceive duration. Areas such as sociology and anthropology have discussed links between modernity, technology use and time pressure at length, yet lack an empirical or cognitive basis for their conclusions (Gleick, 1999; Levine, 1997; Rosa, 2007). Likewise, psychological research on the effects of technology use tend to focus on psychological wellbeing and the mental health consequences of overuse of technology, yet overlook the effect that daily technology use may be having on our executive functions and information processing. This research aims to contribute to knowledge in these areas by focusing on the cognitive effect of information communication technology use on human temporal experience.

Chapter Two of this thesis focuses on previous research that has been conducted in the area of time perception. It highlights some of the distortions and illusions that can occur, and the stimuli which have been implicated in these effects.

It also gives a brief overview of some of the models and theories that have been put forward to explain how we experience time; the three paradigms of timing; and highlights some issues in the area which have yet to be fully addressed in previous research. Chapter Three of this work looks at the research that has been conducted in the area of technology use. This draws on research conducted in areas of psychology, anthropology and sociology. Within sociology it has been long recognised that there appears to be a link between modern life, technological advances, pace of life and time pressure. The psychological research conducted on technology use has tended to focus on how technology use affects psychological wellbeing. It may be reasonable to assume a link between an individual's pace of subjective time and time pressure, and taking inspiration from the areas of sociology it follows to examine a link between technology and time experience. However a review of the literature in the area of time psychology reveals that this has received virtually no attention.

Chapter Three outlines the development of the Everyday Technology Use Questionnaire and Study 1 of this work which looks at a link between the amount of technology used in daily life (as measured by the Everyday Technology Use Questionnaire) and the reported level of Cognitive Absorption in the individual. Cognitive absorption has been shown to correlate positively with willingness to try new technologies and also the perceived ease of use of new technologies (Agarwal & Karahanna, 2000; Lin, 2009). It has also been linked to the time distortion felt during hypnotic sessions (Naish, 2003). Therefore it was felt that perhaps it may have an effect on both the amount of technology that a person uses and their altered temporal experiences and judgements.

Chapter Four reports both tasks from Study 2, designed to investigate whether there is a difference between the temporal experiences of individuals with different levels of technology use. This study utilised a straight forward duration estimation task, and an interval production task, with level of technology use being measured using the Everyday Technology Use Questionnaire.

In order to further investigate a link between technology use and altered temporal experience three additional studies were conducted. The aim of these studies was to begin the task of identifying properties of technology or technology use that may be linked to altered temporal judgements and to examine in more depth any effects found in the previous chapter. Chapter Five outlines and discusses the three additional studies undertaken. The first is based on the principle that using technology affords us the opportunity to choose from many different options at any one time. The second study was based on the idea that the stimuli we engage with when using information communication technologies (sometimes using multiple information communication technologies at the same time) are often multimodal in nature. Therefore it involved three separate conditions where the level of integration of sensory modalities was manipulated. The final study looked at the behavioural priming aspects of living within a techno-centric society. It involved three sub-groups: one control group, one priming individuals to think about time management, and one priming individuals to think about advanced technologies. This study utilised a temporal generalisation methodology.

This thesis also discusses some issues with the current models and theories of how we experience the passage of time in our daily live. In this way it calls on the area to re-evaluate the direction in which current research is focused, with the research to be discussed here indicating that our experience of time may be a secondary effect occurring because of our executive functions. It was hypothesised that in general these studies would reveal that technology use, through interaction with our cognitive processes increases our experience of the pace of the passage of time, causing us to feel that more time is passing than is actually the case.

Chapter Two

Time in Everyday Life

The universe may be timeless, but if you imagine breaking it into pieces, some of the pieces can serve as clocks for the others. Time emerges from timelessness. We perceive time because we are, by our very nature, one of those pieces. (Callender, 2010, pg. 65)

Human time perception relates to our subjective perception of the passage of time and the ability to judge duration. Within our daily lives it can often appear to us that our subjective experience of time is not in line with the amount of objective clock time that passes. Some of the earliest research conducted on this phenomenon was by Hoagland (1933). This research had its beginnings when Hoagland noticed that when he left his wife (who was ill with fever) alone, she felt like he had been gone for much longer than was actually the case. He reasoned that our perception of time must be based on a form of chemical reaction within the body. Therefore, as in any chemical reaction, the heat of her fever increased the speed of this reaction. After testing his hypothesis he found that her subjective experience of time did indeed differ relative to her body temperature. This was one of the first quantifiable findings with some evidence that we experience subjective time relative to and in accordance with internal and external factors. Hoagland (1935) explicates that changes in the environment of a chemical clock may alter its velocity. He felt that these changes could be temperature or variations in the sensory and motor areas of brain creating acceleration or alternatively inhibiting a continuous chemical mechanism. In examining the possible effect of use of information communication technology on temporal perception the current work builds on this assumption that our environmental situation can affect our perception of time's passage. As is laid out in this chapter our perception of time is intricately linked to the environment, including the society in which we live, and subjective time perception appears to be easily affected by external factors.

This chapter gives a brief introduction to the area of human time perception. It is divided into four sections. The first looks mainly at how objective clock time has shaped modern society, highlighting the constant link in history between technological advancement and measured time. It gives an overview of the introduction of standardised time and indicates how we may attempt to alter our own experiences in the attempt to defy clock time. It also draws on sociological research linking the pace of life, time pressure and modern society. In this way it introduces the idea that, as our own subjective experiences of time can be different to clock time; we can sometimes feel time pressure from this conflict. The second section moves from the discussion of objective time into the main area of this thesis, subjective time experience and human timing. It looks at a number of the different models that have been put forward in an attempt to explain our subjective experiences of time and the processes which may govern them. Section Three highlights that research within this domain has not yet examined the effects that society and social changes (such as the ubiquity of computers) might have on our perceptions of time. This is emphasised by looking at some of the research that has been conducted in the area investigating the effects of both external and internal factors which affect our subjective timing. The final section discusses the differences between our experience of time as it is passing (passage of time judgements), time in retrospect (retrospective timing judgements) and our ability to time things, or create timing intervals when we are aware that time is of importance (prospective timing judgements). In doing so it introduces issues that affect these processes and some of the paradoxical experiences we can have with regard time perception.

2.1 Time and technological advances

In today's society time can be seen as an intrinsic facet of modern living. According to the Oxford English Dictionary it is currently the number one most used noun in the English language ('The OEC: Facts about the language - Oxford Dictionaries Online', n.d.). The following section aims to discuss through reference to research in the area, the ways in which time is important within our society and the advent of an overall standardisation of clock time in society. This development of standardised time is inherently linked with technological advances throughout history. This section also looks at the pace of life and time pressure that is felt within modern societies. Time pressure may reveal that there is a conflict between the individual and measured time, with increases in pace of life and modernity appearing linked with this time pressure. This tension may arise from a dissonance in temporality both between individual's subjective time experience and objective measured time, and between the experiences of two individuals. As our perceptions are based on both ourselves and the environment we are in, individuals experience the passage of time differently to each other. A duration that seems short to one person, may feel unending to another. Children often appear to experience the passage of time very differently to adults, which may be exacerbated by their lack of knowledge and understanding of the language or standardised metrics of time. As pointed out by Zerubavel (1982) if one has ever tried to gain insight, into when an event happened or how long exactly this event lasted, from a young child's description we can definitely appreciate how important and necessary a common understanding of the passing of time is.

Before the advent of clocks and wristwatches individual local communities went by their own local time, solar time, which was based on the position of the sun in the sky. With advances in technology and transportation such as cross-country trains, came the need for a much stricter temporal standardisation. Nowadays the normality of our everyday lives has become temporally situated (Zerubavel, 1982). However, clock time as we now know it did not come into being until 1780 when Geneva began to show preference for "mean time" over solar time (Howse, 1980). As pointed out by Thompson (1967) the industrial revolution had yet to take place and punctuality in these days was not a huge concern. The British mail service was the first to provide regularity in time between local communities in 1784 when it began to run its mail coaches to strict schedules and required that each coach guard carry a timepiece with the exact time indicated by Greenwich Mean Time in order to adjust all clocks on their route accordingly (Zerubavel, 1982). This can be seen as the beginning of a reliance on clock time. However, the number of people affected by the British mail services efforts was small. The main push for the use of GMT throughout Britain came with the introduction of passenger trains. In 1840 Great Western Railway began to use GMT throughout its scheduling and by 1855, 98% of public clocks in Britain had been set to GMT (Howse, 1980).

The links between technological advances and our experience of time are grounded in this history. These alterations to our representation of time, which took place over 75 years, could be seen as having some of the most wide reaching effects of modernity. In 1884, after a conference attended by delegates from 25 countries, it was decided to divide the world into 24 different time zones, with GMT being the standard from which all other zones are measured (Zerubavel, 1982). In little over a hundred years this departure from natural solar time to rational standardised time was complete. As has been said, rationality is the key to a modern civilisation (Durkheim, 1964). However, our attempts to take control over the temporal aspects of our lives are an example of the need felt to situate ourselves both within, and distinguish ourselves outside of, this rational temporality. There are many ways that we attempt to influence our experience of standardised time and its passage in today's world. Flaherty (2003) found that people attempt to influence time and its flow with regard to duration, frequency, sequence and allocation of time. This information was collected from qualitative analysis conducted on interviews with 398 individuals from all walks of life. He found that people often attempted to influence the duration of an event, either trying to make it last longer or shorten their subjective experience of its duration (Flaherty, 2003). Shortening an unpleasant experience and lengthening pleasurable ones is a tactic that many people use to simply get through the day. People have become socialised to the idea that focusing their attention on a stimulus can make it appear subjectively longer whereas distracting themselves from stimulus can make it appear shorter.

Another area that Flaherty's research highlighted, sequence, also indicates the willingness and attempts of individuals to take back control over the timing of their lives. Many of his interviewees reported doing daily tasks in a particular sequence in order to either save time (turning on a computer before getting dressed so that it has booted up by the time the individual is ready to use it), or to mix up their routine so their temporal map is not always the same (doing a different thing every morning so their days seem to be more spontaneous). Whatever the personal reasons behind either a strictly sequenced day, or a strictly un-sequenced day, it shows that these individuals are highly aware of the impact that time is having on their lives. This is also the case with the high incidence of reported allocation of time that Flaherty (2003) found to be evident in his participants. Participants attempted to portion out their time throughout the day, with a lot of emphasis being placed on saving time throughout the day to spend as "me time" towards the end.

The attempt to portion time in order to have a provision of "saved" time at the end of the day can be seen in many aspects of modern society. Time has become a commodity which we save, spend and waste. That we are willing to exchange our time for monetary compensation highlights the value that we place on this saved time. Gleick (1999) points out that we are attempting to gain control of our time by engaging in acts such as pushing the door close button on an elevator and investing in microwaves and Burka boilers. He also highlights the commonly held belief that recent generations experience more time pressure, and therefore less free time, than previous generations. This assumption that we are working much longer than ever before simply does not appear to be true. As Gleick points out, people believe they know how many hours they work until they actually create a detailed diary, calculating how much of their days were actually spent on work tasks and not spent socialising and checking emails. One example given by Gleick outlines an individual who believes he works 41 hours per week until he discovers, through use of a time diary, that he only worked just over 14 hours per week on average (Gleick, 1999). This individual mistakenly overestimated his time spent working by 27 hours. Cases like this are common in all aspects of life. We report feeling an overwhelming time pressure, and yet cannot account for the saved seconds and minutes gained by our dedication to all things fast. However these attempts to save time through use of technologies that are marketed as time saving may actually be hindering our desire to experience less stress from time.

The advent of new technologies is often cited as being causally related to beliefs on increased pace of life and time pressure. Rosa (2003) claims this is a paradox of time and that although there is an increase in the technologies that are purported to aid saving time, individuals feel as though they have less time and experience more time pressure. In order to investigate links between use of information communication technology (ICT) and perceived accelerated pace of life and time pressure Chesley (2010) evaluated ICT user versus non-user perceptions of the effect of technology on time pressure and pace of life. Further emphasising the paradoxical relationship between these aspects of modern life she found that information communication technology use was connected to an accelerated pace of life and subjective time pressure. It is worth noting that Chesley's (2010) article was based on research conducted in 2001 and therefore attempts at replication may be necessary to investigate whether this effect has been amplified with increases in the use of ICT over recent years.

It is clear that in little over 150 years objective clock time has completely transformed society. As is the case with more recent advances in technology, clock time was marketed in order to facilitate rather than disrupt. However there now appears to be a shift in the attitude of the general public toward this rigid structure and schedule. As has been pointed out standardised time came about with the onset of high speed long distance transportation. Technology today, however, focuses on high speed communication rather than travel. The time zones that were laid out in 1884 appear to have no bearing within the world of Information Communication Technologies. Business hours have no natural start or end time as online consumerism is constant. In this way we also appear to be fighting the issue of being completely temporally situated, almost by disregarding objective time entirely.

This thesis aims to examine whether modern technologies and society are linked to altered temporal experiences in individuals, causing us to feel that the pace of the passage of time is increasing subjectively. This alteration in temporal judgements, in turn, could create a dissonance between individuals' subjective experiences of time and also between the individual's subjective experience of time and objective clock time. This therefore could be responsible for the subjective feelings of time pressure. As has been described in this section, aspects of the industrial revolution, modernity, and the technological advances related to them, absolutely reformed objective time. Yet clock time is of course very different to the actual experience of the passage and flow of time and our subjective experiences of these.

2.2 Interval Timing (Human Time Perception)

This section details some of the models which have been put forward in the area to explain time perception. Our sense of time differs from our other senses in that we appear to have no designated timing organ, as opposed to how we have our skin for touch, our eyes for sight and so on. This has been noted since the early beginnings of psychology, with William James (1890) dedicating an entire section in his *Principles of Psychology* to the possible underlying processes that govern our time experience. The majority of the current models purport a type of hypothetical internal clock akin to a stop watch, which include both a pacemaker and an accumulator. However theories on time perception have not always been based on this type of model. Some of the earliest work on this area was based on information processing. The suggestion of an information processing model can be traced back to the work of Guyau (1988, originally published 1890) and Benussi (1913). Benussi's basic framework relied on the idea that the more information that is processed within a duration, the longer that duration is perceived to have lasted. Ornstein (1969) utilised a metaphor based on storage size of information to explain how individuals perceive time. This claimed that estimations of time and duration depended on the manner in which the information was received and also on the amount of information that is stored. Thus the amount of information stored can later have an effect on retrospective estimations of duration.

As mentioned above, more recently researchers have put forward theories and models based on a standard stopwatch/clock design incorporating a pacemaker and an accumulator. Some of the most pivotal work on this type of model was conducted Treisman (1963). He suggested that the primary information for an individual's time judgements is based on an arousal sensitive pacemaker, which sends a steady flow of pulses to a counter or an accumulator. As well as this pacemaker and counter there is a reference centre of durations within the mind which act as comparisons to the duration in question (Treisman, 1963).

The bulk of the current literature on human timing is based on prospective timing. This is interval timing where the individual is conscious of the fact that they need to time something, as opposed to retrospective timing where the individual is not aware that duration is an important aspect of an event and therefore has to rely on different mechanisms to judge duration. The prospective paradigm has commonly been explained through the use of two theoretical models, namely the Scalar Expectancy Theory (Gibbon, Church, & Meck, 1984) and the Attentional Gate Theory (Block, 1990). Both of these models stem from Treisman's work and advocate the existence of a basic internal clock model (Figure 2-1). It should be noted that Gibbon et al. (1984) focused on animal timing with Wearden & McShane (1988) and Wearden (1991) addressing whether the Scalar Expectancy Theory held in human timing.

Within a basic internal clock model there is a pacemaker that creates a form of neuronal pulse, and also an accumulator that counts these pulses. When required to judge the duration of an event the switch connecting the pacemaker and the accumulator closes and pulses flow into the accumulator.

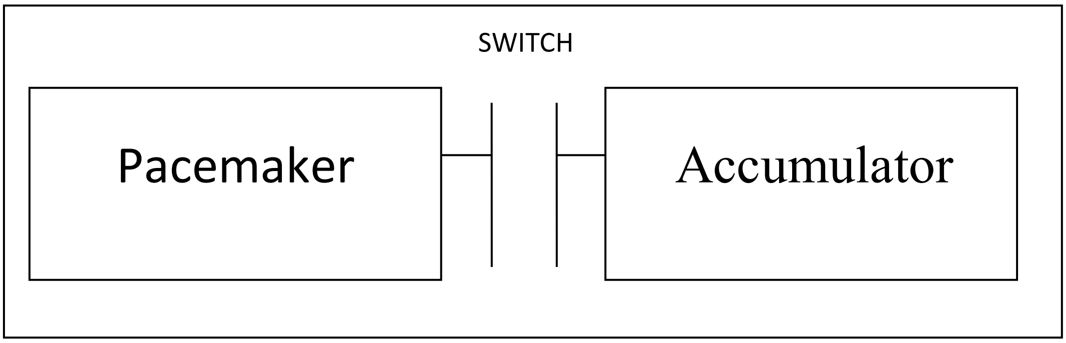

Figure 2-1: A basic Pacemaker-Accumulator Internal Clock

Once the event has terminated, the accumulator references memory locating a duration related to the number of pulses accumulated. Likewise, when required to perform an action for a predetermined length of time the accumulator references memory, locates the number of pulses related to the given duration and sets this as a target. The switch closes and pulses flow into the accumulator. Once the target number of pulses has been accumulated the action is terminated (Coelho et al., 2004). Previous research has claimed that these internal pacemakers appear to be extremely sensitive to any form of arousal, causing the pacemaker to fire more rapidly and, thus, a greater number of pulses accumulate quicker (Jones, Allely, & Wearden, 2011; Penton-Voak, Edwards, Percival, & Wearden, 1996; Wearden, Norton, Martin, & Montford-Bebb, 2007; Wearden, Philpott, & Win, 1999). This arousal has been claimed to be the basis for individuals experiencing subjective time as different to clock time in certain situations. For example, Penton-Voak et al. (1996) used click trains, which are a series of clicks, to increase the "arousal" level in participants and found that this caused them to overestimate and under produce durations in tasks. This finding is consistent with an increase in the rate of firing of an internal clock.

Figure 2-2 outlines the basic Scalar Expectancy Model. It clearly shows the process of how an internal clock could be judging, and making decisions about duration as outlined above. Some theories, like Block's (1990) Attentional Gate Theory, suggest that there are more factors involved in internal timing. Figure 2-3 outlines this theory. It can be seen from this model that the Attentional Gate Theory has a lot in common with the Scalar Expectancy Theory, however it also claims that attention can have an effect on timing. As is shown there is a gate situated between the pacemaker and the switch. When less attention is paid to timing this gate opens to a lesser extent than its full capability. This allows only reduced number of pulses to pass.

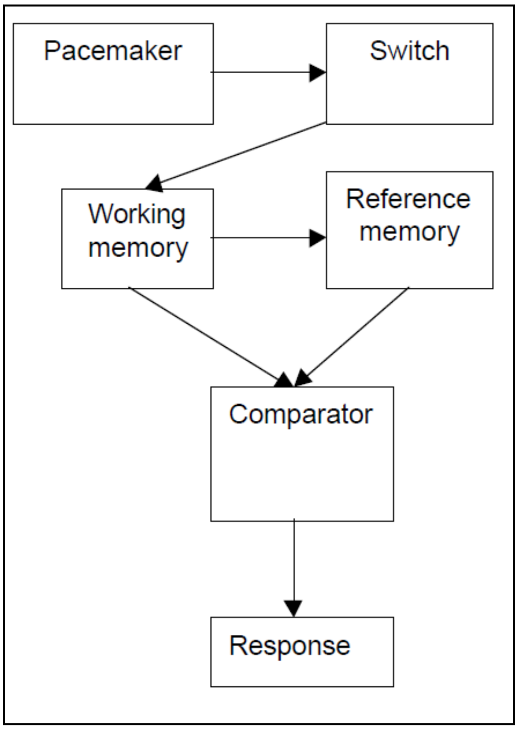

Figure 2-2: Scalar Expectancy Theory Model (Gibbon, Church & Meck, 1984)

Thus, it would take longer for the number of pulses (related to a specific duration) to accumulate in the cognitive counter, creating a dissonance between the objective time and the subjective experience of that time, than if attention was focused on timing during the event. These internal clock models are very accurate at predicting behaviour in prospective timing situations and in explaining how we learn to time.

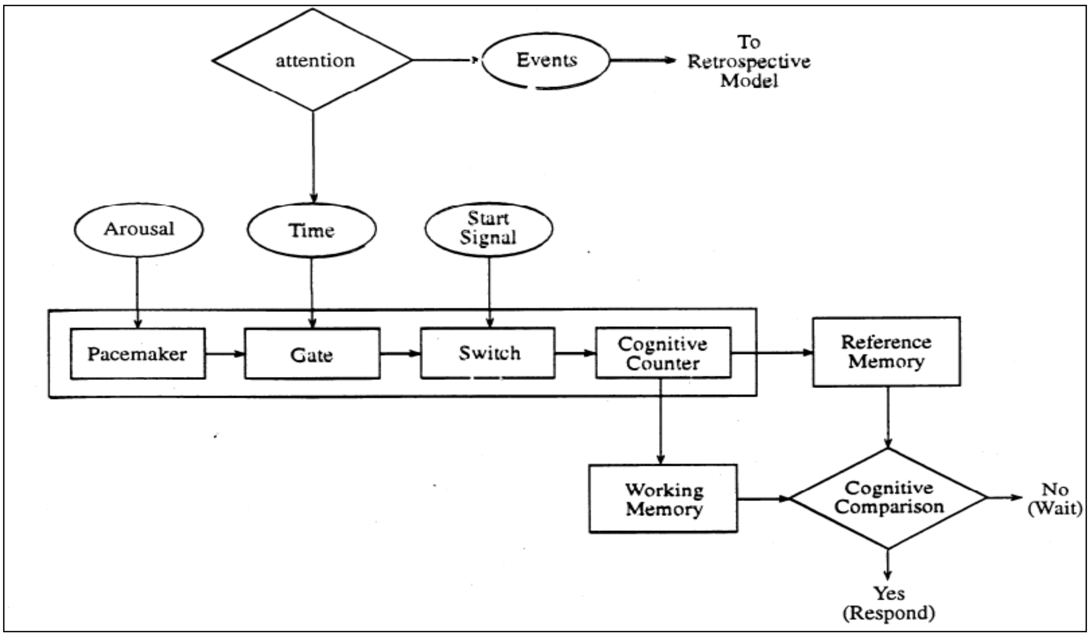

Figure 2-3: The Attentional Gate Model, taken from Zakay & Block (1995).

However as prospective timing tasks are relatively rare in everyday life they sometimes fail to be applicable in everyday situations. Internal clock models are very capable of explaining how individuals learn a duration, or discriminate between intervals. For example, in temporal generalisation studies individuals are presented with a standard duration, and are then asked to respond whether a series of other durations are the same length as this standard (Jones & Wearden, 2004; Wearden, 1992; Wearden & Towse, 1994). This type of learning very rarely occurs in everyday life. Another area which does not appear to be fully explicated within the internal clock literature, is at what point individuals learn the durations which become reference durations in reference memory. Without a full explanation of this one must assume that individuals are constantly refining these stored references in memory with each new exposure to a certain duration, i.e. that such an internal clock would be self-regulating. Wearden (2005a) states that the standard is assumed to be stored on average accurately in reference memory, which when applied to everyday timing would be akin to a self-regulating and calibrating long term reference. Eagleman (2004) claims that the brain may ease the task of consistent time keeping by constantly calibrating its estimations against objective time. In essence according to internal clock models of timing, there should be little to no individual differences apparent in classical timing tasks where an individual is asked to give a verbal estimation of the duration of a stimulus. The logic behind this assumption is that the speed of a pacemaker in an internal clock should have little bearing on the estimations produced when there is no state change involved in a task, a point which has been raised by Wearden (2005b) when discussing internal clock speed in the elderly. The reason for this is that the number of accumulated pulses should still be close enough to the number stored in reference memory for that duration. Or, if an individual's internal clock speed is 500 pulses per minute, and another's is 200 pulses per minute they should both estimate a 60 second stimulus as being one minute in duration as this is linked to their own personal reference for this duration. However we know from experience that in everyday life, two people engaging with the same stimulus can often experience it differently to each other. This highlights some issues which need to be addressed within internal clock models, and raises issues with their application timing in the context of everyday life.

Information processing style models of temporal perception are most often used to describe how we time in retrospect. Guyau (1988) felt that our experience of time was constructed due to the intensity of, differences between, number of and attention paid to stimuli. Ornstein (1969) put forward his own thoughts on timing. He felt that the amount of storage size that information took up would affect our experience of its duration. In this manner he felt that if we have a familiarity with something we will feel that it lasted less time as it will take up less storage space as we create strategies to remember these stimuli. To illustrate this further he utilised a description based on binary code. If you are asked to memorise the binary code 1010 0100 1111 0111 1101 and have no knowledge of binary, you will have to remember 20 pieces of information. However if you have knowledge of binary you will be able to remember the code as 10 4 15 7 13. This type of recall and memory has links to Miller's (1956) classic findings on chunking. Ornstein's studies go on to examine the effect of complexity on timing judgements and also information chunking on timing judgements. He found a lot a support for his storage size hypothesis. However, Ornstein's interpretation of his findings is refuted in Block (1990). He claims that participants do not interpret more complex stimuli as longer in duration than if the stimuli were less complex, rather they remember the duration as having been longer in a complex condition in comparison to the less complex condition. He claims that this is due to the number of interpretations of the complex stimulus that they have created, or rather that it is the variability in the encoding as opposed to the storage size of the stimulus that is causing the effect. Block therefore claims the existence of a different form of information processing type model, the contextual change model (Block & Reed, 1978). In this he claims that it is the number of changes that occur during a time period that affect our retrospective judgement of its longevity.

Until recently these information processing style models of time perception have remained focused on remembered duration, with clock models being used to explain prospective timing. However contemporary research has shown more intricate links between how we process information and our experience of duration. Jones et al. (2011) examined whether increasing the speed of an individual's pace of subjective time through use of click trains would give them more time to process information. They tested individuals on reaction time, mental arithmetic and recall and found they performed better in all tasks when they were preceded by click trains. Internal clock theories of time perception have asserted that click trains act on the pacemaker of the internal clock system causing it to increase the frequency at which it sends pulses to an accumulator (Penton-Voak et al., 1996; Wearden et al., 1999). They hypothesised that by increasing the speed of an internal clock, they were effectively giving the individual more time in which to carry out the task required. Jones et al. (2011) found support for this hypothesis; however they also concluded that there was a possibility that click trains actually speed up the cognitive processes, or increase information processing speed. In the latter, this could mean that our experience of time's passage is merely a secondary effect derived from our information processing speeds. They suggested this possibility as an area that requires attention and one which opens many new avenues for the area of time perception research.

The research on models discussed in this section has highlighted that at times our experience of time can be altered, even through use of simple isolated stimuli. The following section will discuss these variances in our experience of time through reference to research conducted on a number of the stimuli and situations which have been implicated in these temporal distortions.

2.3 Variance in Timing, Time Distortion

As will be seen, previous research looking at the effect that technology use has on our temporal perceptions has been limited. The current research aims to contribute to the development of this area of research. This need for a full investigation of the relationship between technological advancement and our temporal experiences is addressed by the current research. However, research *has* been conducted on many diverse stimuli that affect our subjective time experience and on the interesting phenomena and illusions that occur in relation to our ability to perceive and estimate duration. The discovery that our subjective time experience is not always an accurate portrayal of "real" time and that many external factors can affect our ability to perceive and experience time has led to a recent interest in research in the area of temporal perception. Here I will discuss a small number of the many factors that appear to affect our temporal perceptions. These distortions in our perception can be created using isolated external stimuli in lab settings and, as will be laid out, can also occur because of the factors within the individual.

At the core of this thesis is an examination of links between technology use and time perception and the possible relationship between the two. This relationship is an area which is only recently beginning to receive attention within the cognitive sciences, yet as has been previously pointed out has been long discussed in sociology. The research that has been conducted on the area within psychology so far has been limited in scope and depth. Blatchley et al. (2007) were the first to directly investigate this effect. They noticed that Americans had become increasingly accustomed to completing their daily tasks more quickly than ever before, due to the advent of technologies such as the computer. They utilised a correlational study to investigate whether the level of computer usage affected accuracy on a temporal estimation task. Their basic hypothesis was that the higher the level of computer usage indicated by a participant, the more accurate they would be at estimating time intervals. Their results supported this hypothesis. The researchers found that participants typically spent 15 to 30 minutes on the Internet and more than 120 minutes on the computer a day. Also most participants reported feeling that life was too fast paced and that they felt either somewhat or very pressured by time on a typical day. The correlation between computer usage and absolute error size was, as expected, negative and statistically significant, supporting the hypothesis that people with higher levels of computer usage would be more accurate at estimating time intervals than those with lower levels. The correlation between time urgency and absolute error size was also found to be negative and statistically significant, supporting the idea that the more pressured by time a person felt, the more accurate they are when estimating intervals. All participants were found to be more likely to under-produce the time intervals rather than over-produce them (Blatchley et al., 2007).

Blatchley et al.'s findings suggest that the fast pace of modern life has in some way affected temporal experience. The research however, does not offer much insight into the underlying cognitive processes by which such effect might have been created. Nevertheless, it raises issues regarding pace of life, subjective timing and use of technology. It is interesting that most people felt that life is too fast paced and that they are pressurised by time on a typical day even though technological advances are purporting to be saving us time (fast food, faster downloads, instant messaging, word processing programmes, laptops, smartphones). The prevailing aim of this thesis is to provide an in-depth investigation into a link between modernisation, technological advances, and altered time experiences from a cognitive basis.

Much of the literature which has focused on subjective timing has done so in order to answer the question of "how we time". Therefore it has tended to look at isolated stimuli and differences in our judgements of their duration in order to address this question. Xuan, Zhang, He and Chen (2007) found that subjective duration can be dilated by simply manipulating the magnitude of the stimulus used. In their research they found that brighter, louder, larger, and more numerous stimuli were perceived as being subjectively longer than stimuli of smaller magnitudes but equal length. A possible explanation for this effect is that as the stimuli are larger there is more information for the individual to take in, causing more sensory information to be processed, in turn creating the illusion that the stimulus lasted longer in subjective time that it actually did in real time, as in information processing type models. Similarly it can be explained by arousal causing the individual to feel that the pace of the passage of time has increased as is the case in most internal clock model explanations. Other research has looked at the difference in our temporal perception of stimuli with different modalities (Jones & Wearden, 2003; Noulhiane, Pouthas, & Samson, 2009; Ogden & Jones, 2009). In general research on modality finds that auditory stimuli are perceived as longer than visual stimuli, and that estimations of the duration of visual stimuli are more variable than auditory stimuli. These differences are generally cited as having occurred because of an increase in the arousal levels in the internal clock, however the type of arousal, or indeed why arousal would be increased for one modality and not another is not discussed. Predictability or familiarity has also been shown to affect subjective reports of duration. Pariyadath and Eagleman (2007) found that when a stimulus is shown repeatedly the first appearance is judged to have a longer duration than the following repetitions of that stimulus. Likewise an oddball stimulus which is randomly interjected into a repeated series will judged as having a longer duration than other stimuli of equal physical duration. Pariyadath and Eagleman (2007) purported that a type of repetition suppression causes this illusion. They also proposed the idea that the amount of neural energy that is required to comprehend a stimulus correlates with the perceived duration of this stimulus, an idea very much in line with Ornstein's (1969) information processing storage size model metaphor, as discussed above. The majority of the research described in this paragraph is exploratory in nature in order to attempt to illuminate the mechanisms of how we time. However, as stated above, we appear to have no time perception organ, and therefore it can be difficult to state that any explanation of these effects is more accurate than others. In this way it can feel that although the effects and illusions are interesting in and of themselves, they are ineffective in leading us to a concrete answer on "how we time" and become simply a list of interesting phenomena.

Recently however there has been a growing body of literature investigating more commonly encountered situations than the isolated stimuli as laid out above. This type of research places timing firmly back in the everyday experiences of an individual. One such area which has received a lot of attention lately is the links between emotions and subjective time (Cocenas-Silva, Bueno, & Droit-Volet, 2012; Droit-Volet, Brunot, & Niedenthal, 2004; Gil & Droit-Volet, 2011). Droit-Volet et al. (2004) found that viewing emotional faces led to an increase in the pace of subjective time in the individual. However further research on this has found that in order for this increase to occur, the individual needs to be able to imitate the emotion they see (Effron, Niedenthal, Gil, & Droit-Volet, 2006). If imitation is prohibited the effect does not occur. This highlights that alongside external stimuli that are judged to be of incorrect durations, there are also internal factors that affect our ability to judge duration and can cause time to distort, in this case emotion. In order to assess whether altering the emotion of an individual caused them to experience altered subjective timing Droit-Volet, Fayolle and Gil (2011) altered individuals' emotions by engaging them in a series of movies clips. Dependant on condition these clips were neutral, sad or frightening. They found that watching frightening movie clips appeared to cause an increase in pace of subjective time in the individual. These findings highlight that it is not the external stimulus (the frightening stimulus) that is causing the temporal distortion in the individual, rather, it is the response within the individual and their internal cognitive processes which appear to be causing the effect. Further evidence for this effect of timing being affected by the cognitive processes of the individual, as opposed to the stimulus itself come from research conducted by Ogden, Wearden, Gallagher and Montgomery (2011) on the effect of alcohol consumption on timing. They found that a high dose of alcohol (relative to their study) produced effects indicative of an increased pace of subjective time in the individual.

It would also appear that some individuals are more susceptible to certain types of altered cognitive processes and functioning in their daily lives than others. This trait, known as Cognitive Absorption (CA), is an internal factor linked to Csikszentmihalyi's flow (Csíkszentmihályi, 1990) and has its basis in individual differences and personality psychology. It is measured using the Tellegan Absorption Scale (TAS) (Tellegen & Atkinson, 1974). This scale is a measure of an individual's responsiveness to engaging stimuli, responsiveness to inductive stimuli, ability to think in images, tendency to have cross-modal experiences, the ability to become absorbed in their own thoughts and imaginings, the tendency to have episodes of expanded experiences and the ability to experience altered stated of consciousness (Agarwal & Karahanna, 2000). This scale is also recognised as measuring a person's susceptibility to hypnosis (Naish, 2006; Tellegen & Atkinson, 1974). Naish (2001) points out that the majority of participants experience some degree of time distortion during hypnosis, akin to the subjective time slowing during hypnotic sessions. Naish (2006) found that individuals who have a tendency to become more absorbed in tasks experience more temporal distortion during a hypnotic session than those who do no become as absorbed. Interestingly, in addition to its links with temporal distortions cognitive absorption has been shown to correlate positively and strongly with an individual's perceived ease of use of information technology and perceived usefulness of information technology (Agarwal & Karahanna, 2000). This is likely due to the fact that individuals who are more susceptible to absorption engage with the technology to a deeper level. As absorption in a task seems to bring with it a type of hypnotic flow, which may cause the individual to spend longer using the technology and engaging with it more, it is possible that level of absorption and use of technology may be correlated. In turn, as absorption itself has already been linked to temporal distortion this could be the missing link in understanding this individual difference in temporal experience. A study examining the possibility of this relationship between cognitive absorption and quantity of use of information communication technologies is presented and discussed in Chapter Four.

As highlighted here there is an abundance of literature showing the effects of isolated stimuli on temporal perceptions, and only relatively recently there has been a shift towards investigating these stimuli in context, as opposed to isolating them. In this way there appears to have been some slight shifts in the understanding of the question of "how we time". As individuals come into contact with many different stimuli over the course of a normal day examining stimuli in the context in which we engage with them appears to expose information on our experiences of duration previously obscured. By looking at a "real world" stimulus such as use information communication technology, with its layers of single stimuli, this thesis aims to situate time perception literature in the applied paradigms, within the realm of psychology, in order to gain a better overall understanding of the temporal experiences of the individual as applicable to their daily life. However, it is important to note that there are three generally accepted separate paradigms of how we experience time in our daily lives, two of which have been briefly mentioned above, and will be more fully explicated now.

2.4 The Three Paradigms of Subjective Timing

William James (1890) was the first to make a distinction between the experiences of time as it is passing, and the memory of time in retrospect and the psychological processes that underlie the two. Nevertheless the prospective and retrospective paradigms have been often confused, or the different processes which govern them ignored for simplicity's sake. It was not until Hicks, Miller and Kinsbourne's work (1976), detailing some of the fundamental flaws in research conducted up to that point (lack of distinction between paradigms, lack of understanding of methodologies, and misinterpretation of results), that the substantial differences between these two types of human timing were finally brought to the fore, and researchers began to consider them as separate areas. Yet, as pointed out in Wearden (2005b) this confusion is a fatal flaw in any research on the psychological aspects of human timing, and confounds any real progress that could have been made up until this time. Wearden (2005a) also postulates the existence of a third type of timing judgement in humans, "passage of time judgements" as another means to fully understanding time perception in individuals. The following will give a brief overview of each of these three timing paradigms. It will also discuss the hypothesized processes that underlie each of these paradigms and also the implications of an altered pace of subjective time (an increased rate of a passage of time) on these three paradigms, in an attempt to highlight some of the seemingly paradoxical phenomena that can occur during timing judgements.

Prospective Timing

Prospective timing occurs in an experimental situation when the participant is aware that time is an important feature of the experiment (for example "tap the space key once you feel that ten seconds has elapsed"). Prospective timing judgements may be important in day to day life, for example when setting up or resetting electrical appliances one may be asked to press and hold a certain button for a number of seconds. This is prospective timing as you are aware that time is an integral aspect of the process. However, whether these types of judgements are actually commonplace in everyday timing remains to be seen. In the case of holding down a button on an electrical appliance, do we simply count, or do we hold the button down until we see something happen on the screen of the appliance? Prospective timing judgements are the simplest to study within an experimental setting and they can tell us a great amount about the pace of subjective time in the individual. Prospective timing is often explained through use of an internal clock model, such as Scalar Expectancy Theory (Gibbon et al., 1984) described above. When it is necessary to time a stimulus, in either an experimental situation or an everyday situation, a connection is made between a pacemaker (or pulse creator) in an internal clock system, allowing pulses to flow from the pacemaker into an accumulator. The accumulated pulses are then referenced with long-term memory in order to get a "feel" for the amount of time that has elapsed (Wearden, 2005b) or a threshold of pulses is reached which tells us that the time interval that we are producing has been met.

Retrospective timing

Retrospective timing judgments occur when the individual is not aware that time was an important feature of an event. In experimental situations these kinds of judgments are elicited through use of questions such as "how long has it been since this experiment began" or "how long has passed been event A and event B". Along with the third paradigm of timing, passage of time judgments, retrospective timing is probably used more often in day-to-day life than prospective timing. People often attempt to decipher how long it has been since they have been stuck at a red light, or waiting in a queue, when they were not explicitly paying attention to when the wait commenced. Retrospective timing judgements can also occur in daily life when attempting to remember when we last met an old friend, or how many years it has been since an important event.

Because in retrospective timing judgements the individual is not aware that time is of importance these types of judgements cannot be explained by internal clock models. The reason for this is that a connection cannot be established between the pacemaker and the accumulator in these models as the individual was not aware at the time to make this connection. If it is the case that the individual has become aware that timing is an issue, for example in an experimental setting if the individual's watch is removed at the onset of the experiment they may become subconsciously aware that time is the subject of the experiment and this would no longer be considered retrospective timing and would fall under the prospective paradigm (Block, 1992). These types of timing judgements are therefore most commonly described through use of a form of an information-processing model such as a contextual change model (Block & Reed, 1978) or Ornstein's storage size model (Ornstein, 1969). Essentially information-processing models predicts that the more information that has been processed since a certain event, or during a certain event, then the longer it has been since the event occurred (or in the case of a situation we are still engaged in, the longer it has been since its onset). However, as pointed out by Block and Zakay (1997) individuals' accuracy in retrospective timing judgements appear much more varied than individuals accuracy in prospective timing judgements, indicating that perhaps the process governing the paradigm is much more varied and likely to be confounded, for example through memory issues.

Passage of time judgements

Passage of time judgements are a recent addition to the area of human timing. Although there is no universally agreed upon name for these types of judgements this thesis will keep with the most popular, passage of time judgements, as laid out by Wearden (2005a). Passage of time judgements are concerned with how quickly time appears to pass during a certain situation (for example watching a movie), in comparison with either objective time (clock time) or another situation (waiting in an empty waiting room). These types of judgements are extremely difficult to accurately measure yet nonetheless are probably the type of human timing that we are most familiar with as individuals in day-to-day life. Anecdotally individuals claim that time flies when they are having fun, and that time can drag when bored. Waiting for an important day can cause time to appear to slow to a standstill. Passage of time judgements are interesting in that it is very difficult to test them independently. The feeling that time is passing faster, or slower than objective time is an entirely subjective feeling which can be difficult to quantify. Passage of time judgements are currently explained through use of Zakay's (1992) Temporal Awareness Model (Figure 2-4) among others. This model claims that the speed of the passage of time is related to two separate dimensions namely, Temporal Relevance and Temporal Uncertainty, or simply put, how important time is in the situation, and how uncertain the individual is about the amount of time that has elapsed (Zakay, 1992). The outcome of these dimensions is Temporal Awareness, which if high can make the passage of time appear to become very slow, or low can make the passage of time appear very fast. In this way a low level of temporal relevance and a low level of temporal uncertainty leads to a low level of temporal awareness, a high level of temporal relevance and a low level of temporal uncertainty leads to a medium level of temporal awareness and a high level of temporal relevance and a high level of temporal uncertainty leads to a high level of temporal awareness.

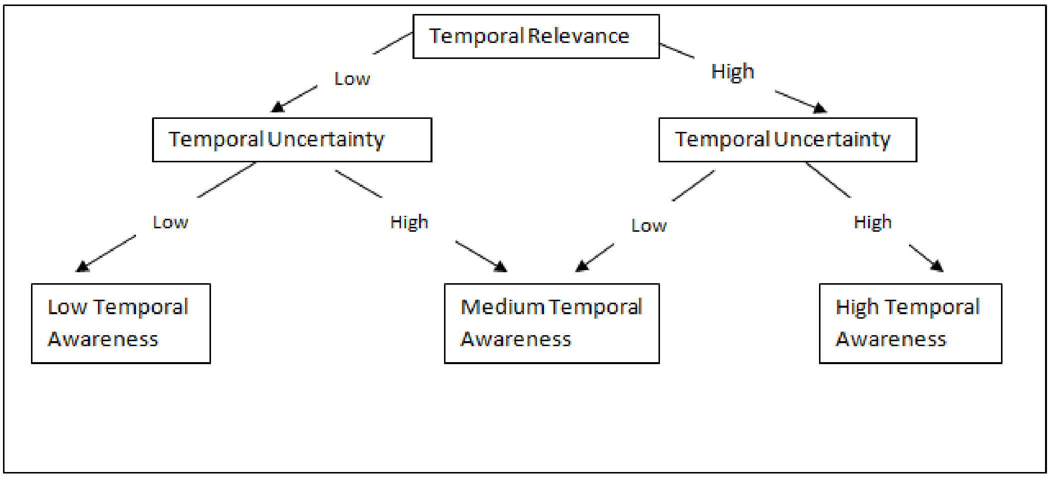

Figure 2-4: Zakay's Temporal Awareness Model (1992).

An everyday situation that clearly highlights this phenomenon is sitting in a dentist's chair getting a painful procedure. Temporal awareness is high because the individual is in pain and wants it to end as soon as possible, temporal uncertainty is high because they are unsure of how much time has elapsed and are also unsure of how long the procedure will take. This causes temporal awareness to become high leading to every second to tick by overwhelmingly slowly.

2.5 Conclusion

This chapter has given a concise overview of the history of and research conducted in relation to human time experience. It has focused mainly on research that has been conducted on the differences in timing and time distortion and the current models which are being discussed as hypothesised processes which govern these experiences. As has been mentioned, these models cannot account for all the variances and paradoxical experiences with regard time perception, however they have contributed invaluable information on how we may indeed time in our daily lives. This chapter also looked at the links between technological advances and our representation of time in modern society. The following chapter will build on this by examining literature on technology's effects on different facets of life and on the individual's psyche, and modernity and time pressure. By examining a possible link between information communication technology use and subjective time the current research aims to situate time perception in the everyday experiences of duration and investigate a possible individual difference in time perception, outside of the realms of state change studies.

Chapter Three

Technology in Modern Life

Computers in the future may have only 1,000 vacuum tubes and perhaps only weigh 1 1/2 tons. (Popular Mechanics, 1949)

Modern advances in technology have changed the way in which we live our lives. It can be easy to forget how quickly technologies such as personal computers and home internet connections have become main-stream. However, research that directly examines the effects that technological advances may have on our psyche or on our cognitive processes is rather sparse, and at times research that *has* been conducted has highlighted contradicting or paradoxical phenomena. The central aim of this dissertation is to explore and examine the possible implications of advances in technology on our subjective experiences of time. This chapter gives a brief review of some of the research that has been conducted within the social sciences on technology, its levels of use and its effects. It is divided into four sections. The first two provide evidence for the ubiquitous nature of technology in western society, and highlight predictors of technology use. The third and fourth sections look at the effects of technology and modernity on both society and individuals within those societies. This chapter highlights the disparities between the focus of research in different fields of the social sciences. The current research aims to provide some bridge in the research gap between sociology and cognitive psychology, by applying quantitative cognitive methodologies to what has mainly been a qualitative area to date.

3.1 Technology in work, school and family life.

The focus of this thesis is an examination of links between technological advances and distorted temporal experiences. It is necessary to investigate these effects on cognitive processes as information communication technologies have become a more integral part of our everyday lives. This section highlights research which shows evidence for a wide spread proliferation of information communication technologies in modern life. In just over a decade information communication technologies have become so widespread that it can seem impossible to imagine work, school or family life without them. In recent years the rate of development of more advanced technologies, available to the general public, has increased rapidly. Unfortunately the fast pace of technological change and development has made it very difficult if not impossible for research to keep up. As a result research can already seem outdated as soon as it has been published. As technology has been seen to advance at such a rapid pace and will undoubtedly continue to do so, investigating the consequences of this should be an on-going concern.

Some of the earliest and most in-depth research conducted on the use and effects of information communication technology in everyday work, school and family life was directed by Robert Kraut. In 1992, Kraut and Attewell conducted a survey of high and low volume email users working for a large multinational bank (Kraut & Attewell, 1997). In 1992 personal email accounts were relatively rare. They were interested in respondents' organizational knowledge and commitment, and also their experience of being overloaded, with regard to their level of use of the technology. They hypothesised that there would be positive effects of technology use in these regards. Of a pool of a possible 26,000 employees who had access to the email facility for almost ten years Kraut and Attewell received 973 responses. They found that heavy use of email correlated positively with an increase in the individual's knowledge of the firm and also their commitment to management's strategic direction. They also found, as they hypothesised, that heavier use of email did not increase their psychological experience of being overloaded. They argued that this could be because email is relatively non-intrusive and does not interrupt normal work flow. However, as people did not have the same access to information communication technologies that individuals today have the vast majority of the emails that participants were receiving were work related. Today, people can be in constant contact with people outside of their own organisation through their email, text messages and social networking. Therefore a hypothesis in today's society would likely differ from Kraut and Attewell's. As such, these kinds of communications today could perhaps have a detrimental effect on their work lives, and add to their feelings of overload. This therefore highlights the need for the research in early studies in the field to be replicated and not taken out of context when being applied to today's society.

In 1995 a team of researchers led by Kraut began the "Homenet study" (Kraut et al., 1998) which utilised longitudinal data to examine the relationship between use of the internet, social involvement and the consequences of social involvement. The research tracked the behaviour of 169 participants from 93 different families in the first two years of their use of the internet. Internet use was recorded automatically and levels of social involvement were recorded using self-report questionnaires. These questionnaires included questions on family communication, size of local social network, size of distant social network and social support. Kraut et al. (1998) found consistently negative effects from greater use of the internet. Greater use of the internet correlated with declines in family communication, and a number of other declines in psychological wellbeing (which will be discussed below). However, a closer look at Kraut et al.'s figures reveal that the mean number of hours spent using the internet was merely 2.43 hours per week. Again it is difficult to apply these findings to today's information communication technology (ICT) users as the nature of the ICTs used has changed vastly. However, the finding that the introduction of communication technologies changed the face of family life still stands today; this can be seen in some of the more recent research that has been carried out.

Recent research into information communication technologies has looked at use of the same technologies in both work/school and home life. This type of research demonstrates the increase of use in these technologies in most aspects of modern life. Much of this research has been conducted investigating the impact that that ICTs may have on family life. It would appear that these technologies have affected the structuring of work and home life, blurring the boundaries between the two. The long-term implications and consequences of this shift remains to be seen. Research conducted by Cardenas, Major and Bernas (2004) found evidence for a link between work/home interference and low job satisfaction. They also found that the family boundary to be more permeable than the work boundary, that is that individuals reported being distracted by work issues more when at home, than by home issues while at work. They argue a type of "spill over" effect that can cause tensions from work/ home to affect other areas of one's life. To this "spill over" effect they added the idea of time based conflict, that is that spending more time in one role, leaves less time for the other role, and can also have negative effects. In order to counter the negative effects they advocate creating impermeable boundaries between home and work with regard ICT use. Park and Jex (2011) built on this work by investigating the role of ICTs in this blurring of boundaries. They claim that ICTs may cause employees to experience greater distractions by allowing the individual to be connected to both work and home, regardless of their location. They found that although these technologies can cause some individuals to experience interference, that this interference can be successfully mediated by the individual putting in place impermeable boundaries on the tasks that they use ICTs for when in work or family situations. This approach however involves the individual making a conscious decision on the ICT use, and following through on this decision. As ICTs appear to give us an on-going opportunity to engage in endless different behaviours and actions through use of their integrated capabilities, adhering to a decision to not utilise all the functions of the technology may indeed be increasingly difficult.

Adolescents today have been surrounded by ICTs since their birth, and tend use ICTs to a greater extent than the older generations. Use of ICTs appears to be almost required in Western society. Younger generations are aware that in order to be employable, especially in unpredictable economic times, they need to be as up to date with new innovations in technology as possible. As pointed out by Lee, Rhee and Dunham (2009) it is a competitive necessity to have employees that are fluent in the ways of the world, not simply a luxury. It would appear that adolescents view virtual communication as a supplement to, rather than a replacement of, telephone and face to face interaction (Subrahmanyam, Kraut, Greenfield, & Gross, 2000) and so constant communication appears to be a fundamental aspect of modern living. It is therefore important that the cognitive effects of these ICTs are examined reliably and in detail in order to ascertain the possible consequences of their use.

The dynamic interaction between our everyday lives and technology appears to have changed the normative structure of day to day existence. As seen above, there is evidence that ICT use may be linked to some issues in psychological health, simply through these changes to our everyday structure. Some of these changes have indeed been positive but there are also negative aspects to this, and as already stated the long term consequences of these changes remain to be seen. Highlighting these alterations and replicating the research on an on-going basis should be seen as essential as ICTs continue to advance and permeate all aspects of everyday life.

3.2 Technology and the Self: Factors that affect or predict ICT use and acceptance

When demonstrating the proliferation of information communication technologies in everyday life, it is also important to highlight who is using these technologies. However there are subtle differences between using these technologies, and fully engaging with these technologies. It is one of the aims of this thesis to investigate any link between increased use of information communication technologies and altered temporal experiences. The difference between ICT use and ICT acceptance may appear to be subtle however to fully understand the difference it is important to realise that most research on these issues has been conducted from a marketing, and research and design point of view. Market research conducted in the area focuses simply on who is more likely to use and to accept new technologies without looking at the effects of these technologies on the individual. As information communication technology becomes ubiquitous this type of demographical information may become redundant. However when looking at an effect of the technology use on the individual, we must also examine whether there is a confounding factor which has caused both the effect in the individual and the technology use. Research looking at use of new technologies such as ICT's quantifies the amount of technology that is being used by different groups of individuals. This type of research may be looking for factors that predict use in different groups in order to highlight possible outcomes of these levels of use, for example, the possible effects on psychological wellbeing. Research on ICT acceptance is generally conducted by marketing companies in order to predict who will be most likely to take their new innovations on board and how they should market to individuals who score low on acceptance. The following section will look at some research that has been conducted looking at personality type, race and age as predictors of ICT acceptance and use. It is clear that a large percentage of the research that is being conducted is on adolescents and young people. This may be because they are the future consumers of these products and are the target market.

In order to predict who would use new technologies some researchers have turned to cognitive styles and also personality types. Use of cognitive styles as a method predicting ICT use was for many years not accepted (Huber, 1983). However there has been research that demonstrates validity in the claims that certain traits have a causal relationship with use and acceptance. For example Zmud (1979) found a link between attitude of the user and the success of management information systems. More recently Lee, Rhee and Dunham (2009) investigated the role of organisational and individual characteristics in relation to the acceptance of ICTs. It was hypothesised that a positive attitude to change would be positively correlated to perceived ease of use and usefulness of ICT. They investigated a number of different variables such as attitude towards change, work group characteristics, ease of use, and usefulness and user satisfaction in a sample of 236 Korean workers in the United States. It was found that work group characteristics and attitude towards change influenced the participants' perceived ease of use of a technology. This ease of use was directly related to usefulness, suggesting that people are more likely to find a simpler technology more useful. They also found a negative correlation between job stress and ease of use, indicating that workers under too much pressure are more reluctant to accept new technologies. This highlights an internal struggle that individuals may be experiencing with regard their technology use. It would appear that technology use does not always help the individual, through time saving and or through aiding efficiency. For some, it may be causing and adding to stress.

Recently this area has received a great deal more interest, perhaps motivated by marketing considerations, as competition between differing information technology companies increases. As mentioned above, a great deal of the research conducted focuses on adolescents and young adults. Ehrenberg et al.*'s* (2008) paper *Personality and Self-Esteem as Predictors of Young People's Technology Use* examined 200 students in the Queensland University of Technology, who owned mobile phones and also had access to a computer and used instant messaging services daily. They administered the NEO-FFI Personality Inventory(Costa & McCrae, 1992) and the Coopersmith Self-Esteem Inventory(Coopersmith, 1989) in order to assess personality and self-esteem and collected data on the level of ICT usage. They found evidence for some addictive tendencies. They also found that disagreeable individuals reported greater mobile phone use for calls and instant messaging (IM) use. Extroverts reported more SMS use along with people higher on the neuroticism scale, who reported significantly higher SMS and IM use.

Individuals who ranked lower in self-esteem reported stronger IM addictive tendencies.

Devaraj, Easley and Crant (2008) created a research model (Figure 3-1) based on the Big Five and technology acceptance and use, which had statistically significant links. They reasoned that as personality is linked to actual behaviour; it could be used to predict use. They added to this the idea of subjective norms, reasoning that personality traits would be related to these, and would predict whether individuals would be more accepting of new technology if they felt that this was expected of them. They studied a pool of 180 students. All students received training on new software; however there was no requirement that it be used after training. Participants were measured on their intention to use the new technology, their self-reported ability at using it and were also administered the NEO-FFI (Costa & McCrae, 1992). Their measure of subjective norm was adapted from Taylor and Todd (1995). As can be seen in Figure 3-1, they found that the Big Five personality constructs had a direct impact on perceived usefulness and subjective norms, moderated the relationship between perceived usefulness and intention to use and also moderated the link between subjective norms and intention to use the technology. They did however find that the links between the personality trait openness and intention to use technology were not as straight forward as they hypothesised, rather, it affected intention to use through a gateway of the perceived usefulness and was not directly linked with intention to use.

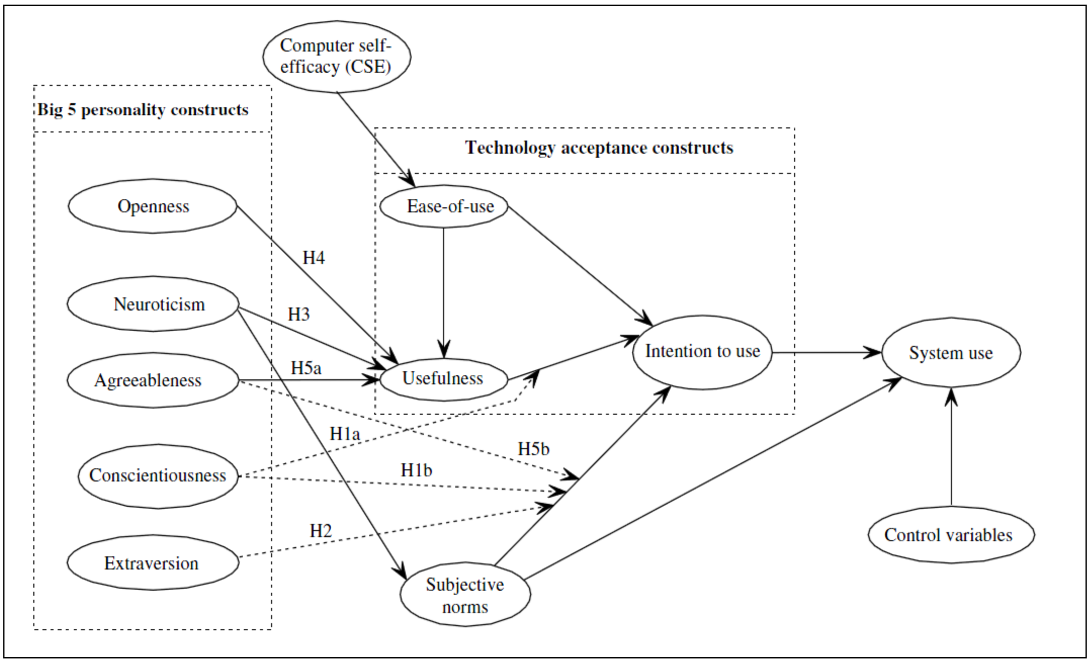

Figure 3-1: Taken from Devaraj et al. (2008). Relationship between the Big Five and technology use and acceptance.

Other research in this area has also examined the idea of "openness" and technology use, through use of a similar trait named cognitive absorption. As has been mentioned this is an internal factor, linked to Csikszentmihalyi's flow (1990) that has its basis in individual differences and personality psychology and is measured using the Tellegan Absorption Scale (TAS) (Tellegen & Atkinson, 1974). It is connected to the trait of openness and is a measure of an individual's responsiveness to engaging stimuli, responsiveness to inductive stimuli, ability to think in images, tendency to have cross-modal experiences, ability to become absorbed in their own thoughts and imaginings, tendency to have episodes of expanded experiences and ability to experience altered states of consciousness (Agarwal & Karahanna, 2000). Agarwal and Karahanna (2000) sought to investigate the link between technology users' levels of cognitive absorption and their beliefs about technology use. Through a review of previous literature in the area they define cognitive absorption in a technology as a state of deep involvement with technology which is exhibited through five dimensions; namely, temporal dissociation (the inability to register the passage of time), focused immersion (total engagement), heightened enjoyment, control (the user perceives being in control of the interaction) and curiosity. They hypothesised that cognitive absorption in a technology would have a positive effect on perceived ease of use of the technology and also that cognitive absorption with a technology would have a positive effect on perceived usefulness of a technology. In order to measure "cognitive absorption with a technology" they created their own version of the TAS, tailored specifically to examine absorption in the technology as opposed to the individual's own level of cognitive absorption in general. They also measured other variables such as self-efficacy (using a ten item scale by Compeau & Higgins, (1995)), and perceived usefulness and ease of use (adapted from scales by Davis,(1989)). A total of 288 individuals participated in the study and they found strong support for their hypotheses (Agarwal & Karahanna, 2000). Lin (2009) also makes use of the "cognitive absorption in a technology" definition as laid out by Agarwal and Karahanna (2000) (that is, absorption as defined by the five dimensions described above). It was hypothesised that cognitive absorption in the technology would affect individuals' intentions to use a virtual community through perceived usefulness and ease of use of said community. The study was conducted in a similar vein to Agarwal and Karahanna (2000) and support for this hypothesis was found.

These findings highlight that there are internal factors in the individual which can indeed affect or predict their levels of technology use. In order to fully explicate any relationship between an individuals' use of technology and their experience of time's passage it is important that any confounding variables which may also be affecting this relationship must be investigated. In this manner the area of cognitive absorption and technology use also needs to be investigated. As has been mentioned in Chapter Two absorption has not only been studied with regards technology. As an internal factor within individuals, their own varying levels of susceptibility to this trait can affect their perceptions of the world around them on an on-going basis. Individual levels of this trait have been used to test their hypnotisability by researchers such as Naish, who has also found links between level of this trait and the amount of temporal distortion experienced by individuals during a hypnotic session (Naish, 2006). This has already been discussed in the previous chapter. The current research examines the trait of absorption, as measured by the TAS (Tellegen & Atkinson, 1974), as an internal causal factor in the actual level of ICT use in individuals, as opposed to the previous research which looked at links between absorption and perceived ease of use and usefulness of ICTs. In this way it examines whether absorption may play a role in the temporal experience of individuals with differing levels of ICT use.

The previous findings that have been presented here highlight the proliferation of information communication technology in everyday life. The following section looks at research which has been conducted on links between this proliferation and the pace of life and time pressure experienced by individuals in modern society.

3.3 Technology, Pace of Life and Time Pressure

The literature outlined in this section draws heavily from the field of sociological and anthropological research. The previous chapter has touched on some of the research conducted investigating modernity and time pressure. An interdisciplinary approach is vital in research into the area of time perception, time pressure, pace of life and technology as the research conducted in the sociological and anthropological fields often lack the empirical evidence necessary to draw solid, replicable conclusions on the effect of technology on the experience of time. As mentioned in Chapter Two there has been little research in the area of psychological time perception looking at stimuli such as modern society or technology. Areas such as sociology and anthropology have discussed links between modernity, technology use and time pressure at length, yet lack an empirical, cognitive basis for their conclusions (Gleick, 1999; Levine, 1997; Rosa, 2007). Psychological research on the use of technology tends to focus on psychological wellbeing and the mental health consequences of overuse, yet overlook the effect that daily technology use may be having on our executive functions and information processing. Garnering empirical evidence of a cognitive effect of technology use benefits both fields and leads to an overall deeper understanding of the effects at play. A link between pace of life and time pressure is to be expected. As the speed of pace of life increases, the subjective feeling of available time decreases causing a sense of time pressure within the individual. An increase in the speed of the subjective time could lead to increased pace of life and therefore in turn be causally linked to increases in time pressure. Highlighting the possible cognitive mechanisms that could be responsible for this link will provide a basis for these different fields of research to unite in a more holistic understanding of human experience. The current research aims to bridge the gap between the different disciplines by taking the concepts of an altered speed of subjective time and modernity, and examining the links between them in order to highlight any possible cognitive basis for issues that have mainly been discussed within sociology to date. This section looks at the ideas of modernity, acceleration, pace of life and time pressure.

Within sociology it has been long observed that with modernisation, the pace of life has increased. Kosselleck (1990) claims that individuals as far back as the French Revolution complained of the speed of modern living and that in 1877 W.G. Greg saw high speed and the pressure it put on life as the most significant aspect of the time. Harmut Rosa (2007) one of the most prolific researchers in the area has developed a model outlining the relationship between the dimensions or motors of acceleration in society (Figure 3-2).

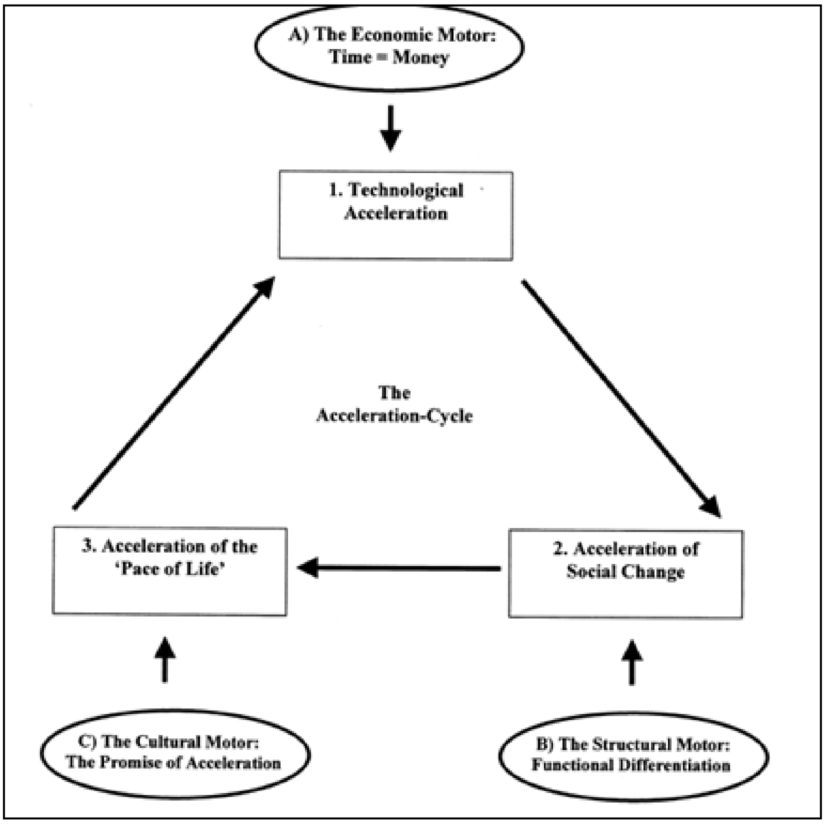

Figure 3-2: The Acceleration Cycle (Rosa, 2007)

As can be seen in the model, the relationships are dynamic and cyclical. Rosa claims that western economies impact on the technological acceleration, which leads to an acceleration in social change within the society, which in turn causes individuals to experience an increase in the pace of life of that society, and initiates a need for faster technologies. Through an interdisciplinary approach, it would be possible to investigate a cognitive basis for these relationships. If technological acceleration associates with acceleration in subjective timing, it may also be linked to the pace of life in a society which, as in Rosa's model, would in turn accelerate the need for further technological advances. This will be discussed in more detail in the coming chapters.

The advent of new technologies is often cited as being causally related to beliefs on increased pace of life and time pressure. Rosa sees this as the paradox of time, claiming that although there is an increase in the technologies that are purported to aid saving time, individuals feel as though they have less time and experience more time pressure (Garhammer, 2002). Chesley (2010) found through research on over 2000 participants that ICT use was connected to accelerated pace of life and subjective time pressure. Similarly Garhammer (2002) indicates that mobile phone users and internet surfers report higher scores of time pressure, while Southerton (2007) finds that individuals appear to attempt take control over their subjective time pressure by turning once again to these technologies, to little avail.

Individuals in modern society appear to have a complex relationship with time and their beliefs regarding time pressure. It would appear that being busy (and therefore under time pressure) are seen as indicators of success (Hochschild, 1997). This type of "event society" places importance on **number of events**, with individuals multitasking in order to experience more events in a smaller time frame (Garhammer, 2002). However as Garhammer points out, a higher pace of life is also, in this manner, sometimes associated with higher levels of life satisfaction and happiness which leads some people to wonder why increases in pace of life (and therefore also time pressure) is a negative aspect of modernity. Pace of life and time pressure appear to have serious ramifications on both mental and physical health (Roxburgh, 2004; Zuzanek, 2004). Roxburgh's (2004) research involves a study examining the mental health consequences of time pressure on 790 respondents to the Roxburgh Time Pressure Scale, which investigates subjective time pressure experiences. The results indicated that high time pressure was significantly and positively related to depression among both men and women. Levine's (1997) research looking at the pace of life in 31 countries ranked Ireland as having the second fastest pace of life, second only to Switzerland, heightening the need for investigation into cognitive aspect of time experience and causes of time pressure.

However, researchers cited in this section do not give any indication of cognitive processes which may contribute to the effects found. This is perhaps linked to the field of study from which they originate. Investigating a cognitive basis for these findings may prove more fruitful in fully understanding the dynamics of modern society. If technology and modernity are linked to increases in both pace of life and time pressure it is likely that this trend will continue. As advances in technology accelerate rapidly it is increasingly important to call attention to the effects and ramifications that this acceleration may be having. Technology has undeniably changed the way in which we conduct our day to day lives. As huge portions of our lives become integrated and automated, it can be hard not to speculate on the possible ramifications on our executive functions. The ways in which we code information and store memories, multi task, plan and problem solve, have undoubtedly been changed through the use of technology, however outside of sociological findings there is little research being conducted on these aspects of modern life. Fields of research such as sociology have highlighted the possible causal links between modern society and acceleration; however it is essential that the effect on cognitive processes underlying our subjective experiences of time is also examined from this point of view.

3.4 Psychological Impact of Technology Use

Most previous research in the area of psychological impact of technology use has focused on psychological well-being; however conclusive findings are hard to come by as the dynamic nature of technological advances can cause findings to become obsolete rapidly. The impact of technology and techno-centric societies on the areas of time perception and cognition appears to be relatively untouched within psychology. The current research is intended to contribute to the investigations into these possible effects. This section will discuss some findings from previous research on psychological impact of information communication technology use, highlighting that previous research has tended to focus solely on the effects of technology on mental health. It will also discuss some issues that need to be taken into consideration when analysing this research.

There appears to be two opposing factions when it comes to the psychological effects of technology use. The utopian view argues that ICTs allow for such things as greater levels of communication between individuals regardless of their physical location (McKenna & Bargh, 2000). McKenna and Bargh also refer to previous literature to highlight that there are many positive aspects to internet use ranging from the positive effects of anonymity, lack of time restraints, reduction in social anxiety, and a decrease in the emphasis placed on physical attractiveness (see (McKenna & Bargh, 2000). This view welcomes the new technologies as only a good thing yet often fails to acknowledge the bad. The dystopian view, on the other hand, appears to be almost fear driven. It is motivated by research that purports that use of technology removes people from the "real" world, causing lower levels of social development and less time spent with family. An often cited report published in 2000 by the Stanford Institute for the Quantitative Study of Society, which was never submitted for peer review, included a press release which claims that of the 4112 respondents to their online survey, a quarter of the individuals who had been using the internet for more than 5 hours per week felt that it had reduced their time spent with family and friends. They also claim that a quarter of regular internet users, who were employed, felt the Internet was responsible for increased time they spend working from home, without a reduction of hours spent at work (Nie & Erbring, 2000). As these findings received press attention at the time, they heightening the support for the dystopian stance, however a review of the data provided allows for no deeper analyses of their findings and appears to have involved no statistical analysis.

As has just been mentioned one of the initial studies conducted looking at the effects of technology use on psychological well-being was, as previously mentioned, Kraut et al.'s (1998) Homenet longitudinal study. They found that greater technology use correlated with increases in loneliness, increases in depression and a decrease in the local social network. Therefore they purported that using the internet led to a decline in psychological well-being. They labelled this as an “internet paradox” as the individuals who participated in the research mainly used the technology to communicate, which would commonly have positive effects. These negative effects, found so early in ICT’s mainstream popularity did nothing to quell the dystopian view of these new technologies. However, in 2002 Kraut et al. published a follow up to the previous research, on data collected in 1998-1999. With this they found that more use of the internet was linked with a large amount of variables linked to overall psychological wellbeing. They found increases in local and distant social circles, face to face communication, community involvement and trust (Kraut et al., 2002). They qualified their findings with a type of “rich get richer” model. That is, that use of ICTs predicted better outcomes for extroverts, or those in an already high standing in their social circles, and worse outcomes for introverts, or those who already shied away from social interactions. Wastlund, Norlander and Archer (2001) attempted to replicate Kraut et al.’s (1998) study using students in Karlstad University, Sweden. In total 329 participants responded to their questionnaire based study, which aimed to examine the causal relationship between technology use and psychological wellbeing. In order to examine psychological wellbeing they administered 5 different scales to participants, namely the Life Orientation Test, The Pittsburgh social extraversion-introversion scale, the UCLA loneliness scale, the hassles scale and the CES-D scale which measures depressive state. However, they failed to find any support that ICT usage would lead to lower levels of psychological wellbeing.

Once again highlighting the profound effect that availability of advanced technologies has on the structure of daily life Gross, Juvonen and Gable (2002) suggest that along the lines of intimacy theory the closeness of the partners whom individuals spend their time communicating with online has an effect on their wellbeing. They took measures of after school activity, loneliness, social anxiety, friendship and depressed mood and had participants make detailed logs of their ICT use. As they predicted they found no correlation between time “online” and psychological wellbeing. However, it appeared that individuals who felt more loneliness or social anxiety on a daily basis were more likely to communicate with individuals who they did not know very well when online and those who felt less loneliness and social anxiety on a daily basis were more likely to use ICTs to seek out friends they knew in their everyday lives and use these technologies as additional methods of interacting with them.

Jackson (2008) gives a thorough breakdown of research that has been conducted on technology use in the social sciences. Jackson’s (2008) review concurs with the need for research to be conducted investigating the effects of technology on cognitive processes. It is necessary that this research is conducted from an unbiased viewpoint, in order to fully understand any effects that occur. Examining the effects of technology use on psychological well-being, although interesting has failed to produce any convincing data supporting either the dystopian or utopian factions. However, examining how technology may be affecting our actual perception of the world around us through a cognitive effect may indeed prove more compelling. Previous researchers have focused their attention intently on mental health, without considering the possible cognitive mechanisms which may underlie these alterations in psychological wellbeing. As has been shown above, technology, modernity, pace of life and time pressure are intricately linked. Time pressure itself is also linked to low life satisfaction and mental health (Roxburgh,2004). Examining the direct link between pace of subjective time and technology use will broaden the area of research on technology into the cognitive domain. Jackson (2008) also highlights the contradictory nature of research that has been conducted within the area. She makes the point that research has shown links between technology use and greater social well-being, less rule breaking and less attention problems, but she also counters this with research that highlights that technology use appears to be linked with greater levels of depression, social withdrawal and in the case of gaming, violence. She mentions that users can utilise the internet to support their maladaptive behaviours, for example accessing pro-ana websites to gain knowledge on how to conceal weight loss or to support beneficial behaviours such as joining online support groups. Jackson (2008) purports that outside of extreme cases where individuals overuse ICTs, there is little compelling evidence that these technologies help or hinder psychological wellbeing. A complete overview of research on both sides of the technology debate shows that, as with most things, there are both positive and negative aspects to using technology. Investigating the cognitive processes which are being affected by use, will aid our understanding of what it is about technology that can causes both such conflicting experiences.

3.5 Conclusion

This chapter has highlighted some relevant findings on technology use in modern life. It should be clear that this research is often contradictory and complicated by the rate of advance especially in information communication technologies. These advances in ICTs have altered the way in which we live our lives. As highlighted in the first two sections of this chapter information technology use has become almost ubiquitous and has altered the normative structure of work, school and family life. This change has led some researchers to suggest that there are links between technological advances and increased pace of life and time pressure. However within the area of psychology most research has focused on the effects of technology use on psychological well-being and mental illness, with little research looking at the effects of technology on perception and cognition. The following three chapters outline a series of five studies conducted investigating technology use and its links to distorted temporal experiences in the individual.

Chapter Four

Development of the Everyday Technology Use Questionnaire (ETUQ) and the ETUQ in Practice

This chapter looks at both the development of the Everyday Technology Use Questionnaire (ETUQ), and also a study conducted using this measure in order to investigate individuals' self-reported use of technology and their level of the trait absorption.

4.1 Development of the Everyday Technology Usage Questionnaire

The current section describes the development, pilot testing and item reduction process of a questionnaire focusing on the use of everyday technology. To date there have been very few questionnaires developed which can be used to explicitly illustrate and measure how much technology a person is using and/or being exposed to in their everyday life. Previous research in the area appears to have focused on different aspects of technology use than the present research. For example some research tends to be focused on sub groups of people such as the elderly (Rosenberg, Kottorp, Winblad, & Nygård, 2009) or those with cognitive impairment (Nygård & Starkhammar, 2007) and their ability to use technology. Further research has looked at acceptance and perceived usefulness of technology on a day to day basis (Agarwal & Karahanna, 2000; Davis, 1989) and others have looked at the use of technologies in practice and treatment (Eonta et al., 2011; McMinn, Bearse, Heyne, Smithberger, & Erb, 2011). In these cases the amount of technology being used is not simply quantified, rather it is the experience of using the technology that is being examined. These types of questionnaires were not appropriate for the research being conducted here. In this thesis it is the overall exposure to and use of information communication technology that is of interest. Research outlined in Chapter Three, such as Kraut et al. (1998) and Park and Jex (2011), utilised detailed journal entries to quantify the amount and type of technologies being used or very simple questions based on the amount of technology being used respectively. Neither of these options would have been appropriate within the current research. A longitudinal study looking at technology use over an expanded period of time would be unfeasible within the constraints of postgraduate research, whereas the validity of the study would be compromised if simply a handful of questions on technology use were asked. In order to add to the literature in a meaningful manner it was decided that a fully developed and tested questionnaire was needed. This allows for future researchers in the area to gather comprehensive information on both the amount and the type of technology being used with minimal time restrictions.

The lack of questionnaires dealing with the level of everyday technology usage may also perhaps be a result of the term "everyday technology" being so ambiguous and use of technology increasingly hard to pinpoint. In today's technologically advanced world most individuals are surrounded by different types of technology. In order to categorise individuals in to groupings such as low, mid and high level users of everyday technology there are a lot of issues which need to first be addressed. For example can microwaves and other household appliances such as refrigerators be counted as technology, as we know it today? Is a person sitting at a desk with a computer for eight hours a day but rarely doing more than using it to check emails and surf the web being as affected by this technology as someone who is working solidly writing computer programmes on it for four hours? Would they be deemed a higher level user? The question here can also be seen as one of quantity versus quality and depends on the type of question you wish to answer within your research. The ubiquity of technology of all kinds effectively makes the idea of looking at technology's effects on cognitive processes impossible in a clear manner. But by isolating those aspects of technology that people perceive as *technology*, and that which affect them as technology rather than as something taken for granted, or so deeply engrained in their habit is important in order to overcome this hurdle. In order to gain a full understanding of what individuals mean when referring to technology in today's society, or indeed what characteristics they would expect in a high level user an initial qualitative aspect to the development of this questionnaire was essential.

4.1.1 Focus Groups

Participants

Eight individuals contributed knowledge to this section of the development. These were split into two focus groups of three and five individuals. All eight were postgraduate researchers in Mary Immaculate College, Limerick.

Aims and Format

The aim of the focus groups was to investigate peoples' attitudes towards everyday technology, in particular time saving technologies, to examine what exactly individuals consider to be everyday technology and to determine exactly how they would go about grouping other individuals into categories such as high, mid and low level technology usage. The researcher decided on a number of skeleton questions in order to help structure the focus groups and also to help keep the conversation on topic. Participants were gathered from the postgraduate student body in Mary Immaculate College, Limerick. They were drawn from a range of disciplinary backgrounds such as English, Psychology, Media, Philosophy and Geography. All participants were informed that they would be taking part in a conversation on everyday technologies in their lives and were informed that these conversations would be recorded as part of the facilitator's research. All gave full consent to participation. A total of eight individuals participated in the focus groups and these participants were divided in to two focus groups of three and five participants respectively. The focus groups were conducted over two days in a quiet room on campus in Mary Immaculate College. A Sanyo Stereo Digital voice recorder *ICR-B170NX* was used to record the conversation. The researcher asked questions such as "What would you consider to be an everyday technology?" in order to get conversation flowing and to keep it on a relevant topic. Both focus groups continued until the researcher felt that all issues had been exhausted and all relevant issues had been dealt with. The first focus group lasted 19 minutes and the second lasted 28 minutes. After the focus groups were completed the data that had been obtained on the digital voice recorder was uploaded to an Mp3 player and was transcribed by the researcher in to a word processing package. Full transcriptions can be seen in Appendix A and B.

Analysis

The researcher utilised the Grounded Theory (Glaser & Strauss, 1967) approach when analysing the data. Domain analysis was carried out on the transcriptions to assess the major domains and sub domains in the text. The researcher firstly deciphered meaning units from the transcriptions; these in turn were grouped in to sub-domains, which were further grouped in to domains. In all, three domains were identified which broke down in to eight sub-domains (see Appendix C for full code book). The three major domains which were identified were: *Types of everyday Technology, Ambiguous aspects of technology* and *the Effects of Technology.* These domains can be broken down into sub domains as follows:

Types of Everyday Technology*:* computers, phones, household appliances.

When asked what they would consider to be an everyday technology the first examples given by the participants in both focus groups were mobile phones and computers. This can be seen in 1:1:2:1, 1:1:3:1, 2:1:3:1 and 2:1:2:1 in the focus group transcriptions in Appendix A and B. Participants also classed microwaves (1:1:6:1 and 2:1:5:1) and cookers (1:1:8:1 and 2:1:10:1) and other general household appliances as having a time saving element, however they did not seem certain in this "Were they time saving or were they just enhancing convenience?" (Speaker 2, focus group 1), "I dunno if it's time saving, because I wash the dishes quicker, just washing them, than sticking them in the dishwasher. It takes about nine hours for the dishwasher...do you know what I mean like?" (Speaker 1, focus group 2). The conversation appeared to continuously refer back to mobile phones and internet/computer, with a focus on the idea of instant communication being the biggest feature of an everyday technology.

***Ambiguous aspects of Technology**:* what is technology? Generational effect, determining level of usage

Participants seemed aware that technology, and more importantly what we as a generation would consider a new technology, is increasingly hard to pin down. They claimed that it was an abstract term (1:10:10:1), and their lack of a direct ability to give a definition of technology was displayed in sprawling answers in their replies "But all this technology, it almost creates a fetish out of things. Like these virtual worlds, life without life, decaffeinated coffee, it's coffee without coffee, cybersex, sex without sex. It's just dichotomies and oxymorons but people still go for it because it's easy. A new fetish is created all the time."(1:5:86). They felt that items that were new within our generation would be the key as there may be generational effects which would cause some people to see the fridge (2:3:23) or sliced pan as new technology (1:2:26).

When attempting to decide how best to quantify level of use participants felt strongly that a level of integration in the information communication technologies would show a person to be a higher level user of these types of technology "Even you see less and less people listening to music on their mp3 player because they just plug their headphones in to their phone. Or Discman, no one listens to Discman anymore. It's all about condensing multitudes of technologies into one. Making it smaller. That's even time saving in general" (Speaker 2, focus group 1, 1:4:59)

***Effects of Technology**:* pro's, cons.

The participants felt that there were two main pros to the information communication technology's advances. These were the convenience factors (which can be seen at 1:1:20, 1:2:41: and 2:6:50) and the time saving aspects (seen at 1:2:29, 2:2:19 and 1:4:59). However they also felt that there was a number of cons to these advances, such as them filling time rather than saving time “And even all the increases in technology create more things to do. You never hear of someone sitting down anymore, there always has to be some kind of activity” (Speaker 2, focus group 1, 1:5:78), “But then if you go back to the point made at the start, if you didn’t have your phone, you'd be saving more time. In the same way if you didn't have the internet if you didn't send back an email you wouldn’t be getting back an email, and then you write back to that so maybe your losing time because of this technology rather than saving any time” (Speaker 4, focus group 2, 2:13:10).

Creating the original ETUQ

These domains were then used to create an initial Everyday Technology Use Questionnaire for the pilot study. The items in the questionnaire were not directly based on the domains identified in the focus groups; rather the researcher used the domains identified in order to focus the items on what was commonly understood to be everyday technologies and aspects of technology use. It was decided to focus mainly on the amount of technology being used but to also ask participants questions based on how many different types of mobile devices they used in order to address the integration issues that focus group participants discussed. Questions were also included based on the types of actions that the individual was conducting on each device, allowing for individuals who engaged more with these devices on a normal day to be classed as higher level users than individuals who, although around these technologies, were not actively engaging with them.

The researcher combined these findings on attitudes towards technology and used them to formulate an initial Everyday Technology Use Questionnaire (ETUQ) for the pilot study. The research focuses primarily on computer and mobile device use, as these forms of information communication technologies were the most synonymous with advances and were felt by the participants to have an emphasis on time saving and management.

The Initial Everyday Technology Use Questionnaire

The initial questionnaire contained questions split into three sections: Demographic information, Personal Computers, and Mobile Devices. Demographic information such as age, education and gender were collected. The Personal Computer section included 23 likert scale questions including things like "How dependant do you believe you are on computers?", "How aware do you feel you are of the features, functions and capabilities of personal computers", and questions based on the frequency that the individual used a personal computer to carry out tasks such as creating databases, checking email, watching DVDs, banking online etc. The Mobile Devices section contained 14 questions, based on the frequency of using mobile devices to carry out tasks such as making phones calls, checking the time, setting alarms, taking photos and browsing the internet. The "mobile devices" that participants were asked to concentrate their responses on were mobile phones, PDAs, MP3 players and Digital Cameras. It is important to note that this questionnaire was developed just previous to the release of the iPad in Ireland and therefore the domain of tablet computing was not mainstream at the time. This, in itself, highlights the rapid progression of information communication technologies in modern society. See Appendix D for a full copy of the initial ETUQ used in this pilot.

4.1.2 Pilot-testing of the Everyday Technology Usage Questionnaire (ETUQ)

Participants

The ETUQ was administered to 200 individuals during its pilot. The majority of the participants were students of Mary Immaculate College, Limerick. They were recruited using convenience sampling on the college grounds. 69.5% of the sample was female and the mode age group was “under 21 years of age”.

Procedure

Participants were selected using convenience sampling and were approached on the Mary Immaculate College campus. The majority of the participants were asked to participate while waiting to partake in another study or to attend a first year undergraduate English lecture. The researcher encouraged the participants to feel free to point out any errors in the questionnaire such as misspelled words and typos and to ask for further explanation if they found a question to be worded peculiarly. The researcher made a note of any such issues which arose in order to correct them in further revisions of the ETUQ.

Materials

The newly developed ETU questionnaire contained 37 items on two scales: computer usage scale and mobile device usage scale (please see Appendix D for a full copy of the piloted ETUQ). The items were mainly presented as questions in the present tense (how often do you use your personal computer to perform the following tasks: checking email, playing video games etc.). The response to these questions was via a Likert scale. Lower responses on the Likert scale indicated a lower level of usage. In addition to these scale questions there was demographical questions and also two questions which related to the amount of hours each participant spent on a computer on a typical day. There was a possible score range of 32 – 216.

Analysis and Adjustment of scale items

After all 200 questionnaires distributed had been completed data was inputted in to PASW Statistics 17 for data analysis. Descriptive statistics were examined first. The researcher made note of any questions which appeared to yield similar responses across the sample. As a result it was decided that in order to yield a more accurate result six items from the computer use scale should be removed and placed in a separate section. These were items 16- 22 on the initial questionnaire as in the appendix. These items involved tasks such as online banking and watching DVD's and it was reasoned that these could not be placed on the same frequency scale as checking email and writing documents as they are simply not tasks that the average individual could be doing several times a day. Cronbach's Alpha was carried out on both the computer usage scale and the mobile device usage scale in order to test the internal reliability of the scales and finally factor analysis was conducted to facilitate item reduction.

4.1.3 Results

Item and Scale Characteristics

Of the 23 item computer usage scale all items showed a good corrected item scale correlation (r >0.3). There was an original Cronbach's alpha coefficient of .76 however when item 3 "How long do you spend on the Internet in the average day" was deleted from the scale this rose to .79. It was decided that this question was too confusable with item 2 “How long do you spend on your computer on an average day” and it was decided that it was not needed. Of the 14 item mobile device scale all items once again showed a good corrected item scale correlation (r >0.3) and there was an original Cronbach’s Alpha coefficient of .73. Removing items would not improve this coefficient.

Item Reduction

Following descriptive statistical analysis it was decided to remove certain items from the computer use section for factor analysis as they would no longer be included in the overall scores in subsequent versions of the ETUQ (they would however be retained for demographic purposes). These items were numbers 1, 3, 4, 5 and 6 in the personal computer section. The remaining 17 items on the Computer Usage scale were subjected to principal components analysis using PASW 17. Prior to this the suitability for factor analysis was examined and it was deemed suitable with a Kaiser-Meyer-Oklin value of .77 and a Bartlett’s Test of Sphericity was statistically significant. Principal components analysis revealed the presence of five components with eigenvalues exceeding 1. Further to this an inspection of the scree plot revealed a break after the fifth component. A Varimax rotation was performed using five components; however because of the amount of cross loading observed the amount of components was reduced to three. Another Varimax rotation was performed and each component showed a number of loadings, with cross-loading being greatly reduced. This three component solution explained a total of 47.67% of the variance, 20.1%, 15.2% and 12.2% respectively. This supports the idea that there are three factors at play in the computer usage scale, these three factors were identified as: personal usage, use related to everyday chores conducted via computer and use related to work. After these factors were identified it was decided to drop items 7 and 8 (which dealt with the features, function and capabilities of the computers) as the questionnaire would be more focused on quantity of use as opposed to the quality of use by the user. This leaves 12 items that were included in the final ETUQ as can be seen in Appendix E.

The 13 items on the mobile device usage scale were also subjected to principal components analysis. Prior inspection showed there to be coefficients in the correlation matrix of .3 or more and the Kaiser-Meyer-Oklin value was .65. Bartlett's test of Sphericity was also noted to be statistically significant. Principal components analysis revealed the presence of four components with eigenvalues exceeding 1, however following further analysis of the data it was decided to retain 3 components for investigation. This was deemed necessary as two of the components showed a lot of overlap and appeared to be subcomponents of one main component. A Varimax rotation was performed and all three components showed a number of strong loadings. These three components explained a total of 55.5% of the variance, 21%, 18.2% and 16.2% respectively. The three factors which can be isolated here are as follows: advanced mobile phone use, mobile device (excluding mobile phone) use and basic mobile phone use.

The final ETUQ contained 23 items that were split into two scales, 12 on computer usage scale and 11 on mobile device scale. Once scored there is a possible range of 0-100 (see Appendix E).

4.1.4 Discussion

More and more people are being immersed in technology every day. As these devices become more ubiquitous it is important that there is a tested way by which to examine to what level individuals are using these devices in their everyday lives. The questionnaire that was developed here is intended to serve this purpose and to give the ability to group individuals in high, mid and low level usage of technologies, if even only when dealing with information communication technologies. The final ETUQ contains 23 items on two scales. Based on feedback from participants in the pilot study a number of items were changed slightly, for example items 25-28, dealing with receiving and making work or personal phone calls, on the initial questionnaire were reduced to one item on the final ETUQ. The scoring was also changed in order to allow for "never" responses on the frequency questions in both the mobile devices and personal computers scales. It should also be taken into account that items 1, 3, 4, 5 were retained for purely demographic information and therefore should not be included in the "total use of technology" result. Once scoring is completed on the remaining 19 items there is a possible score range of 0-100. Within the current thesis all distinction between groups of low and high level users of everyday technologies is based on a median split on this total use of technologies score.

There are several limitations with the questionnaire which still need to be taken in to consideration. It only deals with what can be seen as time saving technologies and more specifically computers and mobile devices or information communication technologies (ICTs). This was a decision based on focus group findings. It deals mainly with the amount of technology that the individual is being exposed to in their everyday life. To refer back to a comment made in the introduction, it was decided by the researcher to focus on the quantity of technology rather than the quality of technology the individual faces on a typical day. However it does give insight into some of the types of tasks being completed by the individual on a day to day basis using ICTs. In all however, the ETUQ as it stands in its post piloted version is a tested questionnaire for assessing an individual's level technology usage in everyday life.

4.2 Study 1: Everyday Technology Use and Cognitive Absorption

Previous research in the area of technology has sought to investigate the link between technology users' levels of cognitive absorption and their beliefs about technology use. As previously explained Cognitive Absorption (CA) is an internal factor, similar to Csikszentmihalyi's (1990) flow. It has its basis in individual differences and personality psychology and can be measured using the Tellegan Absorption Scale (TAS) (Tellegen & Atkinson, 1974). Among other things it is a measure of an individual's responsiveness to engaging stimuli, responsiveness to inductive stimuli, ability to become absorbed in their own thoughts and imaginings, tendency to have episodes of expanded experiences and ability to experience altered stated of consciousness (Agarwal & Karahanna, 2000). Agarwal and Karahanna (2000) found support for their hypothesis that cognitive absorption in a technology would have a positive effect on perceived ease of use of the technology and also that cognitive absorption with a technology would have a positive effect on perceived usefulness of a technology. In order to measure "cognitive absorption with a technology" they created their own version of the TAS, tailored specifically to examine absorption in the technology as opposed to the individual's own level of cognitive absorption in general. Lin (2009) hypothesised that cognitive absorption in the technology would affect individuals' intentions to use a virtual community through perceived usefulness and ease of use of said community. The study was conducted in a similar vein to Agarwal and Karahanna (2000) and support for this hypothesis was found.

The TAS is also recognised as measuring a person's susceptibility to hypnosis (Naish, 2006; Tellegen & Atkinson, 1974). Naish has in recent years been calling for the time distortion felt during hypnosis to be researched in more detail (Naish, 2001; 2003; 2005). He has also shown that individuals, who score higher on the absorption scale, tend to experience significantly more time distortion during hypnotic sessions than those who score low on absorption (Naish, 2006). As an internal variable which appears to have links to both an individual's perception of technology use and also their perception of time it is important to investigate whether this trait is a lurking variable which may mediate the relationship between the amount of technology an individual uses and their experience of the passage of time. For example, if we were to consider that an individual who scores high on the absorption scale is one who is more likely to become absorbed in, and therefore use more technology in their everyday life, according to Naish's findings it is also likely that they will experience more temporal distortion. In this way it is likely that both the temporal distortion and the level of technology use are being created due to the individuals' level of absorption.

This study therefore had three aims. First it examines the trait of absorption, as measured by the TAS (Tellegan & Atkinson, 1974), as a potential hidden variable that may be creating a link between possible temporal distortions felt by individuals who use more technology (as measured using the ETUQ) than others. Secondly it also aimed to examine whether there was a relationship between individuals' levels of absorption and their actual level of ICT use, as opposed to the previous research which simply looked at links between absorption and perceived ease of use and usefulness of ICTs or intention to use a technology. Finally and in a similar fashion, it aimed to examine whether the ETUQ was measuring something other than the TAS or whether it was simply picking up the same traits of the individual.

4.2.1 Method

Participants

181 individuals, mainly college students, participated in the study. They were chosen using convenience sampling and were approached on college campuses, Mary Immaculate College, Limerick, and Limerick Institute of Technology, during lectures. The age of participants ranged from 18 to 58 years (m=23.92, SD= 8.44). 118 of the participants were female.

Design

A correlation study design was utilised to examine the relationship between an individual's level of the trait absorption and the amount of technology they use in their daily lives.

Materials and Equipment

Two separate questionnaires were administered to each participant, namely the 23 item Everyday Technology Questionnaire (devised by the researcher), and the 34 item Tellegen Absorption Scale (Tellegen, 1982). The full lay out of these questionnaires and along with information sheet, consent, and debriefing can be seen in Appendix F. Once all the data had been gathered the researcher utilised the PASW Statistics 18 statistical analysis programme to carry out data analysis.

Procedure

Most participants were approached during lecture and tutorial times on campus in either Mary Immaculate College, or Limerick Institute of Technology. They were given a brief explanation about the nature of the study and were then handed questionnaires which had been printed in a booklet form and included an information sheet, a consent form and also a debriefing. They were advised that their participation in the study was voluntary and that there was no obligation on their part to consent to participation. They were instructed to read the information sheet and sign the consent form if they wished to continue. They were then instructed to detach the consent form from the questionnaires in order to ensure their anonymity. After participants had completed the questionnaires they returned the consent form and questionnaires to two separate bundles, and were thanked for their participation in the research.

Data Analysis and Manipulation

Incomplete or spoiled questionnaires were identified and removed from the analysis, leaving a total of 177 sets of participant data. Initially two new "total" variables were created and named Total Technology Usage (sum of 19 items responses on the ETUQ) and Total Absorption (sum of all responses on the TAS) respectively.

4.2.2 Results

Investigation of the descriptive statistics from the Everyday Technology Use Questionnaire showed that 97.2% of participants were using a personal computer on a daily basis. The number of hours spent on a computer in an average day ranged between 1 and 10 hours, with the mode number of hours spent being 2. However, over a quarter were spending between 4 and 10 hours a day (28.8%). 87% of participants felt that their computer use was moderately to entirely related to their current occupation, however only 72.8% felt the same about their daily internet usage. 68% of participants felt either entirely or considerably dependent on their personal computer, with 58.7% and 59.3% checking their email accounts or social networking sites respectively between one and several times a day. With regards to mobile devices (mobile phones, PDA, mp3 players), the most common use of these devices reported was checking the time, 48.6% reported that they check the time on their devices constantly throughout the day.

Preliminary analyses were performed to ensure no major violations of the assumptions of normality, linearity and homoscedasticity. The data distribution was considered to be non-parametric. An investigation of the skewness of the data indicated that there was a tendency on both scales for scores to be clustered slightly on the lower end, with skewness being equal to .229 on the technology questionnaire and .051 on the absorption scale. In the case of the technology scale this was rather unexpected as it would have been imagined that students would be using a lot of technology in their daily lives. A Spearman's Rank Order correlation was conducted to investigate whether there was a correlation between the amount of technology these participants (as measured on the Everyday Technology Usage Questionnaire) were using and their overall absorption level (as measured by the Tellegen Absorption Scale). There was a weak positive correlation (as evidenced in Figure 4-1) observed between the two variables [$r = 0.177$, $N = 177$, $p = .018$]. This accounted for only 3.13% of shared variance.

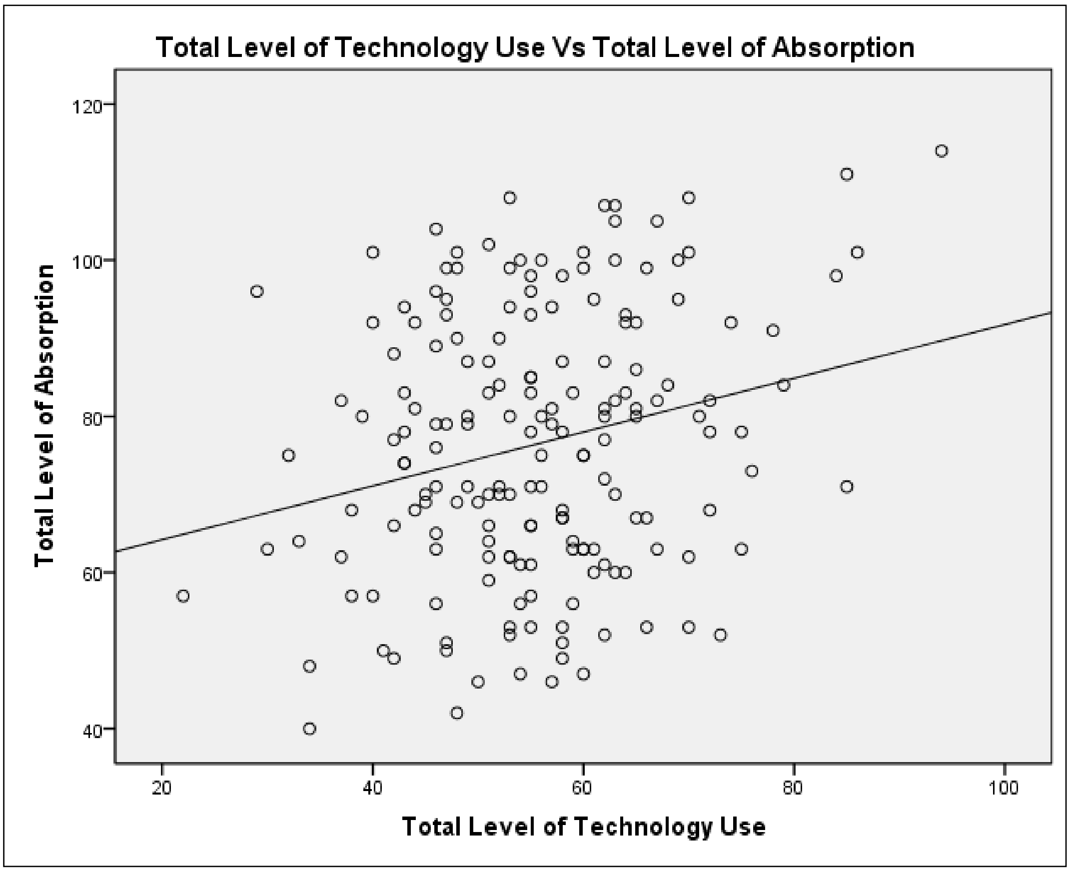

Figure 4-1: Total amount of Everyday Technology Use compared with the Total Level of Absorption reported.

In order to further investigate this relationship a one-way between-groups analysis of variance was conducted to explore the impact of absorption on level of technology use. Participants' data was ranked in to three groups, based on their reported levels of absorption (group 1: low levels of absorption, group 2: medium levels of absorption, group 3: high levels of absorption). The mean reported level of technology use for each of these groups was group 1 (m= 58.10), group 2 (m=59.54), and group 3 (m= 63.19). There was no statistically significant difference in the reported everyday technology use scores for the three groups [F (2,173) = 2.9, p= .06].

4.2.3 Discussion of Study 1

The results shown here indicate a very weak correlation which although statistically significant, may have been affected by the large sample and therefore cannot be relied on. Further investigation through use of an ANOVA found there to be no significant different between groups of varying levels of technology use.

The findings in this study are not in line with what would have been expected through examination of the research conducted on the ease of use and usefulness of new technologies. It would make sense that if, as found by Agarwal and Karahanna (2000), a person who scores high on absorption is more willing to accept and proclaim the usefulness of new technologies that they would also use these technologies for a greater time period in their day to day lives. These findings also appear to negate the possibility of level of absorption being a hidden variable in any disparities in temporal judgements and amount of technology used by the individual.

However, the findings here are far from conclusive. Individuals in this study had a tendency toward both a low level of use of technology, and a low level of the trait absorption. There is a chance that participants did not report answers that truly reflected their experiences. The statements in the TAS can be described (and were described by some participants in this study) as being slightly "outside of the box". Participants may not have felt comfortable agreeing with them thus reporting lower levels than normal. The correlation reported above was statistically significant, albeit weak. Given a larger range of responses this correlation may prove to be much stronger. Perhaps looking at samples outside of an undergraduate cohort would be a better option for future replications of this study.

Chapter Five

Examining Technology Use and the Perception of Time:
Duration Estimation and Interval Production

As laid out in Chapter Two, time is an intricate part of modern society. Flaherty (2003) found that we attempt to influence time and its flow in many different ways in our daily life, in order to make pleasurable experiences feel longer, unpleasant experiences appear shorter and in general to try and take control over the timing of our daily routines. However it is also clear that sometimes our experiences of time are outside of our control. Many different situations and more specifically, stimuli have been shown to have consistent effects on the pace of the passage of time as we perceive it. The more commonly held theories on our ability to time purport a form of "internal clock" and therefore these effects are often referred to as clock speed effects (Wearden, 2005a). The subjective experience of the pace of the passage of time has previously been shown to be affected by numerous different stimuli, some of which have been previously discussed in Chapter Two, Section Three (Brown, 1995; Ogden et al., 2011; Wearden et al., 2007; Wearden & Penton-Voak, 1995; Witherspoon & Allan, 1985; Xuan et al., 2007). There have been many attempts at trying to describe why this may happen. At a basic level, proponents of the Scalar Expectancy Theory claim that different stimuli create different levels of a type of arousal, with more arousal within the "internal clock" causing it to send pulses at a faster rate to the accumulator (Gibbon et al., 1984). Those who subscribe to an information processing theory of time perception feel that the more information that is processed, or alternatively that the more storage space a stimulus takes up, the longer a duration is felt, which can also be explained as an increase in the pace of the passage of time (more time is subjectively felt to pass than is actually the case in real time) (Ornstein, 1969). Others have suggested a similar hypothesis based on the amount of neural energy that is required to comprehend a stimulus correlating with the perceived duration of the stimulus (Pariyadath & Eagleman, 2007). Whatever the cause, the effect is that certain stimuli appear to last longer to us subjectively than others. For example stimuli of greater magnitude appear to last longer than stimuli of lesser magnitude (Xuan et al., 2007) filled durations appear to last longer than unfilled (Wearden et al., 2007; Ornstein, 1969), and unpredictable stimuli appear to last longer than predictable (Pariyadath & Eagleman, 2007).

The two tasks in this chapter were conducted from an accumulator-pacemaker style internal clock standpoint and were based on the hypothesis that arousal affects our perception of duration. They aimed to investigate a more ecologically sound stimulus as the independent variable (use of technology), and were originally borne out of Blatchley et al.'s (2007) finding that there appeared to be some link between computer use and absolute error on a timing task, a negative correlation to be precise. The studies presented here investigate whether the amount of technology that a person uses in their day to day life (as measured by the ETUQ) has any links to their perceived pace of the passage of time, or their perception of duration. In this way this research is different to much of the other literature. The independent variable had a high level of naturalistic variation and was not manipulated in any way; individuals were not exposed to greater or lesser levels of technology directly previous to the tasks. Participants were also not trained on any duration during the study. Therefore, although the experiments took place in a lab setting, the participants' temporal judgements were based on their own internal representation of duration in their day to day life, with as little manipulation as possible being conducted by the experimenter.

In order to quantify participants' perceptions of duration two separate tasks were utilised: interval production and duration estimation. Interval production is a commonly used method of examining how individuals' temporal judgements compare to "real" standard time. Interval production is extremely straightforward as long as the researcher controls for certain confounding variable such as chronometric counting. Experimental participants in these types of studies are asked to produce a duration, for example "Please hold the space bar down for 4.5 seconds". Their produced duration is then plotted against the actual duration they have been asked to produce. It has been shown that individuals are generally very accurate at these kinds of tasks however the standard deviation of time estimates increases linearly with the mean time to be estimated; this is the scalar property in the Scalar Expectancy Theory (Wearden, 2005a). An underproduction in a task like this could indicate that the individual feels time is passing at a faster pace, whereas an overproduction could indicate that they feel time is passing at a slower pace, scalar timing models would explain this as an increase, or decrease, relatively, in the pace of the internal clock.

Duration estimation works somewhat like an inverted interval production task. Once again it examines how temporal judgements compare to real time. Experimental participants are asked to pay attention to a stimulus or a sequence of stimuli of some form. They are asked not to use chronometric counting and are then asked to estimate how long the stimuli lasted. Their estimation is then plotted against the actual duration of the stimuli. Counter to the production tasks an overestimation in an estimation task could indicate that the individual feels time is passing faster than real objective time, and an underestimation would then indicate that they feel the pace of time as passing slower. Interval production and duration estimation can be very useful in examining the discrepancies between subjective temporal judgements and objective time in independent subject studies especially where state change is not an option. For example, in the following studies the participants were categorised into two groups, high and low levels of use of technology, based on their technology use in their own day to day lives. Manipulating their level of technology use was not an option in this case. This was an important facet of this research, examining participants' "real" temporal judgements as opposed to manipulated judgements.

It was hypothesised that individuals who were using more technology in their day to day lives would under produce in production tasks and overestimate in estimation tasks to a greater extent than those who use less technology. The reasoning for this comes from both the idea of arousal causing an increase in our perception of duration, and also from the sociological findings on modernity, advances in technology, pace of life and experience of time pressure. As pointed to in Chapter Three the advent of new technologies has often been cited as being causally related to beliefs on increased pace of life and time pressure. Chesley (2010) found ICT use linked to accelerated pace of life, and time pressure and Garhammer (2002) found internet and mobile phone users reported increased levels of time pressure and described a paradoxical relationship between time pressure and time saving devices. If individuals who are using more technology do indeed under produce and overestimate to a greater extent, this could add to the evidence of a causal relationship between time pressure and modernity. If we subjectively feel that time is passing faster than is objectively the case then it would follow that we would feel more stress related to time.

5.1 Study 2: Technology Use and Duration Estimation (Task 1)

This experiment involved the use of a timing task based on verbal estimation. Participants were presented with tones of varying lengths and were asked to estimate the duration of the tone. Within this experiment participants were grouped into two categories using the Everyday Technology Usage Questionnaire. The mean estimate of the participants for each tone was calculated, and compared between groups. A modified version of Roxburgh's (2004) *Time Pressure Scale* was also administered to the participants to examine their self-reported pressure regarding the passage of time in their daily lives.

5.1.1 Method

Participants

Fifty six members of the general public contributed usable data to this study. They were selected using mixed purposeful sampling methods, mainly through maximum variation and chain sampling. The age of participants ranged from 19-55 years (m=29.89yrs, SD= 9.24). Thirty of the participants were male. Participants were chosen by the researcher using maximum variation and chain sampling in order to give the most diverse demographic possible, and in order to reach a wide cohort of individuals of varying levels of technology use. Therefore the researcher specifically targeted individuals from a wide age range, with very different occupations. Occupations ranged from students to academic staff, unemployed or retired individuals to company CEOs, artists, horse-riding instructors, computer programmers, game developers and engineers.

Design

This study utilised an independent subjects, quasi-experimental design. The independent variable was overall technology use, which functioned on two levels, high or low usage; the dependent variable was estimation of duration of the given stimulus.

Materials and Equipment

Participants were tested in a quiet lab space in Mary Immaculate College, Limerick. The experimental programme was created using the E-Prime 2.0 stimulus presentation software. This software was run on a Dell desktop computer and participants listened to the tones though Sony Dynamic Stereo headphones. The Everyday Technology Use Questionnaire was used in order to group participants into either a high or low technology usage category. A modified version of Roxburgh's (2004) Time Pressure Scale was used to investigate the participants experience with time on a daily basis (see Appendix G). Item 3, 4 and 8 were reversed to give negative statements, to encourage participants to answer more accurately, and the ninth item "There just don't seem to be enough hours in the day" was replaced with "You are always late even when meeting friends" in order to move participants away from simply basing their answers around their work lives.

Procedure

Once each participant had read an information sheet (Appendix H) briefly explaining the experiment they were asked to sign a consent form. After consenting to participation they either began the estimation tasks or were asked to fill in the Everyday Technology Usage Questionnaire and the modified Time Pressure Scale, the order was counter balanced over all participants. For the estimation task each participant was seated at a computer desk and given headphones to allow them to hear the stimulus. Once they were ready to begin the researcher started the experimental programme and the participant was presented with written instructions on the computer screen. They were given a brief overview of what would be expected of them during each trial and were told to press the space bar when they were ready to begin. If they had any questions, they would be able to ask them of the researcher when they had completed practice trials.

Once the participant pressed the space bar there followed 2 seconds of silence followed by a 500-Hz tone (the stimulus). Onscreen instructions prompted the participant to press the space bar again once they had heard the tone. This led them to another screen where they were able to input their estimation of the duration of the stimulus. In order to constrain outliers participants were informed that all stimuli would be within a range of 250ms to 4000ms and that they were to be as precise as possible when inputting their estimation, in the xxxms format. Once they had inputted their estimation they simply pressed the enter key and the next trial began automatically. The durations of the stimuli presented in the experimental session were as follows: 500ms, 1000ms, 1250ms, 1500ms, 1750ms, 2000ms, 2250ms, 2500ms, 2750ms, and 3000ms. These stimuli were presented to each participant in a randomised order, with each individual duration being presented once. There was no feedback given on performance to the participant.

Each experimental session consisted of 10 trials, and was preceded by 3 practice trials in order for the participant to become comfortable with what would be needed of them. These practice trials were not recorded.

Data Analysis and Manipulation

Participants' data was removed from analysis in cases where it was clear that the participant had misinterpreted the instructions, for example not relaying estimates in milliseconds or giving estimations outside of the range specified. Next the researcher reversed coding on three statements in the Time Pressure scale questions. These statements were: You are never in a hurry, You have enough time for yourself and, You never run out of time.

Two new variables were created by totalling the ordinal data on the ETUQ and the Time Pressure Scale into scalar data. Finally the participants were ranked on total technology use in to two groups, high use and low use using a median split.

5.1.2 Results

Inspection of the descriptive statistics from both the Everyday Technology Use Questionnaire and the modified Time pressure Scale revealed that 94.6% of participants were using a personal computer daily. The range of scores on the ETUQ was 11-81 (m= 56.3), from a possible 100. 42.9% revealed that they spent between 3 and 5 hours a day on this personal computer, a further 17.9% reported spending between 8 and 12 hours on their computer daily. 64.3% of these participants say that they check their email daily and 35.7% access social networking sites daily. 25% were constantly making and receiving calls on their mobile phone throughout the day, and 42% constantly sent and received SMS. 73.2% felt considerably or entirely dependent on these everyday technologies in their everyday day lives, which 83% felt was moving increasingly faster. Over half (50.9%) of participants reported never having enough time in their daily lives. A Pearson product moment correlation was conducted to investigate whether there was a correlation between the amount of technology these participants (as measured on the Everyday Technology Use Questionnaire) were using and their overall time pressure (as measured by the time pressure scale). Preliminary analyses were performed and no major violations of the assumptions of normality, linearity and homoscedasticity were observed. There was no correlation between the two variables, [$r = .2$, $n = 56$, $p = 0.15$].

Participants were ranked into two groups based on their score in the Everyday Technology Usage Questionnaire using a median split. The two groups were renamed high technology use and low technology use. The mean estimation of duration of each tone was calculated across participants and these mean estimations were plotted against the duration of the tones in ascending order as can be seen in Figure 5-1.

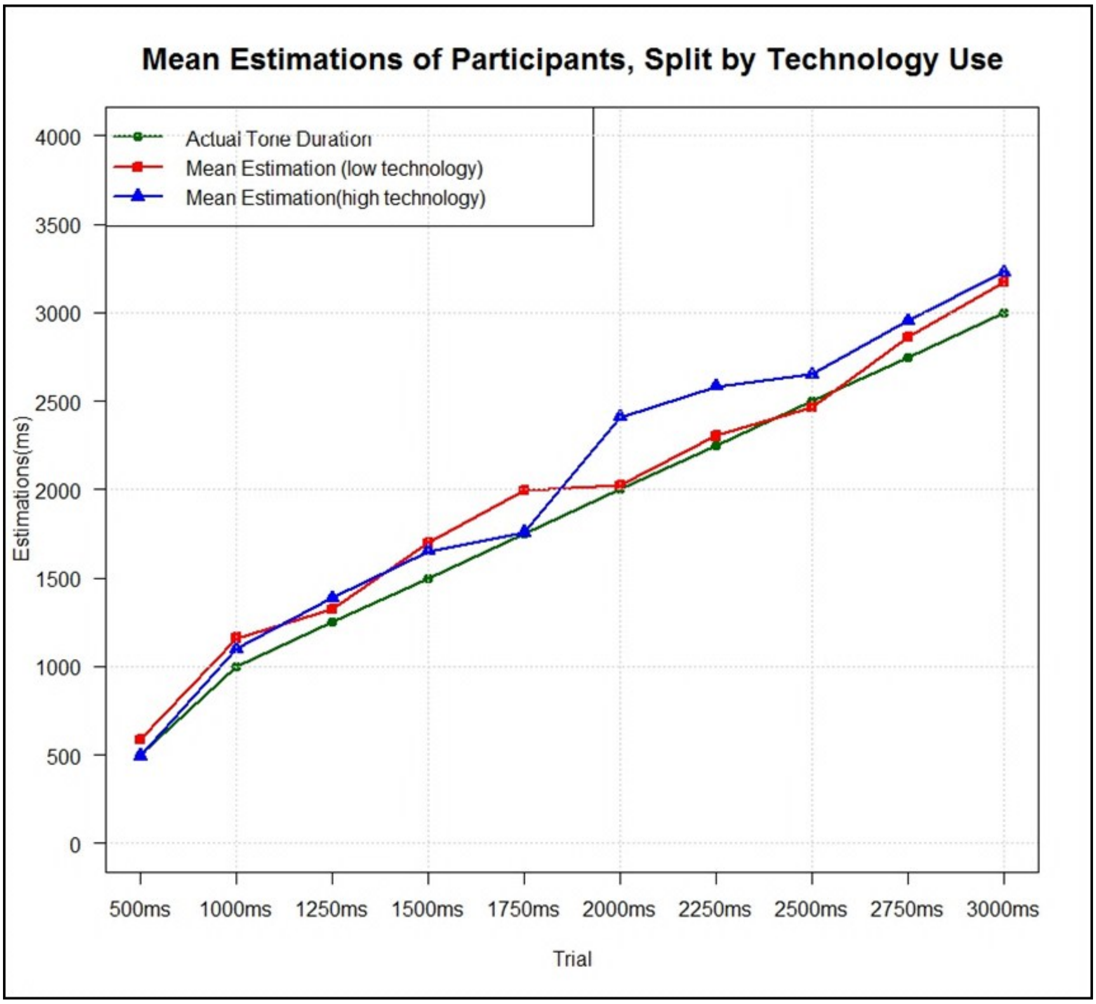

Figure 5-1: Shows the mean estimations of participants split in to two groups (high and low technology usage).

As a comparison Figure 5-2 illustrates the mean estimations of both groups combined and plotted against the actual duration of the tones played during trials. From these graphs it seems that there may be a difference between the estimations of those with differing levels of everyday technology use. It would appear from Figure 5-2 that all participants tended to overestimate the duration of the tone. If we were to use an “internal clock” model this would suggest that in general the pacemaker of these participants was running faster than objective real time.

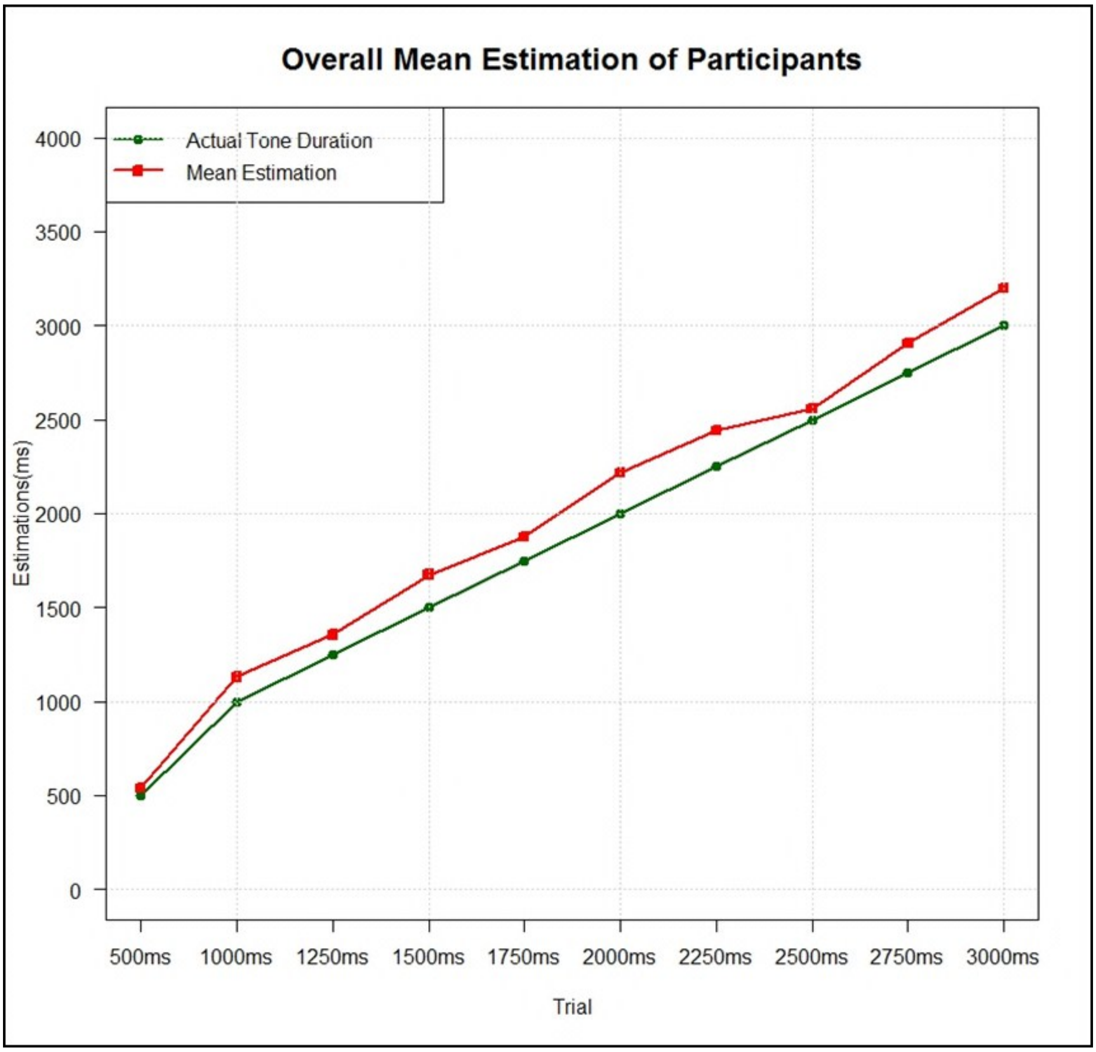

Figure 5-2: Shows the mean estimations of all participants plotted against the actual duration of the tone played.

In order to investigate whether the difference between the estimations made by participants in the high and low technology use groups (as illustrated in Figure 5-1) was statistically significant multivariate analysis of variance was performed. The mean estimation of the duration of each tone across participants was entered as separate dependant variables (10 variables) and the independent variable was everyday technology use, on two levels, high usage and low usage. Preliminary assumptions were checked and there were no violations of normality, linearity, outliers or multicollinearity. When the estimations of durations were considered overall there was a statistically significant difference between the estimations made by participants with high use of technology and low use of technology: F (10, 45) =2.4, p= .022; Wilks' Lambda= .65; partial eta squared =.02. However, when the results for each trial were considered separately using a Bonferroni adjusted alpha level of .005, none of the variables reached a statistically significant level. This indicates that although overall there was a significant difference in the shape of the responses made between the two groups; this significance did not remain when looking at the results at the levels of individual trials.

There was one significant gender difference revealed through this study. An independent samples t-test was conducted to compare overall time pressure scores for males and females. This revealed that females (m=42.57, SD= 6.06) were statistically more pressured by time in their daily lives than males (m= 36.73, SD= 7.73; t (56) = -3.11, p=0.03).

5.1.3 Discussion of Task 1

The almost uniformly high levels of technology usage among the participants of the present study appear to confirm presumptions about use and dependence on technology in modern society. The participants in this study were not all in technology driven careers. Instead there was a mix of many varied occupations; horse riding instructors, artists, clerical workers, unemployed, retired amongst others. Their levels of technology use may be seen as indicative of the necessity to have IT skills in most walks of life in modern society.

We can see in Figure 5-2 that individuals in general tended to overestimate durations, this is suggestive of a perception that time is passing at a faster rate. As most participants in this study are around computers and technology in their daily lives, we would expect the data to be along these lines if technology is in fact having an arousing effect on a hypothetical internal clock. When the participant data is split by technology use however, it can be that those with higher levels of use actually overestimate to a greater degree when the durations pass 2000ms. In fact, individuals with lower levels of use are appeared more accurate at estimating these durations. This once again suggests a tentative link between technology and alterations in a natural timekeeper. If people are consistently experiencing an altered sense of the amount of time that is passing, as may be suggested by this research, this could be adding to the pressure experienced in their daily lives. The findings that have been presented here are far from conclusive and any tentative link warrants further investigation.

5.2 Study 2: Technology use and Interval Production (Task 2)

This involved the use of a second timing task based on producing durations. Participants were informed that they will be asked to produce different durations, without the aid of mental or verbal counting. In essence duration production tasks are the inverse of verbal estimation tasks. As this was the second task in this study the participants within this task were grouped in to two categories of everyday technology use, high and low; using the Everyday Technology Usage Questionnaire and Roxburgh's (2004) Time Pressure Scale was used to investigate the participants' self-reported time pressure in their daily lives.

5.2.1 Method

Participants

Sixty members from the general public contributed usable data to this study. As explained above they were selected using mixed purposeful sampling methods, through maximum variation and chain sampling. Participants' ages ranged from 19-56 years (*m*= 30.35 yrs., *SD*= 9.69). Of the sixty participants 33 were male.

Design

This study utilised an independent subjects, quasi experimental design. The independent variable was everyday technology usage, which functioned on two levels, high or low use, as identified using the Everyday Technology Use Questionnaire. The dependent variable was total production.

Materials and Equipment

Participants were tested in a quiet lab space in Mary Immaculate College, Limerick. The experimental programme had been created using E-Prime 2.0 stimulus presentation software. This software was run on a dell computer and participants inputted their responses using the keyboard. The Everyday Technology Questionnaire as devised by the researcher and Roxburgh's (2004) Time Pressure Scale were also used during this experimental session (Appendix G).

Procedure

Each participant was given brief information and instructions on what this experimental session would involve (Appendix H). They were then asked to sign a consent form. Once each participant consented to participating they either began the production trials or were told to fill in the Everyday Technology Usage Questionnaire and the modified Time Pressure Scale, the order was counter balanced over all participants.

For the production task they were seated at another desk in front of a computer. With the experimental programme already running they were greeted by onscreen instructions. They were informed that a numerical duration would appear on their screen. Their task would be to recreate this duration using the keyboard. To signal the beginning of the duration they were told to tap the space bar once, and to signal the end of their production they were told to tap the space bar again. Once they had tapped the space bar for the second time, signalling the end of the production, the next duration to be produced automatically appeared on the screen. They were also informed that there would be three practice trials and that any questions they had could be conveyed to the researcher after these three trials. Once again they were told to press the space bar when they were ready to begin.

The durations to be produced were as follows: 500ms, 800ms, 1200ms, 1700ms, 2100ms, 2500ms, 2600ms, 2800ms, 3200ms, 3500ms, and 4000ms. These durations were presented in a random order to the participants and each was presented once. Participants received no feedback on the accuracy of their productions.

Each experimental session consisted of 11 trials and was preceded by 3 practice trials which were not recorded.

Data Analysis and Manipulation

Descriptive statistics were analysed and in some cases it became obvious that participants had simply misinterpreted what had been asked of them, for example thinking that their production began from when the duration appeared on screen as opposed to when they tapped the space bar. It was decided by the researcher to remove these participants from further analysis. As in the previous study, reverse coding on three statements in the Time Pressure Scale was performed (You are never in a hurry, You have enough time for yourself and, You never run out of time).

As mentioned in the previous study two new scalar variables were calculated using the ordinal data from the ETUQ and the Time pressure Scale. Finally the researcher ranked the participants scores on total technology use in to two groups, high level users and low level users using a median split.

5.2.2 Results

Through inspection of the descriptive statistics from the Everyday Technology Usage Questionnaire, it was found that 95% use a personal computer daily with the other 5% using one weekly. 43.3% reported using their PC for between 3 and 5 hours a day, with another 18.4% reporting using theirs for between 8 and 12 hours a day. 80% of participants regard their personal computer use to be moderately to entirely related to their occupation, whereas only 68% thought the same of their internet use. 71.7% felt either considerably or entirely dependent on their PC, and not one participant reported being “not at all” dependant on their personal computer. 100% of this sample owned mobile phones.

Analysis of responses to the modified Time Pressure Scale showed that 81% of participants felt that life is moving at an increasing pace. 70% used phones, computer screens and digital displays on household appliances as their preferred method of telling the time as opposed to the 30% who reported using a clock or watch. 65% felt that they were considerably or entirely reliant on time keeping devices to accurately know what time it is, and over half (58.3%) felt pressed for time in their daily lives.

An investigation into the relationship between level of technology usage (as measured by score on the Everyday Technology Usage Questionnaire) and overall time pressure felt (as measured by the modified Time Pressure scale) revealed a significant positive correlation [$r = .28$, $n = 60$, $p = 0.03$], between technology usage and reported time pressure.

Participants were ranked into two groups based on their total everyday technology usage score. These two groups were renamed high technology usage, and low technology usage. The mean production for each duration was calculated across participants and these mean productions were plotted against the durations in ascending order, as can be seen in Figure 5-3. As a comparison the groups were combined and the overall mean productions were plotted against the durations asked for in ascending order. This can be seen in Figure 5-4.

It is clear from Figure 5-4 that, in general, participants under produced the duration requested. This would is indicative of an increased rate of firing in a hypothesised pacemaker-accumulator model of an internal clock. It can also be observed in Figure 5-3 is that there is a consistent difference between participants with low technology use and those with high technology use, and it would appear that the pacemakers of those with a higher level of technology use are firing at a greater rate than those with a lower score on the technology use scale (as they are under producing to a greater extent). Through a more detailed examination of the graph we can see a slight slope effect, as duration to be produced increases, so too does the participants deviation from said duration.

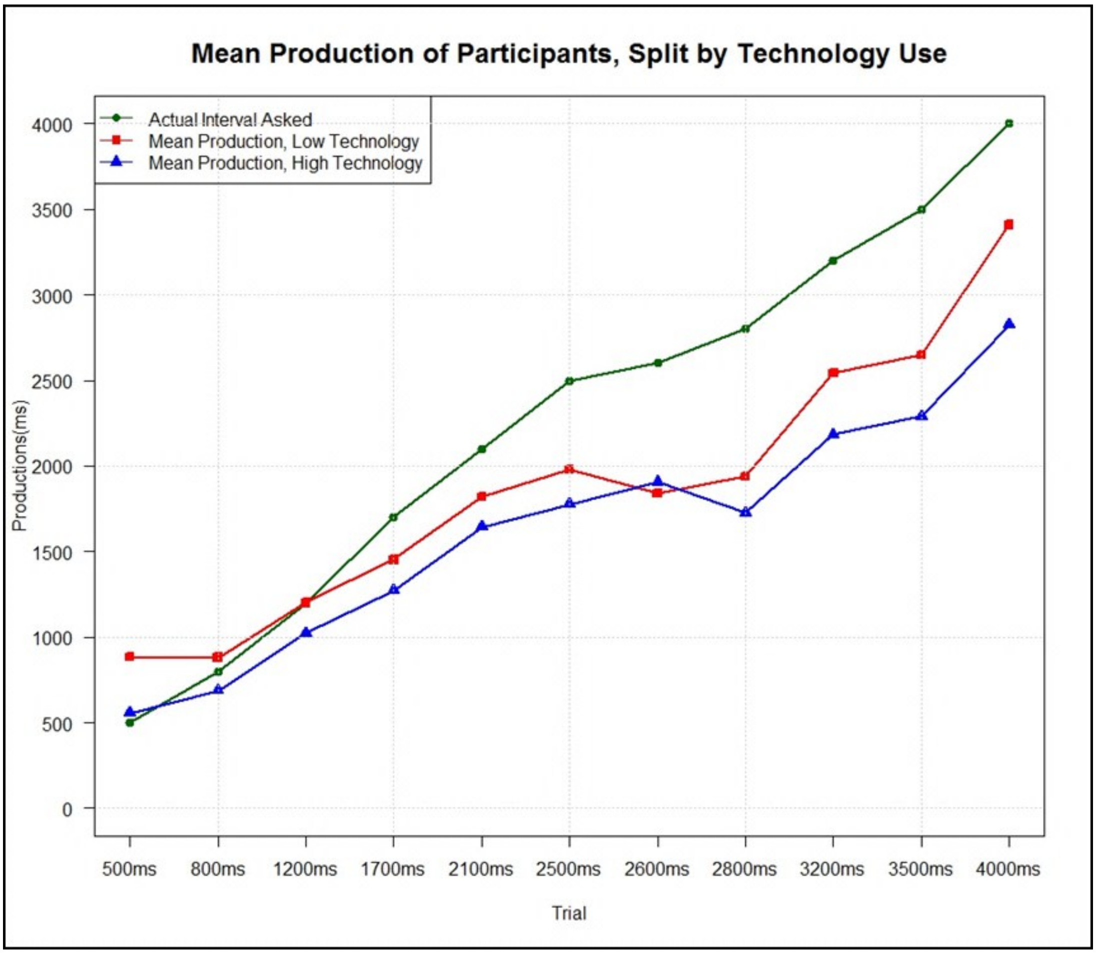

Figure 5-3: Shows the mean productions of participants for each trial, split into two groups (high use of technology and low use of technology.

In order to investigate whether there was a significant difference in productions between the two groups (high and low use of technology) a multivariate analysis of variance was performed. Each duration was entered as separate dependant variable, therefore there was 11 variables and the independent variable was overall everyday technology use. Preliminary assumption testing was carried out and checks for normality, linearity, univariate and multivariate outliers showed no severe violations. There was a statistically significant difference between the high and low technology usage groups when the looking at the overall productions: F (11, 48) = 2.48, p= .015; Wilks' Lambda= .98; partial eta squared= .362. However, as in the previous task when the results for each duration were considered separately using an adjusted Bonferroni alpha level of .005, no duration reached statistical significance.

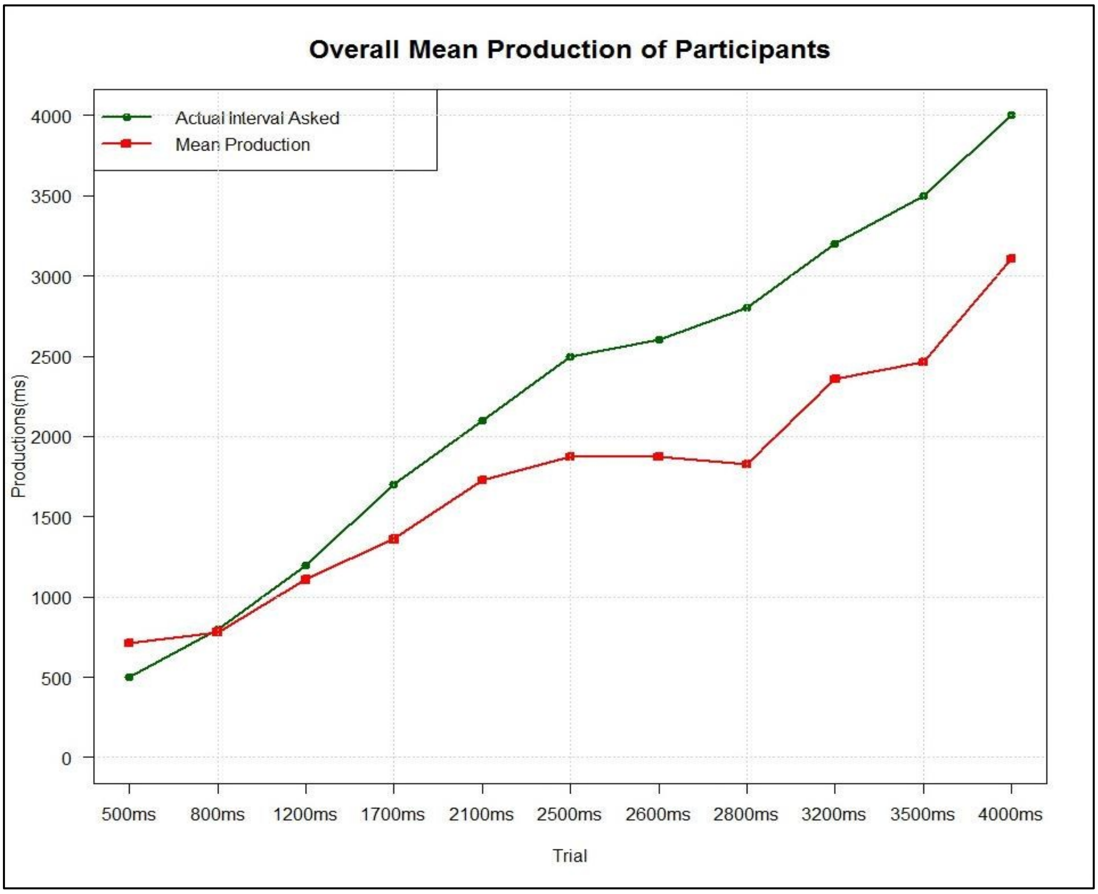

Figure 5-4: Shows the overall mean productions of participants for each trial, combined in to one group.

5.2.3 Discussion of Task 2

As in the previous task the descriptive statistics from the two questionnaires confirmed some intuitions about modern life. Within the sample used here every participant owned a mobile phone. Mobile phones appear to have taken over as the main time keeping device used by individuals in their daily lives as well, with the majority of participants choosing to check the time on their phone rather than a watch or wall clock. The relationship between the amount of so called time saving devices, and level of time pressure in people's daily lives correlated. The correlation was small; however, the range of level of technology use appears to have been rather narrow and skewed to the upper range, with most individuals using a computer every day. This was unexpected as maximum variation sampling method had been used in order to attempt to get both low and high levels of users. This seems to be, however, a facet of modern life, and it may be extremely difficult to find people today who are not surrounded with these technologies, or at least some form of time saving device, complicating the results that have been found. There is however some evidence within this study that these forms of time saving devices are actually adding to feelings of time pressure.

In Figure 5-4 it is clear that all participants continuously under-produced, that is to say that they produced durations that were shorter than what had been asked of them. Once again we might illustrate this kind of effect by considering the pace of the passage of subjective time. If we look at the 2800ms trial we can see that participants felt that this amount of time had passed, when in fact only just over 1800ms had passed. Inspection of Figure 5-3 shows, as expected, participants who used more technology in their daily lives under produced to a greater extent than those who used less. Previous research has induced these types of distorted time experiences in individuals through use of click trains (for example Penton-Voak et al., 1996). However in this task participants in both groupings (high and low technology use) were engaging with the same stimuli as each other. This would imply that there was something within these groups which may have been creating the experience of a faster pace in the passage of their subjective time. As this temporal judgement was based on their own inherent time experiences then it may suggest that individuals who use more information communication technology in their everyday lives also appear to have an altered rate of subjective time.

5.3 General Discussion of Study 2

The findings on technology use in these studies are in line with the reported findings of Park and Jex (2011), with individuals in these studies using large quantities of information communication technology in both their home and work lives. As pointed out by Cardenas et al. (2004) the consequences of blurring of the boundaries of work and home can be very serious, being linked to depression, exhaustion, and low life satisfaction. Kraut et al. (1998) found that with even low levels of technology use (2.43 hours per week) can come a decline in wellbeing and family communication. The majority of participants in the present studies reported using their computers for between 3 and 12 hours per day, and were drawn from a wide range of occupations from housewives, unemployed persons and horse riding instructors to video game developers and engineers. This highlights that there is a need to continue to have recent research focusing on the effects of technology us on well-being as level of use increases.

Interpreting the results of the two tasks reported here is challenging. On the one hand the consistency of the differences in both estimation and production between the low-technology-use and high-technology-use groups indicated by the graphed results, as well as the significance levels in the combined analyses, is very suggestive. There are hints here that perhaps an effect may be present. However, this effect disappears under the Bonferroni correction. However this simply means that significance was not present on any individual trial, yet overall the responses of the two groups were significantly different to each other in both tasks. The small range of scores produced on the ETUQ also makes comparisons difficult, as it means that there was not in fact a very large difference between the scores of the low- and high-technology use groups, complicating the analysis further. Therefore although we may speculate that the differences in estimations and productions may have in fact been more pronounced if a wider range of responses on the ETUQ had been found, we cannot be certain that this would be the case.

As has been pointed out, a lot of previous research has focused on our perception of duration, its variability and what exactly causes this variability. Much research has focused on how introducing a repetitive stimulus, either flashes of light or brief clicks, prior to the onset of a duration to be estimated appears to create some type of arousal within our timing mechanisms causing us to feel a stimulus has lasted longer (Penton-Voak et al., 1996; Treisman, Faulkner, Naish, & Brogan, 1990; Wearden et al., 1999). Other research has looked at intensity (Treisman, 1963) and more have looked at body temperature (see Wearden & Penton-Voak, 1995). The common factor across all research investigating an increase in the subjective experience of duration appears to be linked to arousal. Our judgements appear to be sensitive to the arousing qualities these independent variables imbibe. Indeed, the more intense the stimulus (and therefore presumably the more arousing) the longer our subjective experience of its duration (Penton-Voak et al., 1996; Treisman, 1963). Although technology was not utilised in a similar fashion as the stimuli in the studies just mentioned there is a possibility that daily technology use is having this same type of effect on our ability to judge durations. All participants in these studies were exposed to some form of technology in their daily lives; this is merely a symptom of modern life. Likewise, when looking at the mean responses, both groups of participants in these studies overestimated and under-produced the durations presented. Across these two experiments, there are suggestions that participants with higher levels of technology experienced time passing at a faster rate during the trials. However, participants who used more technology appeared to have overestimated and under-produced to a greater extent. It would be interesting to run this experiment using two samples with very different levels of technology use, however time saving technologies appear to be so ubiquitous that this may prove difficult in Western society.

The findings of these studies open the area of the psychology of time perception as it stands today to further examination. It suggests that within non clinical populations and every day experiences, our perception of duration may not be simply capable of being reduced down to rigid models. This research suggests that individuals exhibit statistically different experiences of time when they are split by how much technology they are using. This research also highlights a possible issue that pacemaker-accumulator style internal clock models, such as the Scalar Expectancy Theory appear not to account for. As laid out in Chapter Two, within scalar timing, pulses flow from the pacemaker to an accumulator, which then references long term memory in order to link the number of pulses in the accumulator with a stored duration in long term memory. Within this framework, certain stimuli can create arousal causing the pacemaker to pulse more frequently, with in turn causes more pulses to be accumulated, leading the individual to pull the wrong duration from their long term memory store, creating an overestimation of a duration in an estimation task. However as this type of internal clock appears to be self-calibrating, and self-correcting, if an individual has a clock that continuously runs at a faster pace they will have corrected for this problem. The basis for this comes from the internal clock models' links with memory. As a duration is memorised over time it will become linked to a certain number of pulses in long term memory; during an estimation or production task this threshold of pulses is signalled in the accumulator through links between working and long term memory (Wearden, 2005b). Therefore if an individual has a continuously increased internal clock rate they should, according to these types of models, be automatically recalibrating their subjective timing with objective representations of time on an on-going basis. The use of technology, as categorised in these studies, was not a variable that could be manipulated by the researcher. It was based on their own daily use and therefore any effects that it may be having on their "internal clocks" should have been balanced out by calibration in their timing mechanism. In order to explain this more clearly let us imagine that an individual in these studies who uses more technology has an internal clock that fires at a rate of 20 pulses per second, and an individual who uses less technology has an internal clock that fires at a rate of 10 pulses per second. They both listen to a tone that lasts 1500ms. The high technology use individual will have accumulated 30 pulses in this time, and the low technology use individual will have only accumulated 15 pulses during this time. However when each individual references their memory store they should both still feel that 1500ms has passed if their internal clock is well calibrated. The responses elicited from participants were based on their everyday temporal judgements, and show that there is a statistically significant difference between these two groups and therefore are contrary to what would be expected with internal clock timing models. Admittedly, it is worth noting once again that this effect was weak, and perhaps calibration is a factor which is suppressing this effect. In either case, this highlights a need for more investigation into both the mechanisms that may be causing the ostensible timing effect, and the mechanism of a supposed self-correction calibration within an internal clock model.

The findings of these studies also add an empirical cognitive basis to the sociological theory of a link between modernity, pace of life and technological advances. For example take the claim of a paradoxical relationship between the number of time saving devices that an individual uses and the feeling that they have less time and experience more time pressure (Garhammer, 2002). In the studies presented here, individuals who were using technology in their daily lives exhibited behaviours which may be indicative of them experiencing time passing faster than was actually the case. If this is occurring it may add to their subjective time pressure as it would create a dissonance between subjective and objective time and they could feel an impending deadline approaching at a faster pace and would therefore feel like they would not have enough time to complete a task in the allotted time period. If we look at Rosa's (2007) dimensions of acceleration in society, in Chapter Three, we can see that the dynamic nature of technological acceleration, social change and acceleration pace of life is circular. Therefore the increases in pace of life facilitate the further increases in technology. In order to negate the negative outcomes associated with pace of life, time pressure and technological advances it is important that we garner a deeper understanding of possible links between these variables.

In order to gain a clearer understanding of this, three further studies were conducted. These aimed to assess some different facets of technology and techno-centric societies and the effects that they may or may not be having on temporal perceptions. It was hoped that by adding a more detailed account of the effects of the underlying aspects of these technologies that the link between information communication technologies and altered temporal judgements would be illuminated further and that this would allow for a greater understanding of naturalistic timing judgements in everyday life. Once again, the focus of these studies was not how we learn durations; rather it was how our natural timing judgements can be altered by the environment in which we find ourselves.

Chapter Six

Examining the Effect of Separate Aspects of Technology on Time Perception: Three Further Studies

The previous chapter outlined two tasks from a study which may suggest that individuals who are using more information communication technology in their daily life experience the passage of time differently to those who are using less. Specifically, there is tentative evidence that individuals who use more of these technologies experience time as passing at a faster pace than those who are using less information communication technologies. As highlighted in both the review of literature outlined in Chapter Two and Three and in the descriptive statistics laid out in both Studies 1 and 2, individuals in modern society have developed a form of dependence on information communication technology, so much so that our society could be viewed as techno-centric.

The advantages that come with advances in technology are plentiful. We are no longer restrained by inability to travel; we can conduct international meetings and conferences from our homes, we can complete work projects from doctors' waiting rooms; we can download our favourite musicians' albums while looking at the Seven Wonders of the World. The realms of possibilities within a technologically connected world are almost limitless. However there also appears to be downsides to this. Work-home boundaries are being confused and people appear to feel under more stress related to time and roles than in previous generations (Cardenas et al., 2004; Park & Jex, 2011). As pointed to in Chapter Three, a link between technological advances and increases in pace of life and time pressure has been discussed in sociological fields for many years (Rosa, 2007). Findings from both tasks in Study 2 suggest a possible difference in the temporal judgements of individuals with low or high levels of technology use. Understanding any relationship between technology and time perception therefore will require more focused, specific research that examines some of the potential mechanisms by which technology may be having some effect.

Breaking down "technology" or even a "techno-centric society" into a comprehensive list of smaller properties, or affordances would be outside of the reach of this research. In order to allow for this research to be applicable to the greater population it was decided to focus on the most apparent aspects of advanced information communication technologies. Technology affords us many different options at any one time. When interacting with information communication technologies individuals are repeatedly making decisions about which option to choose, for example watching a video instead of typing an article. In order to address this aspect of these technologies Study 3 looks at the effect of the number of available options on timing judgements. Information communication technologies are also complex in terms of sensory modal integration. When interacting with these types of technologies your senses are engaged in many different ways; at any one time you may be processing static images, kinetic images, and sounds. In order to examine the effects of this increase in modal integration on temporal experience Study 4 investigates this aspect of technology. Finally, there may also be a behavioural priming aspect to information communication technology use. In this way, it may cause individuals to feel that time is passing at a faster pace through one of two ways; either they are attempting to emulate the high speed aspects of the technology or they are focusing on the dichotomous time wasting/time management aspect of these technologies. During the focus groups, outlined in Chapter Four, participants consistently mentioned that there is a time saving aspect to information communication technologies, while at the same time there being a time wasting aspect to them. It was apparent that use of the technologies caused individuals to focus on time, whether it was in a positive or negative manner. This behavioural priming aspect is examined in Study 5. Each of these properties will be described in more detail in the introduction to their related experiment. These three experiments are purposefully diverse. There are a large range of varied mechanisms by which technology could be affecting temporal experiences and with little previous work to guide and narrow potential research questions this project aims to be exploratory in nature in order to identify variables which might offer potential for more in-depth research in the future.

6.1 Study 3: Number of Available Options

The aim of this study was to investigate one aspect of technology in order to examine whether it produces altered temporal judgements. It utilised a basic duration estimation methodology, with independent subjects being split into three groups. The aspect of technology being investigated was the “number of available options”. Advanced technologies give us the ability to do any number of things at any point in our daily lives. As has been outlined in previous chapters, we can take tours of cities and chat with people thousands of miles away 24 hours a day. Therefore we are constantly making decisions when using these technologies about which option to choose. As highlighted by Park and Jex (2011) use of information communication technologies have also blurred the boundaries between work and home life. In this manner the individual constantly has the option of engaging with these two separate areas of their life no matter where their physical location. They advise creating strict boundaries and implementing rules on where and when you can use information communication devices for certain purposes. However this in itself also adds another option to the mix, as the individual has to continuously choose to abide by these boundaries.

Although there are many options, the physical behaviour of the user generally remains fairly standardised, as they are engaging with the same hardware, regardless of the option chosen. Therefore this study aimed to simply alter the number of available options for the participant, without altering their action. In this way it was important to create a task which allowed for a similar response and one which was not overly demanding on cognitive processes, in order to control for as many confounding variables as possible. As the results would rely on the individuals' perception of the duration of the task shown as a proportion of the objective time that had passed it was important not to obfuscate their estimation with issues that may also alter temporal experience for example differences in movements or differences in cognitive load. Although a number of different possibilities were explored it was decided to have individuals engage with a simple simulated balloon popping task. In this task, depending on which condition they were assigned to, participants would be asked to simply choose an onscreen balloon to pop from either 1, 2 or 4 balloon options.

Current theories of time perception such as Scalar Expectancy Theory (Gibbon et al., 1984) or Attentional Gate Theory (Zakay & Block, 1995) may actually create opposing predictions for the outcome of this study. As outlined in

Chapter Two both these theories are based on a hypothetical pacemaker-accumulator style internal clock model, with pulses being sent from the pacemaker to the accumulator when a timing judgement is to be made. Within the Scalar Expectancy Theory the pace of the pulses being sent to the accumulator can be altered by arousal within the internal clock. Previous research has claimed that the pace of these hypothetical pulses appears to be increased when in a filled duration (which is simply an interval which is filled with any kind of stimulus) (Wearden et al., 2007) or when the magnitude of the stimulus is increased (Xuan et al., 2007). Wearden et al. (2007) found that intervals that were filled were judged as lasting 55-60% longer than intervals that were unfilled. Xuan et al. (2007) found that increasing the magnitude in terms of number of stimuli, size of stimuli, luminance of stimuli or numerical value of digits increased the individuals perception of its' duration. In the current study the magnitude of the available options increases across the conditions, and the duration is "filled" with more options. Therefore it is likely that an arousal sensitive pacemaker-accumulator model would predict that that participants in the higher number of options conditions would give a longer estimation of the duration of the trial, than those in the lower complexity condition, due to the arousal created in the internal clock. The Attentional Gate Theory (Zakay & Block, 1995) purports an attentional gateway within the internal clock model. This gateway is based between the pacemaker and the accumulator of this model, and varies the number of pulses that reach the accumulator. When there are less attentional resources available for time perception this gateway is not opened fully, therefore allowing less pulses to reach the accumulator. This model would therefore predict that as there is less attention being paid to the passage of time in this study (as individuals are paying attention to the decisions they are making) there will be less accumulated pulses at the end of the trial. This would cause the participants in the higher number of options condition to give shorter estimations of the elapsed time.

To an extent this study is following on from the finding in the previous chapter that individuals who used more information communication technology may have been experiencing timing judgements indicative of an increase in the passage of subjective time. Therefore it aims to investigate whether the number of available actions offered to us by information communication technologies may be a factor in an increase in the passage of subjective time. It was hypothesised that participants in the higher number of available options condition would give significantly longer estimations of the duration of the trial than those in the lower number of available options conditions.

6.1.1 Method

Participants

Fifty eight members of the general public took part in this study. They were chosen using convenience sampling. There was a mean age of 27.29 years (range 18-56, *SD*= 8.63). 35 of these individuals were female.

Design

This study utilised an independent subjects design. Participants were informed that depending on the condition they were placed in, they would have an option of which onscreen balloon they should click on to burst. There were three separate conditions: no option (meaning there was only one balloon on screen at any one time), two options (meaning there was two balloons on screen at any one time), and four options (meaning there was four balloons onscreen at any one time). The response behaviour was a simple mouse click and remained stable across all three conditions. The independent variable was the number of available options. The dependant variable was the participants estimated duration of the experiment shown as a percentage of the actual duration of the experiment.

Materials and Equipment

Participants were tested in quiet areas, and wore headphones to block out external sounds. Extraneous auditory and visual stimuli were minimised. The experimental programme was written using the E-Prime 2.0 stimulus presentation software. Stimuli were presented on Dell notebook computer. Data was exported from the E-Prime 2.0 software to the IBM SPSS Statistics 19 statistical analysis software for data analysis. Stimuli were a series of screens containing various numbers of balloons (1, 2, and 4 depending on condition). Figure 6-1 shows a sample of a screen from the 4 balloon condition.

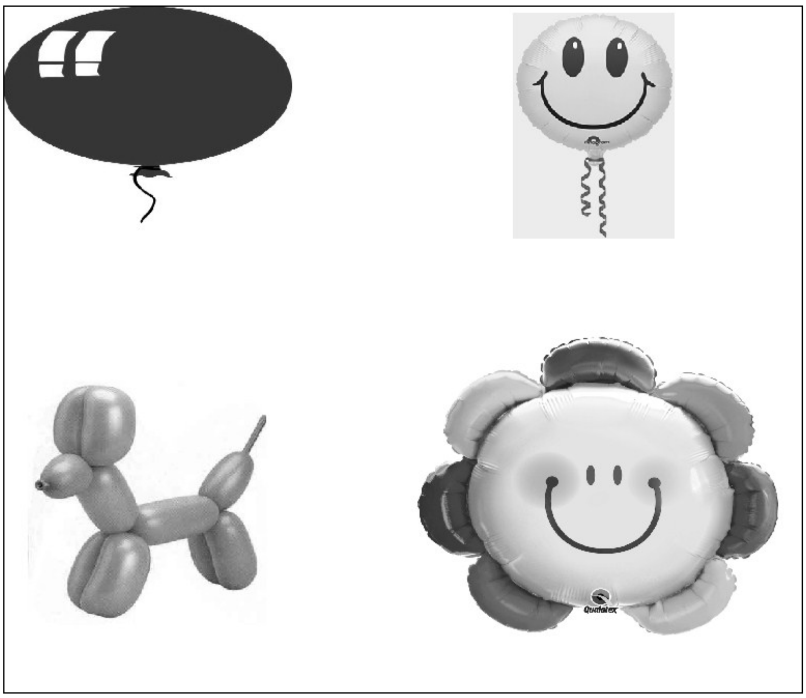

Figure 6-1: Sample screen from four balloon option condition.

Procedure

Once participants had read the information sheet (Appendix J), signed a consent form (Appendix K) and understood the instructions for the experiment they were asked to put on headphones to block external noises. Before they began the trials they were informed that they would also be asked at the end of the experiment how long in minutes and seconds they had been engaged in the experimental session; however they were asked to refrain from attempting to count the time passing. They then began the experiment by pressing the space button. Depending on the condition they had been placed in they were greeted by one (no option condition), two (two option condition) or four (four option condition) balloons onscreen. They had been informed that they had free choice to “pop” any of the balloons they wanted to, by clicking on them using the mouse. They then heard a popping noise and another set of balloons appeared on the screen. They continued popping balloons for 50 trials. Once they had popped all the balloons a screen appeared asking how long they felt they had been popping the balloons for. Once they had entered their estimation they were finished the experiment. Feedback was not given to the participants unless they expressedly asked for it. As each participants’ experimental session lasted a different length (some popped the balloons faster than others) the estimations of durations were then transformed in a percentage of the actual duration of the experimental session and these percentages were examined across conditions.

6.1.2 Results

After inspection for outliers using the descriptive statistics of the estimations of the duration two participants were removed from analysis. Thus the number of participants per condition was: condition 1/ no option condition (*n*= 19), condition 2/ two option condition (*n*= 18), condition 3/ four options condition (*n*= 19).

After assessing normality the data was deemed to be parametric and a one-way between groups analysis of variance was conducted in order to assess whether there was a significant difference between groups in the estimated duration of the experiment shown as a percentage of the actual duration of the experiment across the conditions. Subjects were divided into three groups depending on condition. Figure 6-2 shows the mean responses of each group. There was no statistical difference between the groups [F (2, 53) = 0.11, p= .896].

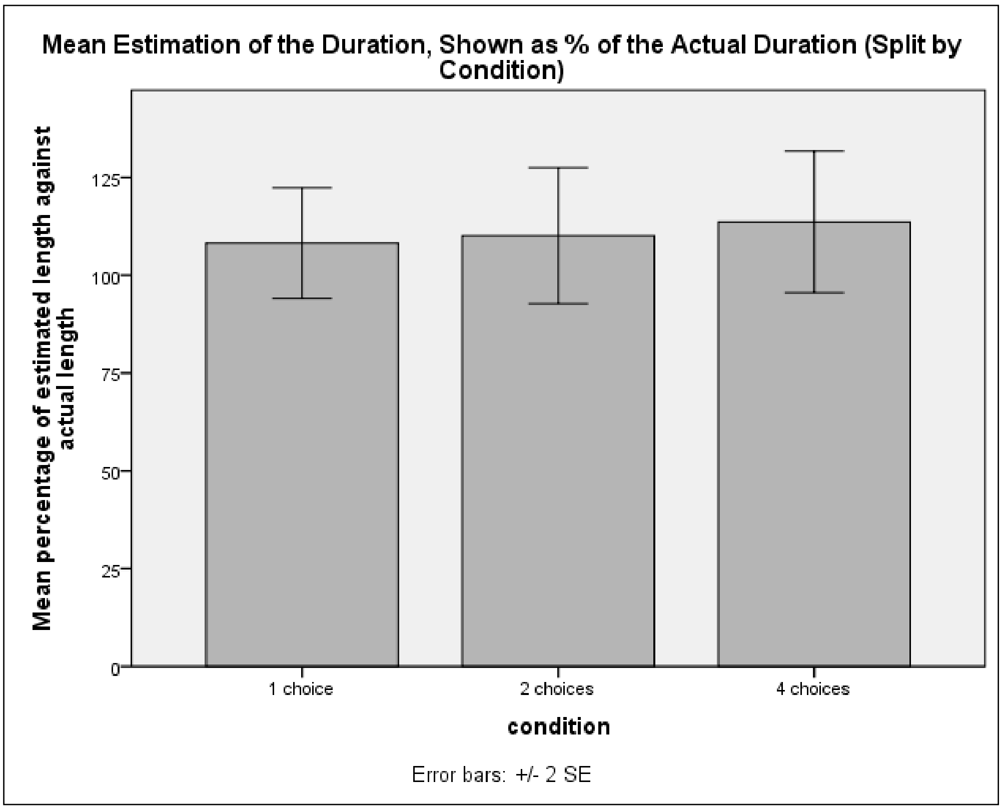

Figure 6-2: Shows the mean estimation of each group (shown as a percentage of the actual duration of the trial)

6.1.3 Discussion of Study 3

The aim of this experiment was to explore whether the number of available options (or actions) would have an effect on the temporal experiences of the participants. The previous chapter discussed a tentative effect of information communication technology on temporal experience, with individuals who used more of these technologies in their everyday lives appearing to exhibit some signs of an increased pace in their subjective passage of time. It was expected within this experiment that the more options available to individuals, the greater the estimation of the duration of the experiment. The results here would indicate however that the number of options, or possible actions, available to us at one time does not lead to changes in our durational estimations indicative of an increased perception in the pace of the passage of time. Although this in not in line with what was expected, reference to research conducted in the area of attentional based models of timing may illuminate a possible reason. Vroon (1970) conducted research where participants we asked to actively respond to the presented stimuli. It was found that reported duration was shorter if individuals had to process more information. Block (1990) suggests a type of perceptual load theory to account for this anomaly. As the participants in the study are concentrating their focus on the decisions, they have little resources left to perceive the passage of time, causing them to give unreliable judgements of the duration that has past. It is entirely possible that this occurred during this study. Participants had been instructed that would be asked at the end of the experimental trial how long they had spent popping balloons, however it is plausible that the processes involved in time keeping were not available while decisions about which balloon to choose were being made. However, there was no significant difference in either direction, and individuals in the no option condition performed similarly to those in the "high" option condition. Future research outside of the realm of technology use and time perception should indeed investigate this idea of decision making and time perception more, however at this point; this study suggests that the number of available options does not seem to affect temporal experience.

6.2 Study 4: Integrating Sensory Modal stimuli

Previous research in the area of temporal judgements of single stimuli has consistently found that auditory stimuli appear longer than visual stimuli of the same duration. This has sometimes been attributed to a "clock speed" effect in the literature (Wearden et al., 1998; Wearden, Todd, & Jones, 2006). This interpretation postulates the existence of a pacemaker which is sending pulses at a faster rate to an accumulator when the individual engages with auditory stimuli, than when they engage with a visual stimulus. For example, Experiment Four in Wearden, Todd & Jones (2006) outlines a simple verbal estimation task and finds that participants in an auditory condition (500Hz tones) judge the duration of stimuli as significantly longer than participants in a visual condition (blue squares). They conclude that this has occurred because the pacemaker has one speed of pulse for when it is processing auditory stimuli, and another slower speed for when it is processing visual stimuli. Further previous research has also found that individuals judge moving stimuli as lasting longer than static stimuli (Brown, 1995). Brown felt that this effect gave support to a contextual change model of time perception (Block & Reed, 1978) where the number of contextual changes in an interval affects our perception of the duration of that interval. However when engaging with stimuli in our day to day lives we tend not to simply experience sensory stimuli in a vacuum. When engaging with information communication technology, or indeed when simply living within an advanced technological society our sensory neurons are constantly relaying information to our central nervous system about our environment. While surfing the internet or interacting with mobile devices we constantly see moving images, hear sounds and can even receive tactile feedback (such as touchscreen vibrations). As of April 3rd 2012 only 7.9% of websites use no client side scripts ("Historical trends in the usage of client-side programming languages for websites" April, 2012). These scripts can create the constantly animated advertisements or backgrounds seen on many websites. Further to this Ahrens and Sahani (2011) found that individuals appear to create judgements on the passage of time based on probabilistic stimulus change, relying on sensory input for this information. However in today's world even while attempting to read a document online you can be interrupted by advertisements and moving images within the same window. Or while relaxing at home with a book you may feel inclined to have the television on in the background and simultaneously refresh your email on your phone. Our ability to create probabilistic determinations on how these stimuli will change from moment to moment may be unreliable. This is divergent from a lab environment, where most extraneous sensory stimuli are controlled and single modality stimuli are examined. This experiment aimed to examine the relationship between integrated stimuli from different modalities and temporal judgements. With this in mind, the following experiment was designed in order to ascertain whether increasing the multimodal integration of a stimulus are linked to participants' subjective experience of its duration. This was conducted through a standard duration estimation task, with participants split into three groups based on condition: no integration, medium level of integration, and high level of integration.

6.2.1 Method

Participants

Forty three members of the general public took part in this study. They were selected using convenience sampling. Their age ranged from 18-54 year (m= 27.28, SD= 8.24) and 29 were female.

Design

This study utilised an independent subjects design. The independent variable was the level of integration of modalities, which functioned on three levels. The lowest level involved participants viewing a series of visual static screen shots from a stop motion animation. The medium level involved participants viewing a visual, moving stop motion animation. The high level condition involved participants viewing the same visual, moving animation; while also listening to the auditory output of the animation. The dependent variable was the estimated duration of the stimulus.

Materials and Equipment

Participants were tested in quiet areas, and wore headphones to block out external sounds whether they were in a condition including sound or not. Steps were taken to minimise any extraneous auditory or visual stimuli. The experimental programme was written using the E-Prime 2.0 stimulus presentation software. Stimuli were presented on a Dell notebook computer. The stimuli presented in each condition were: a series of still images from an episode of the animation *The Plonsters* (Figure 6-3 gives an example of a screen shot from this animation, however during the experiment these were presented in full colour) lasting 3 minutes and 30 seconds; a muted episode of the animation *The Plonsters* lasting 3 minutes and 30 seconds; or an episode of *The Plonsters* played in full sound lasting 3 minutes and 30 seconds. This cartoon was chosen as the stimulus for this study in order to control for as many hidden variables in the study as possible. There were a number of reasons for this. It is likely that the rhythm of music would have an effect on temporal perception therefore music videos could not be used. *The Plonsters* also involves no speech comprehension as the characters only communicate using tones rather than words; therefore speech processing was not a worry. The cartoon was also popular with children in the 1990s and it was felt it would appeal to and engage the participants in the study and would motivate them to concentrate fully on the task for the trial duration.

Figure 6-3: A sample screen shot from The Plonsters

Procedure

All participants read the information sheet (Appendix L), and signed a consent form (Appendix K). The participants who took part in the low level of complexity condition were seated in front of the computer and were first greeted by a set of instructions informing them that they would be watching a series of still images and that at the end there would be a number of questions asked of them, including how long they had been watching the still images for. In actual fact there was no other questions posed, however it was deemed necessary to allude to questions to ensure that participants would give the cartoon their full attention. There followed a brief synopsis of the storyline of that particular episode of *The Plonsters*:

> *"Plummy drops into the countryside and has the idea to build a nice home. In a short time he builds the walls, a roof and the windows and doors. Finally, he makes the furniture. Plif and Plops who drop in too, really like the house and with one trick they succeed in getting into the house and locking themselves in. Of course, it all goes wrong and after some turbulent problems they find out that they would have achieved more by being friendly to one another. That way they all get a nice house for the three of them."*

This same synopsis was given to all participants across condition in order to insure that the context of the cartoon remained stable across condition.

Once they were ready to begin the experiment they pressed the SPACE bar and were greeted by the series of still images. The still images were created by the researcher and care was maintained to not affect the context of the storyline in any way. This series of still images ran for 3 minutes and 30 seconds. The participants in this condition therefore engaged with a visual, static, silent stimulus.

Once they had read the instruction and synopsis, participants who took part in the medium level of integration condition were greeting by the same episode of *The Plonsters* which was played in full for them, however the sound on the laptop was muted during this condition. This episode also ran for 3 minutes and 30 seconds. The participants in this condition therefore engaged with a moving, visual, yet silent stimulus.

Once they had read the instruction and synopsis, participants in the high level of integration condition were also greeting by the same episode of *The Plonsters.* Once again this was played in full to them, and they were also able to hear the audio of the cartoon played through the headphones they were wearing. This episode also ran for 3 minutes and 30 seconds. Therefore the participants in this condition were engaging with a moving, visual and auditory stimulus.

After the cartoon or still images had terminated a screen appeared asking participants to enter how long the felt the episode had lasted. They entered this estimation in minutes and seconds and were then free to leave.

6.2.2 Results

After inspection for outliers, normality testing and a visual comparison of the mean estimation of durations, as indicated in Figure 6-4, a one way analysis of variance was conducted in order to explore the impact of layering modalities on subjective experience of duration. Subjects were divided in three groups based on the condition they had been placed in: low level of complexity (n=14), medium level of complexity (n= 13), and high level of complexity (n=16). There was a statistically significant difference in the mean estimations of duration for the three groups [F (2,

40) = 4.95, *p*= 0.04]. Post-hoc comparisons using the Tukey indicated that the low level layering condition responses (*M*= 249.93, *SD*= 41.53) were statistically different from participants in the high level layering condition (*M*= 332.75, *SD*= 82.55). Participants in the medium level of layering condition responses (*M*= 284.92, *SD*= 84.3) did not differ significantly from either of the other two conditions.

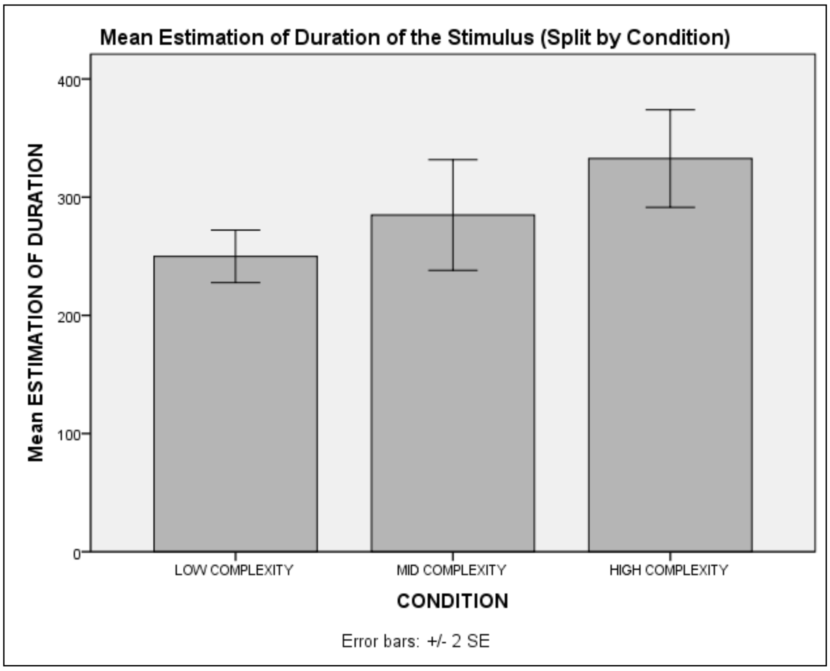

Figure 6-4: Shows the mean estimations of duration of the stimulus, split by condition. (Y axis is scored in seconds)

6.2.3 Discussion of Study 4

The aim of this experiment was to explore the idea of integrating visual, kinetic and auditory modalities of stimuli, as a factor in technology and techno centric society and its possible links to altered temporal judgements. The data described here clearly suggests that in conditions where there is a higher level of integration of modalities in the stimulus, the duration of the stimulus is felt as subjectively longer than when integration is low. This research is in line with what would be predicted by a number of models of timing. Scalar Expectancy Theory would describe this as a clock speed effect. In this way proponents of this theory would suggest that a form of arousal in the pacemaker of the internal clock caused by the heightened complexity of the stimulus caused these individuals to accumulate more pulses, which in turn caused them to confuse the experimental period with one of objectively longer duration. Researchers, such as Ornstein, who claim the existence of a memory storage style timing model could exert an information processing type analogy to explain these results, the more information that is stored during the experimental period, the longer that period is felt. Others (Block & Reed, 1978) may argue that it is not the amount of information that has been stored that is the key; rather it is the amount of changes in contextual information that have been encoded that will lead to these results. This explanation would also be somewhat linked to Ahrans & Sahani (2011) finding that individuals may experience time based the probabilistic changes in the stimulus perceived using sensory input.

We may also consider a slightly altered information processing theory. It may be that the speed at which we process information is causing altered perception of time. As has been previously mentioned Jones et al. (2011) have recently highlighted evidence for a link between information processing speeds and the subjective experience of time. They attempted to investigate whether use of click trains before a task would, through an increase in subjective duration, give individuals more time to process information and increase reaction times. However through analysis of their results they found that it was also possible that these click trains had in fact increased the speed of information processing in the individual. If this is the case then the increase in the speed of subjective time demonstrated in previous literature (for example Penton-Voak et al., 1996) may actually be created by this increase in the speed of information processing, i.e. subjective time perception may be an epiphenomenon or secondary effect of information processing speed. In the lower complexity condition participants were not as rushed to process the stimulus on the screen because the image was still and remained there for over a second. In the medium and high complexity conditions there were a large number of frames shown per second with each frame being the equivalent of the image that the participants in the lower complexity condition had seen. It follows from this that individuals in the medium and high complexity conditions were forced to process information faster than those in the lower complexity. As those in the high complexity condition also had to process auditory information they would have had the fastest rate of information processing. This approach to timing is also able to account for the three paradigms of timing, prospective, retrospective and passage of time judgements, something which internal clock models find difficult to incorporate. This will be discussed further in the next chapter. It is possible that the speed of information processing is linked to the speed at which we perceive the pace of the passage of time, and would therefore affect our reported estimations of duration.

In order to investigate whether technology may also have a subconscious priming effect on our temporal judgements one further study was carried out.

6.3 Study 5: The Priming effects of Thinking about Time or Technology

This study was intended to investigate whether the “time saving/time management” aspects of technology are having a priming effect on behaviour.

Previous literature in the area of behavioural priming has found that environmental cues can have many effects on outward behaviours. People who have been primed with the elderly have been found to subsequently walk slower (Bargh, Chen, & Burrows, 1996), people who have been primed with the Disney Channel have been found to behave more honestly than those who have been primed with E! (Fitzsimons, Chatrand, & Fitzsimons, 2008) and people who have been primed with the retailer name Wal-Mart exhibit reduced subsequent spending (Laran, Dalton, & Andrade, 2011). Research conducted by Zhong and DeVoe have found that subliminally priming individuals with fast-food logos, caused them to exhibit increased reading speed, increased preference for time saving products over inefficient products, and impatience with regard monetary gains (preferring a lower immediate gain than a greater delayed gain) (Zhong & DeVoe, 2010). A strong link can be drawn between fast food and a techno-centric society. As pointed out in Gleick (1999) it is our overarching desire for instant gratification that pushes and creates these types of fast societies. Technology use gives us this potential for instant gratification. However at the same time it is a constant reminder of the passage of time. This was evidenced in the conversations in the focus groups outlined in Chapter Four. The participants displayed frustration at the fact that information communication technologies are a combined time saving, time keeping, time management and time wasting tool. In today's society we can feel bombarded with information that time is important and that we should not waste it. This information can be blatant, like the saying "time is money" or it can be more subtle and can affect us subconsciously, through terms like fast food, instant messaging or quick start. In lab settings click trains (a series of clicks) have been shown to increase the individuals' subjective experience of time (Penton-Voak et al., 1996). The exact process by which this occurs remains unclear, but it would appear that the clicks prime the individual to feel that time is passing at a faster pace relative to the speed of the clicks. This current study aims to examine whether being primed to think about time management, or advanced information communication technologies will have a similar effect on the subjective timing of the individual as these click trains, in an attempt to further elucidate any effect found in Study 2 of this thesis.

This experiment utilises a temporal generalisation state change task in order to assess individuals' temporal experiences before and after a state change intervention. Temporal generalisation created by Wearden (1992) involves presenting a participant with a standard duration (for example a tone 500ms long) a number of times and asking them to remember this duration. They are then presented with comparison durations of varying lengths and have to reply whether each comparison is of the same duration of the standard. After this a state change, or intervention, occurs which involves having the participant engage with the stimulus being examined, in the current case a priming paragraph. After this intervention stage the participant repeats the task of comparing durations with their learned standard. Evidence for a change in subjective timing is then gathered by investigating any differences in the responses before and after the intervention stage.

There were three separate sub groups in this task: a control group, time management as prime group and technology as prime group.

6.3.1 Method

Participants

Forty members of the general public took part in this experiment. They were selected using convenience sampling. Their ages ranged from 18- 54 years (*m*= 27.8, *SD*= 8.4 years). 28 of the participants were female.

Design

This study utilised a repeated measures design. Participants completed a temporal generalisation task, and then read one of three paragraphs which acted as a priming stimulus, and then finally completed the temporal generalisation task again. There were three different sub groups investigated in this study. These sub groups of participants were based on the content of the priming paragraph that the participant read. The first sub group simply read a book review with no mention of time management or technology. The second subgroup was primed to think about time management skills, and the third subgroup was primed to think about advanced technologies. Analysis was conducted within these subgroups.

Materials and Equipment

Participants were tested in quiet areas and wore headphones to block out external sounds. Extraneous auditory and visual stimuli were minimised. The experimental programme was written using the E-Prime 2.0 stimulus presentation software. Stimuli were presented on Dell notebook computer. Data was exported from the E-Prime 2.0 software to the IBM SPSS Statistics 19 statistical analysis software for data analysis. During the temporal generalization task participants heard

500 Hz tones played. The standard duration tone was 500ms and there was eight other durations used for comparisons (100ms, 200ms, 300ms, 400ms, 600ms, 700ms, 800ms, and 900ms). Each of these comparisons along with the standard was played 5 times during the pre-intervention section, and 5 times during the post-intervention section (totalling 45 responses before and 45 responses after intervention).

Procedure

Once participants had read the information sheet (Appendix M), signed a consent form (Appendix K) and understood the instructions for the experiment they were asked to put on headphones. They had been informed that there were a number of steps involved in this study. Once they were ready to begin they pressed the space bar on the keyboard in front of them. This began the learning segment of the experiment. They heard a 500ms 500 Hz tone played ten times with 2000ms gap between each presentation. They were informed onscreen that this was the standard duration which they would be required to remember for the rest of the experimental session. Once all the repetitions of the standard had played they began then next step. During this step they heard 9 tones of varying duration (100ms, 200ms, 300ms, 400ms, 500ms, 600ms, 700ms, 800ms, 900ms) each played five times, in random order. After each presentation of a tone had played they were required to enter into the keyboard whether they thought it was the same length as the standard that they had memorized. They did this by pressing y (yes) or n (no). After all 45 tones had played they received a refresher of the standard duration. This was played 5 times. They then moved on to the intervention stage. During this stage all participants read a brief document (< 250 words), which varied according to the condition in which they had been placed. Those in the control condition (*n*=13) read a book review which had no mention of time or technology, shown here:

> *One of the great things about Bill Bryson's books is his ability to grab your attention and draw you in to find out what odd fact he's going to come up with next. So I hadn't even got through the introduction when he came up with the gem about why all churches in Norfolk appear to have sunk into the churchyard (they haven't; it's the churchyard that has risen 3 ft or more because of the number of bodies buried there, which if you do the maths of how many people live in a parish, how many die each year, and how long the churchyards have been there is not so remarkable. And keep on reading to find out just how many bodies were buried in urban cemeteries in the Victorian era - quite astounding).*
>
> *He is also a great debunker of accepted truths - for instance, there's a lot of interesting comment about the widely accepted view that most food, especially bread, was adulterated with all sorts of disgusting and probably toxic substances. Bryson refers to somebody who tried baking bread with all these supposed adulterants, and showed that what was produced was actually inedible, with the exception of alum, which, he points out, if used in small quantities actually improves bread, and is also used nowadays as an additive to many products.*

Individuals in the time management as prime condition (*n*= 12) read a number of time saving and time management tips, shown here:

We are all guilty of it. Wasting time on distractions or simply being unconscious of how our time is managed at work. Look at the following list to see which of these time wasters apply to your work day.

1. *Watching something print or photocopy*
2. *Waiting for your computer to boot*
3. *Making a list, then making a list from the list*
4. *Recording a meeting in 2-3 calendars*
5. *Doing a task that is low priority because you want to do it*
6. *Not filing an important paper(s)*
7. *Not putting away something so you can find it easily again*
8. *Chatting with co-workers*
9. *Attending meetings that you don't need to or participating in discussions that are not relevant to your work*

Here are three rules that can help you put an end to some of the above time wasters and increase your efficiency at work.

The one touch rule.

Read an email or piece of paper and classify it so that you are not re-reading it multiple times.

The one calendar rule.

Have one calendar that you record everything on – personal and work commitments and time-sensitive tasks.

The three priority rule.

Each day set your top three priorities that need to be accomplished. Complete those three priorities first before taking on any other tasks.

And those in the technology as prime condition (n= 15) read a review of the Apple iPad which had recently been released, shown here:

LED-Backlit IPS Display

The high-resolution, 9.7-inch LED-backlit IPS display on iPad is remarkably crisp and vivid. Which makes it perfect for web browsing, watching movies or viewing photos. With iPad, there is no up or down. It's designed to show off your content in portrait or landscape orientation with every turn. And because it uses a display technology called IPS (in-plane switching), it has a wide, 178° viewing angle. So you can hold it almost any way you want and still get a brilliant picture, with excellent colour and contrast.

Thin and Light

One of the first things you'll notice about iPad is how thin and light it is. The screen is 9.7 inches measured diagonally. So overall, it's slightly smaller than a magazine. At just 0.68 kg (1.5 lbs) and 13.4 mm (0.5 inches) thin you can use it anywhere. And a slight curve to the back makes it easy to pick up and comfortable to hold.

Up to 10 Hours of Battery Life

To maximise battery life, Apple engineers took the same lithium polymer battery technology they developed for Mac notebook computers and applied it to the iPad. As a result, you can use iPad for up to 10 hours while surfing the web on Wi-Fi, watching videos or listening to music.

Accessories

> *What makes iPad even better? Accessories. The iPad Keyboard Dock combines a dock with a full-size keyboard. You can import photos from a digital camera or SD card with the iPad Camera Connection Kit. The iPad Case not only protects your iPad, it lets you use it in various positions. And different adapters let you connect iPad to TVs, projectors and displays.*

Once participants in each condition had finished reading they pressed the space bar and this began the second series of 45 comparison durations as described above. The proportion of yes responses to each duration was then calculated across participants.

6.3.1 Results

The aim of this experiment was to assess whether there would be difference in the proportion of yes responses below and above the standard, pre and post intervention. The results will be presented separately for each subgroup in this section.

Control Subgroup

Figure 6-5 shows the mean proportion of yes responses to each duration across the experimental trial, pre and post intervention. It can be seen from this graph that the responses appear to shift to the left post intervention. In order to investigate this shift a number of tests were conducted. A one way repeated measures ANOVA was conducted on data from all participants in this subgroup to compare responses pre and post intervention. A significant effect of duration was observed [Wilk's Lamda = .010, f (8, 5) = 61.787, p= .0005]. This is to be expected and merely confirms that there was a significant difference in the responses across the trials and that participants were not arbitrarily choosing their responses. There was no significant interaction effect between durations and intervention phase.

A paired sample t-test was conducted in order to investigate whether there were a higher proportion of yes responses to durations below the standard, after the intervention than before. A higher proportion of "yes" responses below the standard (after the intervention than before) would indicate that after reading a short book review participants were more likely to confuse shorter durations with the standard, or put in another way, they felt the shorter tones to be subjectively longer in duration. This found that there was no significant difference post intervention in proportion of "yes" responses.

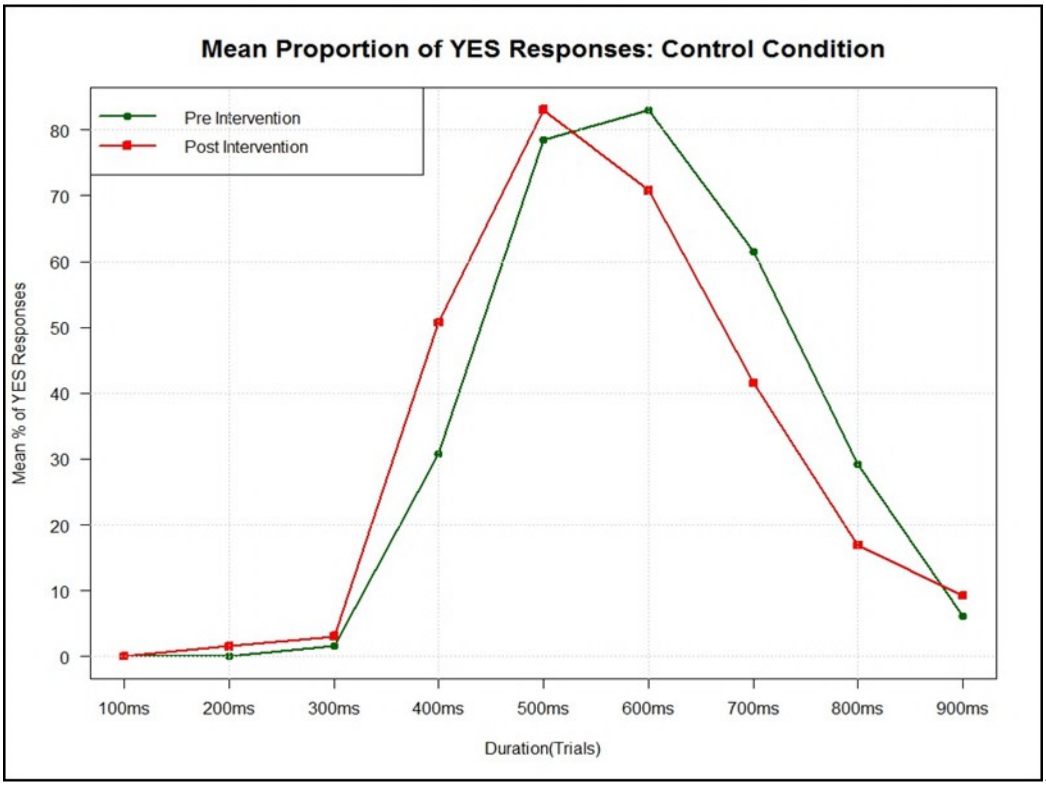

Figure 6-5: Mean proportion of yes responses across trials. Control subgroup

Likewise in order to investigate whether there was a lower proportion of yes responses above the standard after the intervention than there were before (indicating that they were more likely to confuse a longer tone with the standard), a second paired sample t-test was conducted. This was also found to be non-significant. It can be concluded from this that there was no significant difference in the responses before and after the intervention or state change.

Time as prime subgroup

It can be seen from Figure 6-6 that in this subgroup, the responses once again appear to shift slightly to the left post intervention. Visually it would appear that participants were more likely to confuse a tone of shorter duration with the standard after they had read a short piece on time management. A one way repeated measures ANOVA was conducted on data from all participants in this subgroup to test this by comparing the yes responses pre and post intervention. A significant effect of intervention phase was observed [Wilks' Lamda = .662, $f\,(1, 11) = 5.604$, p=.0037]. This indicates that there was a difference in the responses before and after the intervention. As with the control condition a significant duration effect was found, this was to be expected. In order to investigate whether there was a higher proportion of yes responses to durations below the standard, after the intervention than before a Paired Samples t-test was conducted. This found there to be statistically more yes responses below the standard post intervention (m=80, SD= 16.14) than pre intervention [m=48.33, SD = 11.92, $t\,(11) = -2.258$, p= < .045]. This indicated that their perception of duration was altered following being primed by time management paragraph.

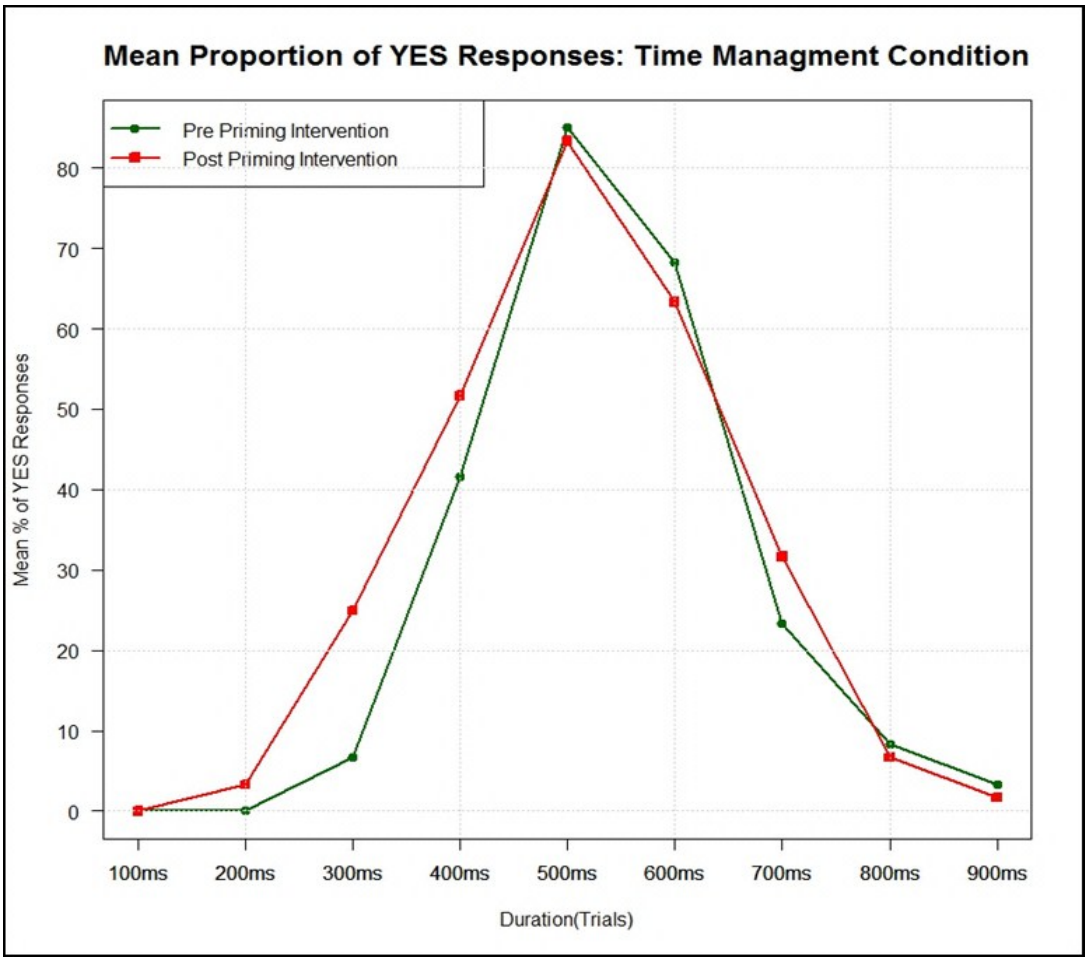

Figure 6-6: Mean proportion of yes responses across trials (time as prime subgroup).

Technology as prime subgroup

Figure 6-7 highlights that once again within this condition responses tended to shift to the left post intervention. An ANOVA was conducted on this data in order to compare responses pre and post intervention. A significant effect of duration was once again observed. In order to investigate whether participants were more likely to confuse tones of shorter duration with the standard after reading about technology, a paired samples t-test was also conducted comparing the proportion of yes responses to durations below the standard, after

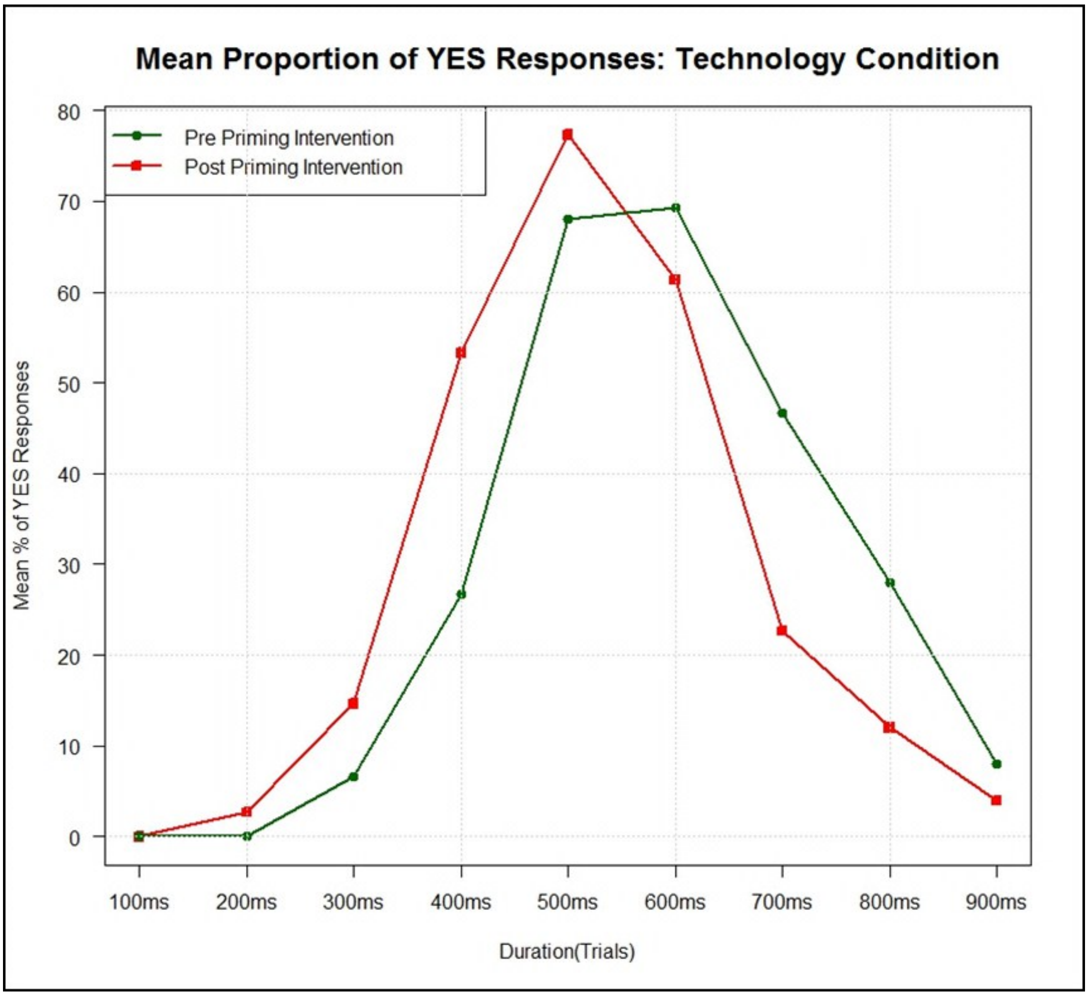

Figure 6-7: Mean proportion of yes responses across trials (Technology as Prime subgroup).

and before the intervention. This found there was statistically more yes responses below the standard post intervention (*m*= 70.67), *SD*= 12.01) than pre intervention [*m*=33.33, *SD*= 10.98, *t* (14) = -2.736, *p*= .016]. Likewise in order to investigate whether there were a lower proportion of yes responses above the standard after the intervention than there was before, a second paired sample t-test was conducted. This was also found to be significant with pre intervention yes responses (*m*= 152, *SD*= 15.09) being higher than post intervention yes responses [*m*= 100, *SD*= 21.38, *t* (14) = 2.49, *p* =.026]. This indicated that, as in the time management condition, participant's experience of duration was significantly altered simply by reading about technology.

6.3.3 Discussion of Study 5

The findings in this study suggest that our estimates of duration can be easily manipulated, even when passively engaging with certain stimuli. Simply reading about time management or about technology appears to have an effect on our temporal judgements. These results are in line with what would be expected when comparing to previous research in the area of behavioural priming. Zhong and DeVoe (2010) showed that individuals who have been subliminally primed with fast food logos show impatience. This impatience may also have been linked to the stress felt when we perceive that time is passing quicker. Fitzsimons et al. (2008) found that priming individuals with the Apple logo caused them to behave more creatively than those who were primed with the IBM logo. They argued that these effects occur as the individual is attempting to emulate the virtues of the brand. This may also be the case in this study. In the same ways that click trains appear to increase the speed of subjective time (Penton-Voak et al., 1996), priming our subjective timing with ideas of speed relating to information communication technology may have the same effect. Individuals may be attempting to emulate the time saving and high speed information processing properties of information communication technologies. As mentioned above Jones et al. (2011) recently highlighted evidence for a link between information processing speeds and the subjective experience of time. They attempted to investigate whether use of click trains before a task would, through an increase in subjective duration, give individuals more time to process information and increase reaction times. However through analysis of their results they found that it was also possible that these click trains had in fact increased the speed of information processing in the individual. As has been mentioned if this is the case, then the increase in the speed of subjective time demonstrated in previous literature may actually be created by this increase in the speed of information processing, i.e. subjective time perception may actually be an epiphenomenon of information processing speed. The results presented also add evidence to this link.

These studies have investigated three aspects of technology and techno-centric society and found evidence that two of these have the ability to alter our judgements of time. There may be countless other aspects of technology that are also having effects. This raises the question of whether these effects are compounded when engaging with technology as a whole in daily life. How the current theories of time perception can deal with this real world timing remains to be seen. Standard pacemaker-accumulator style theories are very capable of explaining and predicting how we learn specific times, and make timing judgements in a prospective paradigm. They have also been extremely useful in developing an understanding of how single stimuli can alter our perception of duration while engaging with these stimuli. However there is little explanation of why these effects occur, how long these effects last or how they can be applied to "real world" situations where individuals are engaging with multiple stimuli at a time. The current research highlights the need for psychologists researching time perception to perhaps focus on time perception as it naturally occurs.

6.4 Conclusion

This chapter has outlined three separate studies designed to each investigate different aspects of technology and techno-centric society and their links to altered temporal perceptions. These mechanisms were chosen to be studied in order to further elucidate the complex effects found in Study 2 and as they are related to the most apparent qualities of information communication technologies. The mechanisms chosen for investigation were: increased number of available options, integrated modalities and behavioural priming effects. These studies found that although the number of available actions did not appear to have any significant effect on temporal judgements, the level of modal integration of the stimulus and priming did.

Chapter Seven

General Discussion

7.1 Implications for the area of Human Timing

Our perception of duration and experience of time has been studied within the area of psychology since its earliest beginnings. In *The Principles of Psychology* William James (1890) dedicates a chapter to the perception of time. He discusses the experience of time in retrospect as opposed to prospect, our abilities to discriminate between simultaneous and non-simultaneous stimuli, looks at the experience of filled durations feeling longer than unfilled and even contemplated the different brain processes which may underpin these experiences. Although the area of time perception has received attention since this the exact mechanisms by which we experience the passage of time remain elusive. Many researchers have put forward models attempting to explain our experience of time, with each model based on a different approach. Some have claimed that our experience of time's pace has a chemical basis (Hoagland, 1935). Others have supported different information processing or cognitive processes based theories (Benussi, 1913; Block & Reed, 1978; Guyau, 1988; Ornstein, 1969; Zakay & Block, 1995) and others claim that we judge duration based on pacemaker accumulator style internal clocks (Gibbon et al., 1984; Treisman, 1963; Wearden, 1991). Each of these different types of model has their advantages and disadvantages. For example, in general, information processing type models have been used to explain retrospective timing whereas pacemaker accumulator style models have been used to explain prospective timing. However, pacemaker accumulator models, for example Scalar Expectancy Theory, cannot (and do not claim to) account for retrospective timing.

Much of the research conducted in the area of prospective interval timing has focused on alterations in the speed of the pacemaker within this pacemaker-accumulator model, and stimuli which may alter this speed. As has been pointed out throughout this work the alteration of the speed of this internal clock is often cited as being caused by arousal levels being greater when engaging with one stimulus rather than another. However, why the arousal levels should be greater is rarely discussed. For example Wearden et al.(2006) found that auditory stimuli were judged as lasting significantly longer than visual stimuli, hypothesising that this difference is caused by increased arousal for auditory but not visual stimuli. The question remains as to what "arousal" is being discussed and what it is about auditory stimuli that create an increased level of this arousal versus visual stimuli. As the pacemaker, as yet, is still a hypothetical mechanism, it is impossible to test the validity of claims that it is running at a specific pace for one set of stimuli, and running at a different pace for others.

Studies conducted within the prospective paradigm generally involve "unnatural" types of tasks. As discussed previously in this thesis, within a temporal generalisation task participants are asked to learn a standard duration and then make comparisons with other durations. Although this shows us a great deal about how individuals learn durations in the short term and issues that can affect this learning, this type of learning is probably unlikely in our daily lives and our ability to perform well on tasks such as this in a lab setting may not be comparable to how we time naturally. The reason that research has been conducted on these types of tasks may simply be because these models have their basis in animal timing in the 1980s. This is to be expected as models based on scalar timing, such as the Scalar Expectancy Theory, have been shown to predict timing in these types of tasks in humans quite accurately. However there have been some difficulties when utilising these types of models when attempting to investigate real world timing. Taking the perception of duration of emotional or evocative stimuli as an example, research conducted by Droit-Volet et al. (2004) found that consistent with arousal based models emotional faces were judged as longer than neutral faces. However, in attempting to replicate this finding Wearden (2011) claimed that this effect appeared to be more fragile than had been previously supposed and may be based on other factors. Effron et al. (2006) found that it was necessary for the participants to be able to imitate the emotional faces, and embody them in order to experience a temporal effect. This in itself raises questions about the sensitivity of the pacemaker to arousal. It would appear that the individual has to engage with the stimulus at a higher level, perhaps utilising multiple executive functions in order to elicit the "arousal" effect, therefore raising a possibility that a hypothetical pacemaker may indeed be more intricately linked with these executive functions than previously assumed.

The results of the duration estimation and interval production tasks as discussed in Chapter Five also highlight the complexity of human timing when looking purely at our internal representations of time, as opposed to how we learn duration. The participants in these two studies were not trained on specific durations, or separated into arbitrary conditions by the researcher. The grouping variable used was their self-reported everyday use of technology, which was not manipulated by the researcher, and the productions and estimations made were completely based on their inherent perceptions of duration. Therefore the estimations and productions were spontaneous in so far as the individual was relying on their own predetermined representations of duration as opposed to a duration learned within the trials. These studies found a statistically significant difference in the overall estimations and productions of the participants, with inspection of the graphs showing that individuals who were using more information communication technologies tended to be under producing intervals to a greater extent than those who were using less. However when each individual trial was tested for significance using Bonferroni's adjusted significance this difference was removed. From this we can conclude that although the overall responses of the two groups differed from each other significantly, this effect was not strong enough to affect individual trials. Therefore, although these findings allude to poorly calibrated internal representation of time in certain non-clinical individuals, it also raises the question of why this effect was weak. There are a number possible reasons why this may have occurred. First, as mentioned above, it is possible our experience of time within an ecologically valid paradigm, as opposed to the learning and comparison of durations, is simply more complex than we can currently account for. Secondly, the range of information communication technology use was not as wide as the researcher had wished and was skewed toward the upper end. This was the case even though all efforts were taken when sampling in order to find the widest range possible. This may simply be symptomatic of modern society, and indicates the ubiquity of information communication technologies. In this way it could be speculated that the effect would be stronger if there was a wider cohort of participants, however, testing this may be difficult. Thirdly the effect may be being confounded by an on-going calibration system in our internal representations of time.

As mentioned above, current internal clock models do not appear to account for individual differences in prospective timing judgements. The reasoning for this is that these kinds of models rely on an accurate average concept of the duration being stored in reference memory (Wearden, 2005b). Although previous research in the area appears to hold that within nonclinical populations individuals have some standard form of mechanism for experiencing time and calibrating their internal representation of duration with standardised clock time, this thesis provides evidence that this may not be the case, and in fact individuals internal representations of durations can appear to be poorly calibrated to standardised time on an on-going basis. The findings from the duration estimation and interval production tasks in Study 2 found significantly different overall responses in estimations and productions in individuals split by their level of information communication technology use. At first glance these findings may appear to have been in line with an arousal effect, from the point of view of internal clock models, however in this case it is not this straight-forward. If, as claimed by internal clock models, the individuals' accumulators link with long term memory where we have created a bank of representations of durations (Wearden, 2005a), then even with a constantly elevated speed in the pacemaker these representations of duration should have recalibrated with objective time in order to create the accurate average representation of that duration in reference memory. There should therefore have been no difference in the estimations and productions of the sub-groups in these studies. No matter whether the individual's accumulator stored 1000 pulses or 2000 pulses this should have linked with the average number of pulses in reference memory for that duration for that individual. However, when examining the responses on a trial by trial basis, using Bonferroni's adjusted significance value, this statistically significant difference disappears. Therefore it is possible that calibration is occurring, but at a rate that is unable to counter the information communication technology use effect efficiently, thus resulting in this weak effect.

The suggestion remains that poorly calibrated internal representations are quite possible and that some individuals exhibit signs of an increased pace of subjective timing, which is not accurately calibrated to standardised time. Individuals who were using more information communication technologies overestimated and under-produced to a greater extent in these tasks, which may be indicative of an increased pace of subjective time, occurring without a lab based state change. Therefore, although these pacemaker-accumulator models can effectively account for how humans learn durations and can distinguish between two durations of varying lengths, they may not be as adept at explaining timing in a more everyday sense.

In order to further investigate whether there may be an information technology use effect on temporal perception; and perhaps isolate some of the potential mechanisms by which this difference in timing between those use either high or low amounts of information communication technologies in daily life may occur occurring; three further studies based on aspects of technology were undertaken. The first was based on the principle that using technology affords us the opportunity to choose from many different options at any one time. It was found that the number of available options had no significant effect on our perception of time. The second study was based on the idea that the stimuli we engage with when using information communication technologies (sometimes using multiple information communication technologies at the same time) are often multimodal in nature. Therefore it involved three separate conditions where the kinetic, auditory and visual modality integration was manipulated. It found that there was a statistically significant difference in the perceived duration of the experimental trial between those in the lowest complexity and those in the highest complexity conditions. Individuals in the high complexity condition reported significantly longer durations than those in the lower complexity condition, indicating that they felt time was passing at a faster pace during this condition. Therefore it would appear that if there is an information communication use effect on timing judgements, that the multi modal complexity of information communication technology may be an aspect of technology responsible for this effect. The third study outlined in Chapter Six was based on both the emphasis placed on time management and focus on technology within modern societies. Information communication technologies are often marketed as time saving and time management tools. This study aimed to investigate the behavioural priming effects of this on time perception. Through use of a temporal generalisation task it found significant differences in the responses pre and post intervention in both the time management and technology subgroups, but no statistical significance in the responses pre and post intervention in the control subgroup where there was no mention of time management or technology. This would indicate that this aspect of information communication technologies may be also, in part, responsible for any effect of information communication technology on timing.

As the arousal sensitive internal clock models have been used mainly to explain "clock speed effects" occurring due to isolated stimuli, and complexities based around calibration and individual differences within these types of models discussed above, it was felt that these models were not the best fit for explaining the findings in this thesis. Reviewing the current findings in line with recent literature in the area (Droit-Volet et al., 2011; Effron et al., 2006; Jones et al., 2011; Ogden et al.,

2011) alongside some of the classical findings such as Ornstein (1969) perhaps highlights a need to revisit information processing, and cognitive mechanism type models for human timing. These recent pieces of research have focused more on timing in everyday situations such as when engaging with evocative stimuli (Droit-Volet et al., 2011; Effron et al., 2006), timing under the influence of alcohol (Ogden et al., 2011) and the practical benefits of increased pace of subjective time (Jones et al., 2011). In each of these one can draw close links between the higher executive functions and the experience of time.

An interpretation of the results in this thesis from this point of view is linked to Ornstein's (1969) storage size/information processing view of time perception and the recent work by Jones et al. (2011). It implicates the speed of information processing in the subjective experience of the speed of the pace of time. In Jones et al.'s (2011) article the researchers conducted four separate experiments looking at click trains and information processing speeds. As discussed here in Chapter Two, click trains have been shown to increase the pace of the passage of time in many different experiments (Penton-Voak et al., 1996). The bulk of this previous research has been conducted from an internal clock model perspective and interprets these findings in the usual manner suggesting that arousal created by the click trains in the pacemaker of the internal clock cause pulses to accumulate more quickly in the internal clock, causing individuals to feel subjective time passing at a faster speed. The research conducted by Jones et al. (2011) sought to investigate the practical benefits of an increased speed of subjective time and examined whether speeding up the subjective timing in individuals through use of click trains would also increase their information processing speeds. They found that when tasks involving reaction time, arithmetic, and recall are preceded by click trains individuals exhibit behaviours consistent with an increase in the information processing speed. Within their general discussion of these results they state that there are three possible reasons for these findings: that speeding up the internal clock of the individual with click trains actually allows the individuals “more time” in order to process information; that click trains actually speed up information processing speeds directly with subjective time perception being implicated as a by-product of this; or that there is some lurking variable causing both effects. Although they are unable to draw a concrete conclusion from their research on the direction of the causal relationship between information processing speeds and speed of subjective time, they highlight that the link between the two needs to be investigated further within the literature (Jones et al., 2011). Similarly the work of Droit-Volet et al. (2011) and Effron et al. (2006) on timing of evocative stimuli found, as discussed above, that in order for a timing effect to occur the individuals in the study had to embody the emotion, as opposed to simply viewing it. In this way they had to engage their executive functioning and information processing to a greater level. The findings from this thesis also add to this area of the literature in this manner.

As suggested in the Integrated Modalities study outlined in the previous chapter, the amount of information that has to be processed by the individual appears to be linked to their experience of its duration. A standard storage size model (Ornstein, 1969), or contextual change model (Block & Reed, 1978) would explain this as the more information that is processed, or need to be processed the longer the duration appears to the individual. An interpretation based on Jones et al. (2011) deviates slightly from this. In this interpretation it is the speed of the cognitive processes involved in information processing that are creating a feeling of subjective time. This suggests that the faster the speed of information processing, the quicker the individual feels the pace of subjective time and also the longer a duration is felt to have lasted. In the Integrated Modality study participants in the higher level of integration condition had to process moving visual stimuli as well as auditory stimuli within the same time period as participants in the low level of integration condition were simply processing static visual stimuli, therefore their cognitive processes were under more pressure to process this information faster. This speed of information processing model would explain then why individuals who were in the higher integration condition reported feeling the duration as significantly longer than those in the low integration condition.

Next we can we apply this interpretation to Study 5, the Behavioural Priming study. Participants were tested using a temporal generalisation method. In this way they learned a standard duration and completed a series of trials based on whether the tones they were listening to were the standard which they had learned. They then read a priming paragraph which was dependant on the subgroup they were in, and then completed the series of trials again. In this experiment there was no effect on timing in the control subgroup where the paragraph was not based on time or technology. However there was timing effects found in both the time management paragraph subgroup and the advanced technology paragraph subgroup. In both these subgroups participants exhibited behaviours analogous to an increased rate in their pace of subjective timing. From a speed of information processing point of view it is possible that participants who had been primed with the technology paragraph may have been attempting to emulate the properties of information communication technologies. These technologies process information at a high speed, and such emulation would create the effects found. Likewise those who were in the time management subgroup may have been primed to process information faster in order to not waste time. This would also lead to the significant difference in number of yes responses below the standard after priming than before.

Finally, we may also apply this understanding to the findings in the two tasks laid out in Study 2. Individuals who are using information communication technology to a greater extent in their everyday lives may be having their information processing speeds primed on an on-going basis by these technologies, and also affected by the integrated sensory modalities in which they engage with on a frequent basis. It could be that individuals who are using more information communication technologies on a daily basis have been trained to process information at a faster rate, and this manifests in them under producing and overestimating to a greater extent in these trials, or feeling like time is passing at a faster rate. The effect that was found was arguably weak, however this may be a matter of self-regulation, and calibration of internal representations of time as has been mentioned above. Although in this case the pace of the subjective time is an epiphenomenon of our speed of information processing, we would still need to create some ties between the experience of time and objective clock time. In this way we would create mental representations of durations based on our subjective experiences of these durations. However, as technology advances, there may be some lag in the updating of these representations of time, which may slightly suppress our ability to self-regulate and create a dissonance between our internal representations of a duration and clock time.

Another benefit of a Speed Information Processing model is that it can be used to explain the experiences of all three paradigms of time perception, that is, prospective timing, retrospective timing and passage of time judgements. Although internal clock models have done much to explain prospective timing, there are issues that they may be ill-equipped to address (for example individual differences and real world timing involving engaging with multiple stimuli). Internal clock models focus mainly on how we learn durations and are able to distinguish between one duration and another of a different length. They were created in order to explain how animal timing occurs, and then investigated in humans in order to examine whether we time in a similar fashion (Rakitin et al., 1998; Wearden, 1991; Wearden & McShane, 1988). However, in this manner they may not actually represent how humans time in their natural environment. They are also restricted in so far as they can only be used to explain prospective paradigms of timing, which are rare in daily life. Yet recently they are being utilised in some attempts to explain more ecologically valid situations, for example the experience of time under the influence of alcohol (Ogden et al., 2011), or the experience of emotional stimuli (Gil & Droit-Volet, 2011). These findings have not been as conclusive as they may appear at first glance (Wearden, 2011), and this may simply highlight that pacemaker-accumulator models are not suitable for application to these types of timing, which although prospective within a lab based experiment, are unlikely to fall within the prospective timing paradigm in a realistic setting.

Use of a Speed of Information Processing type model can explain the three different paradigms of timing, prospective, retrospective and passage of time judgements, while still accepting that they are different in nature. In order to fully explicate this, take for example the seemingly paradoxical effect of hindsight on the duration of summer holidays as a child. Summer holidays can appear to fly by, yet in hindsight appear to have lasted a lifetime. Vice versa uneventful weeks can drag and be monotonous, yet, in hindsight again they have flown by. Current models fail to explain how the situation is perceived differently when we are actually engaged in it. If the speed of information processing governs the speed of subjective time, then it follows that when the speed of information processing is increased the individual will tend to overestimate the amount of time that has passed as they process more information during this time. During summer holidays, especially as a child, each day is filled with experiences, often novel and engaging. As the child is processing more information during this time, their pace of subjective time increases, leading them to feel that time is flying, yet this increase in the pace of subjective time would also lead them to feel that more time has passed than is actually the case. This would cause them to overestimate the length of time that they have been engaging in an activity while on holiday, as is similar in the case of Jones et al. (2011) research on click trains and information processing speeds. This would explain altered prospective timing. As they feel that time is flying by this implicates their passage of time judgements accordingly. For example if only 20 seconds has passed and the individual feels that 40 seconds has passed, logically in this case their subjective passage of time judgement should also be that "time flew". This would be the case because they have managed to squeeze 40 seconds of experience into 20 seconds of objective time thus explaining passage of time judgements.

To illustrate the effect of increased cognitive processes on retrospective timing we can refer to an experiment outlined by Wearden (2005b) in which participants either watched 9 minutes of the film *Armageddon* or else waited in a simulated waiting room situation. They were then asked to judge whether time had passed faster or slower than normal in these situations. Most participants claimed that time passed faster during the *Armageddon* situation. After a ten minute separation task (reading) they were asked to judge how long they felt they has been either watching the film or waiting in the waiting room. As time was felt as being faster in the film condition than in the waiting room condition, the researchers predicted that the participants would say that it was objectively shorter. However they found the opposite to be the case, with the film condition being judged as longer than the waiting room situation. These results are however in line with speed of cognitive processes/information processing model of timing as more information was actively being processed in the movie watching condition than in the waiting room condition. While watching the movie the individual's increased speed or velocity of cognitive processing caused them to feel that time was passing at a great speed. Individuals who waited in the waiting room were under no cognitive load to process information and therefore it is possible their cognitive processes were running at a slower speed. This would lead people in the film condition to give longer estimations of the trial duration than those in the waiting room condition. This Speed of Information Processing model can therefore explain all three types of timing paradigm. Prospective judgements are based on the amount of information that is being processed, if more information is being processed during an event, it is judged as longer subjectively in an estimation situation. Retrospective judgements are judged based on the amount of information that has been processed during the event, this may be somewhat similar storage size related such as in Ornstein (1969), or contextual change based such as in Block and Reed's (1978) interpretation, as once again an increase in the speed in cognitive processing will cause individuals to process more information. Finally passage of time judgements are made based on the velocity of the information processing, with the velocity of the passage of time being positively correlated with the velocity of information processing. Therefore during situations where we process information at a faster rate, such as when on holidays, the time feels like it is flying in the moment, whereas when we are forced to process information at a slower rate, such as when we are confined to a dull waiting room, then the time will appear to drag.

As ever, there are a number of limitations of the current work. Within the time and resource limitations of doctoral research a number of research opportunities were outside its scope. Future research should address these issues. Firstly, it would be invaluable to conduct this research as a cross-cultural study. Throughout Irish society technology has become pervasive and finding cross sections of the population who are not exposed to advanced technology proves difficult. Future research should focus on comparing societies which have yet to experience a technological boom, and who are less reliant on information communication technologies, with technologized Western societies. Similarly, although the ETUQ was an appropriate and important method of quantifying participants' technology use, it may not be the most accurate method of doing so. Future research should attempt to have participants use technology use diaries, or applications which log their technology use, as a method of recording their exposure to ICTs. These would give more insight into both the amount and type of technology being used.

Another area which has been highlighted in this thesis as requiring attention is the calibration, or self-regulation aspects of timing judgements. As has been mentioned, although our subjective experience of time is different to objective standardised time, it would appear that we must create some calibrations between our internal representations of duration and that duration's numerical value. It may be worthwhile investigating the effect of a constantly increased pace of subjective time on an individual's estimation judgements, in order to examine whether their accuracy improves as they begin to recalibrate their mental representation with objective durations; and the time span needed for this recalibration to occur.

There is also a need for an in-depth study to be conducted looking at links between altered temporal experiences and time pressure. In a study not included in the body of this thesis (see Appendix O) the researcher conducted an investigation into galvanic skin response and heart rate under time pressure. This data was also split by the level of reported technology use of the participant (as measured by the ETUQ). Although skin conductivity increased as time passed during the study the researcher did not feel fully satisfied that this galvanic skin response (GSR) was in response to the time pressure felt, or perhaps linked to another hidden variable in the task. It was also felt that GSR may not be an appropriate measure for measuring physical effects of time pressure and it was decided not to include this work in the main body of this thesis. The GSR data could be interpreted in two contradictory ways. For example individuals with a higher level of technology use appeared to exhibit less stress responses to being placed under time pressure. This could be interpreted as them experiencing less time pressure, or it could also be interpreted as them being accustomed to time pressure in their daily lives and building up a physical resistance to the physical stress associated with it. Upon realising this the researcher felt that it would be a conflict of integrity to include it. However, in the interest of transparency it was necessary to include it in the appendix. This was to highlight to future researchers that this work was conducted, and that they should perhaps seek a different method in investigating the physical symptoms of time pressure. Taking all these things into consideration it was decided to instead focus the research on the various aspects of technology which may affect time perception.

As with all research, there is a need to test the replicability of all the results found here. This is outside the scope of this thesis, however it is hoped that the issues that have been raised here both from a temporal perception modelling aspect and from a cognitive effects of technology use aspect will be investigated further both by the current researcher and others.

7.2 Implications for the area of Modernity

The original aim of this work was to investigate temporal perceptions in everyday life and the relationship between exposure to technological advances and temporal experience. Chapter Two and Chapter Three of this dissertation draw on research from within Psychology and Sociology which lay out the rationale for an argument of a link between these two variables. It highlights that within sociological and anthropological fields of study it has been long recognised that there appears to be a link between modern life, technological advances, pace of life and time pressure. It is reasonable to assume a link between time experience and time pressure, and therefore follows to examine a link between technology and time experience. However a review of the literature in the area of time psychology revealed that this has received virtually no attention.

In order to examine this link a reliable measure of everyday technology use was necessary. Chapter Four outlines the development of the Everyday Technology Usage Questionnaire and Study 1 looking at a link between the amount of technology used in daily life (as measured by the Everyday Technology Usage Questionnaire) and the reported level of Cognitive Absorption in the individual. Cognitive absorption has been shown to correlate positively with willingness to try new technologies and also the perceived ease of use of new technologies (Agarwal &

Karahanna, 2000; Lin, 2009). It has also been linked to the an individual's hypnotisability and the time distortion felt during hypnotic sessions (Crawford, 1982; Glisky, Tataryn, Tobias, Kihlstrom, & McConkey, 1991; Naish, 2003). Therefore it was felt that perhaps it may have an effect on both the amount of technology that a person uses and their altered temporal experiences and judgements. However there was no correlation found between level of cognitive absorption and level of everyday technology use in this study.

As has been discussed above, the initial studies outlined in Chapter Five found that individuals who are using more information communication technology in their daily lives may have been experiencing the pace of time moving at a faster rate than those using less. Chapter Six went on to discuss experiments conducted which found that an altered perception of the passage of time may be linked to both the multimodal complexity of information communication technologies and also a behavioural priming effect caused by individuals attempting to emulate the time saving or time management aspects and fast processing speeds of information communication technologies. Previous research in the area of psychology has found that use of ICTs can have positive effects in that they allow individuals to not be confined by their physical whereabouts and can allow them to experience things that might not have been possible without these technologies, however it has also found that the blurring of boundaries caused by these ICTs, especially work/home boundaries, can cause negative ramifications such as stress and distraction in the individual (Park & Jex, 2011). Other research links this type of blurring of boundaries with increases in depression and exhaustion and decreases in life and job satisfaction (Cardenas et al., 2004). The findings presented in this thesis may also add to this area. If an individual feels that time is moving at a faster pace they will feel more pressure from approaching deadlines, than if they felt time passing at a slower pace. Individuals who work with information communication technologies on a daily basis may be experiencing the same altered temporal perceptions as the participants in these studies on an on-going basis. If this is the case, the time pressure felt from an increase in the pace of the passage of subjective time may be adding to the exhaustion and depression felt and would also explain the anecdotal feelings of being under more time pressure than previous generations and the paradoxical relationship between time saving devices and time pressure (Garhammer, 2002). As mentioned in the previous chapters, time pressure and pace of life has been linked to negative physical and mental health issues. Roxburgh (2004) found that high levels of time pressure are positively related to high levels of depression, among other mental health issues. Levine (1997) studied 31 countries' pace of life and found Ireland ranked second, coming only behind Switzerland, and rating above the UK and USA. Within sociological research it has been found that mobile phone and internet users report higher levels of time pressure (Garhammer, 2002), and it has been generally held that with advances in technology come increases in perceived time pressure and pace of life (Rosa, 2007). The findings of this research add a quantitative, cognitive basis to these mainly qualitative previous finding that modernity is affecting our experience of time.

7.3 Conclusion

Although this thesis should not be seen to fall within the dystopian view of information communication use, it shows that there may be negative ramifications of using large amounts of these technologies in everyday life, perhaps contributing to time pressure and stress. In order to negate the negative ramifications of technology use (i.e. increases in time pressure due to increases in the perceived speed of subjective time) individuals need only to be made aware that this subjective feeling may not correlate to objective clock time. Having a faster pace of life cannot be seen as entirely negative, as pointed out in Garhammer (2002) a higher pace of life is associated with higher levels of life satisfaction and happiness. As is also suggested by this research, if technology use has caused individuals to increase their speed of information processing, then the advantages of this are clear. There may be practical benefits of this in enhancing study techniques, or promoting efficiency in the workplace. An increased subjective time pressure may be the price of this, however if individuals are able to separate the subjective experience from the objective reality this effect may be minimal. This area is entirely undeveloped from a cognitive psychology point of view and as such the current thesis hopes to have opened avenues for new research to occur, both within the area of time psychology and also the effects of technology on cognitive processes and the ramifications of these effects on behaviour.

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Appendices

Appendix A: Focus Group Transcriptions from Group 1

Speaker	Dialogue	Code
Intv	Ok, am thank you for coming to my focus group, so am, what we're going to be talking about today is technology and just how you use technology in everyday life. Right, so, what would ye, first off, what would ye consider as everyday technology?	
Sp3	Computers?	1.1.2
Sp1	Mobile Phones?	1.1.3
Sp2	Television?	
Sp3	Alarm clocks? Watches?	
Sp2	Microwave?	1.1.6
Intv	Washing machine?	
Sp1	Cookers. Modern cookers not the old kind of ones.	1.1.8
Sp3	Self-heating toilets	
Sp1	It's such an abstract term really, such a broad definition.	1.1.10
Intv	Ok, am, what about time saving devices?	
Sp3	Internet, email?	1.1.12
sp1	Text messages. Well not really text cos it takes a while to text…but ya, it's more, it's instant communication	1.1.13
sp3	Ya, twenty years ago people, if ah, you were, ah trying to communicate across the country from Dublin to Limerick you'd have to spend 20 minutes writing a letter and then go and send it and it would have to go over and backwards if it was something official that couldn't be done over the phone. That can be done instantaneously in email.	
sp2	Digital television and what's that recording thing.	1.1.15
Intv	Sky Plus?	
sp2	Ya…	
sp1	The web cast thing, you know where you're face to face, that thing, Skype I think.	
intv	What about things like am, kettles and washing machines and those kinds of things? They would have been time saving technologies back in the day. Would we still consider them to be time saving or…	

sp2	Were they time saving though or were they just kind of enhancing convenience? Because it doesn't take much longer to boil the water in a saucepan rather than a kettle	1.1.20
sp3	Are you talking about time saving in the context of how we're saving time right now, how we're learning how to save time, because for us growing up washing machines are the standard so they're not really time saving for us.	
Intv	So would you say that they, they wouldn't, you wouldn't think that they're saving us time because…	
sp3	Not our generation	1.2.23
sp1	Ya but I remember my mum had a twin tub and	
Intv	What's a twin tub?	
sp1	It was before automatic washing machines and you had to wash am at one side and then they'd dry in the other side and they say that the washing machine revolutionised women's lib in the sixties so I can see the point that the , what's the other thing, even sliced pan is time saving. But the washing machine definitely when it came in changed things.	1.2.26
Intv	But it wouldn't be affecting us?	
sp1	Not today's people, but I'd say even in the mid-nineties there was still people around with twin tubs	1.2.28
sp3	The microwave, when I'm making beans I have the choice between getting a saucepan and using the hob, or using the microwave. They microwave is quicker.	1.2.29
Intv	The thing is most things have some kind of time saving element to them so what would you…	
sp2	Yeah, It's a commercial feature now. It's not about quality, it's about convenience. Like those kettles that can boil water in like three seconds.	1.2.31
sp3	It comes down to, you now, doing something because I can.	
Intv	Ok so, what about, that was time saving devices and basically we're saying everything is a time saving device, what would we consider the top few, if you were saying, if you were listing the time saving devices that you use, regularly, what would you say?	
sp1	I'd say, that the well now that I think of it the phone definitely, the email	1.2.34
sp2	The internet	
sp3	Ya, the internet and computers in general.	1.2.36
all	Ya, ya definitely.	
sp1	Even like I wouldn't use the golden pages as much	
sp3	Ya, a lot of things that you would have had to go to the library for before now you can just get online.	
sp1	Even Microsoft word and stuff.	1.2.40

sp2	Ya, it’s easier, it's easier to type a word in to a search box on a journal than having to look up the index and stuff.	1.2.41
sp1	Even the DVD over the VCR, or the VHS. It's quicker.	
sp3	Ordering books over Amazon, or those things.	
sp2	Digital cameras, you can look at them straight away rather than printing off, you don't have to set up the light or manipulate surroundings; the camera does all that for you.	
Intv	And what about time keeping devices?	
sp3	The sun?	
Intv	Well obviously clocks and watches?…	
sp2	Phone? Cos even when you’re not, when you don’t even realise you’re doing it your, if your waiting for a message to come your kind of much more aware of , conscious of the time, so you do tend to look at your phone clock a lot more. And email, they’re all connected.	1.3.48
Intv	Would you say a lot of people rely on their phone as their watch rather than an actual watch these days?	
sp3	I do, I don't, I don't wear a watch.	1.3.50
Intv	And sticking with the phone, you've got calendars and alarms and stuff like that. Would you use your phone as your alarm clock and your calendar and all that kind of thing?	
sp2	Do people even use calendars as you know, for remembering occasions anymore? Or is it just to remember days and do people programme alarms in to their phones to remind them to do things rather than writing them down? Cos you don’t see people writing on a calendar on the wall or on the fridge anymore to remind them to do things.	1.3.52
Intv	And the IPhone as well has all those apps that you can put on to remind you of everything. Am, OK so basically we’re saying internet and computers for time saving devices phones and stuff for your time keeping. Ok so everyone is using all these different technologies, what would you say distinguishes someone with high level use of technology from someone with low level use...	
sp2	Dependence and reliance on them	1.3.54
sp3	I think everyone has a reliance on phones now.	1.3.55
Intv	There still has to be some difference between if you see high level and low level usage people, what is that?	
sp2	Those blue tooth things, they always have them in, am in their ears.	

sp3	You see a lot of people with Wi-Fi and stuff and the second they sit down in a bar or a coffee shop or something they're out with the lap top straight away. I think even the lap top is going to be a dead technology soon enough, publicly, because people have their I phones and stuff, TV and communication on their phones.	
sp2	Even you see less and less people listening to music on their mp3 player because they just plug their headphones in to their phone. Or Discman, no one listens to Discman anymore. It's all about condensing multitudes of technologies into one. Making it smaller. That's even time saving in general	1.3.59
Intv	So you're saying that someone who has more things…	
sp3	If you have the blackberry or the iPhone, you have literally everything on the one thing. A number of different technologies on the one thing.	1.4.61
Intv	So that would show you that you actually have a higher level of usage?	
sp3	You're spending more money on it as well, so you're obviously, ya.	1.4.63
sp2	But if it's for business or social reasons…	
Intv	Ya would you consider their to be a difference between the two, whether your using it for business or pleasure? Like is there a difference between someone who'd sitting in front of their computer for eight hours a day, they might not actually be using the computer at all, but it's there and it's on. There has to be a difference between them and someone who is solidly using a computer.	
sp3	But what about when they go home?	
Intv	Exactly, how do you distinguish between the quality at work and home?	
sp2	You'd have to do a diary to be honest; you'd have to know their exact usage.	1.4.68
sp1	That's a good idea the diary.	
sp3	No the blackberry and the iPhone are time saving devices, even the last five years, whereas someone before they might have a classic iPod, then they'll take that out, they'll watch TV, then if they got an email they'd have to go upstairs to check whereas now you can have all these things on the one thing. You don't have to leave the couch.	1.4.70
sp2	Even the gym is a time saving device, its exercise without moving.	

sp3	That new plan they're talking about that goes just outside the atmosphere and can get to Australia in like five or six hours. I heard about it ages ago. It was something I read about ages ago and I think they were trying to make it in to a proper airline, obviously it will take years for prices to go down but they go just out of the atmosphere	
sp2	Even motorways and the TGV	
sp3	When you consider how quickly they changed the toll system on the m50. Now you just drive through and you have a tag. Just because people were annoyed at having to wait.	
sp1	The airport, self-check in and online.	
sp3	Time in money	
Intv	Am, ok so basically we have decided that everything in modern life is some form of time saving device. So do you think that these devices have alleviated stress? And freed up time or have they made it worse.	
sp2	So we don't have spare time, we think we do but we just fill it with more stuff.	1.5.78
sp3	So we just create more things to do in the time we have.	
sp2	And even all the increases in technology create more things to do. You never hear of someone sitting down anymore, there always has to be some kind of activity.	
Intv	So no? Because people are doing two or three things at the same time because of the technology?	
sp2	Yeah, when information can be got so quickly there's an onus on getting information very quickly. There's more pressure on people to create information.	1.5.82
sp3	You'd see now that people don't even buy newspapers or magazines anymore because they just go online to read, websites. I'm going to get to a time where I'm not even gonna have to leave my bed.	1.5.83
Intv	So we haven't really freed up time, but because we can do things faster we take on more things? Ok.	
sp2	But all this technology, it almost creates a fetish out of things. Like these virtual worlds, life without life, decaffeinated coffee, it's coffee without coffee, cybersex, sex without sex. It's just dichotomies and oxymorons but people still go for it because it's easy. A new fetish is created all the time.	1.5.85
sp3	Well it saves us having to drive to town and go to a bar. Get straight to the business. Porn is a time saving device.	
sp1	Brothels, there's no chat up, there's no getting to know you, there's none of that crap. Time is money!	
sp2	Ya actually, do people have time to go to the bar anymore?	

sp3	Well, if you look at people's behaviour in nightclubs there's less, there's less of an idea of courting than there was before. It's more; let's get moving as fast as possible.	
Intv	Ok I think we'll wrap it up at that. Thanks a million for your help.	

Appendix B: Focus Group Transcriptions from Group 2

Speaker	Dialogue	Code
Intv	Ok, right, thanks a million for coming to my focus group on technology usage.Ok so, basically what would ye see as , what would ye count as the most prominent everyday technologies that you'd use in your daily lives.	
Sp 4	Mobile phones I suppose first off.	
Sp3	Laptops?	2.1.3
Intv	Ok, mobile phones, laptops.	
Sp3	Kettle, microwave...	2.1.5
Sp1	I use a lot of musical equipment, amps, guitars, keyboards	
Sp5	There'd be lots of other household stuff as well, besides the microwave.	
Sp4	PlayStations, cd players...	
Intv	Just back to the household stuff for a minute,	
Sp2	Toaster	2.1.10
Sp5	Washing machine, that kind of stuff, it's all digital display stuff, anything like that I suppose.	2.1.11
Intv	Yeah, ok so, out of those kinds of technologies, what would you...which would you consider to be time saving.	
Sp5	Dishwasher is time saving, washing machine is time saving,	
Sp1	I dunno if it's time saving, because I wash the dishes quicker, just washing them than sticking them in the dishwasher. It takes about nine hours for the dishwasher...do you know what I mean like?	
Intv	Yeah.	
Sp1	Ya, like what do we mean by time saving...	
Intv	Like basically, which of those would you say, are purporting themselves as time saving devices.	
Sp2	Is it only household, eh, like my car saves me an awful lot of time, when I'm using that.	
Sp3	Phones, because you can’t be sending letters because they're slow...	2.1.19
Sp4	Yeah, the internet as well phones for letter because emails you're saving time.	2.1.20
Sp5	Yeah, although sometime the phone isn't as time saving as you think it is because if it ring, if somebody sends you a message you feel obliged to look at it and to reply to it.Wheras if you haven’t got your phone, you don't get your message and you don't reply to it, therefore you don't have that time interrupted. Or you don't use that time as such. So sometimes phones, I think, can, not interfere, but impinge on your life. Like, just you know, on holidays to be able to switch it off and not have it, it actually gives you a feeling of freedom, it’s great.	2.1.21

Intv	Am, ok so just from the time saving aspect, am, so we're basically thinking phones, computers, they're the most obvious. Would you count the washing machine as a time saving device still? Or the fact that our generation has always had it, like...	
Sp2	Yeah, I suppose if you're going down that route, the fridge is a big time saver as well like... I don't have to go out and milk a cow every morning.	
Sp5	Or you don't have to preserve foods because they can be refrigerated.	
Sp2	Where do you draw the line like?	2.2.25
Intv	So would you draw the line so at stuff, like, stuff that you've always had doesn't really count as a time saving device.	
Sp2	Yeah, if you can find it hard to remember a time before that, a time when this device wasn't around or that technology wasn't around, I suppose you can eliminate that.	2.2.27
Intv	Fantastic.	
Sp2	But then, I didn't always have a car, so I do regard the car as a big time saver eh, because, when I bought a car I got to college eh got to work eh much quicker so for me that is a big time saver.	
Intv	And what about things like am, Microsoft word and those kinds of things on computers?	
Sp2	Every programme that comes out, I find, isn't a time saver because you've got to learn that new programme again, so Microsoft word 2007 doesn't save time for me because I haven't figured out how it works yet. So every time they do bring out new technology it doesn't save time, it's intended to but you've got to go away and learn it.And by the time you've finished learning that new programme they've brought out word 2011 and you have to find out how that works.	
Intv	Ok.What about time keeping devices, what would you consider a time keeping device. Would you go with clocks and watches or are you more likely to use your phone? Does anyone wear a watch?	
Sp4	I look at my phone, even if I have my watch on,	
Sp5	No, I'd always check my watch, yeah.I'd be happier to be without my phone than to be without my watch. Maybe that's a sign of my age I dunno...	
Intv	What about calendars and to do lists...would you still have a calendar on a wall, or would you use your phone	
Sp1	I would use the calendar on the wall.	
Sp2	I use my phone and my computer, for the time, the dates all the time, I have a calendar, and I have a clock at home but I don't really use them. I use my phone and my computer for everything like that	2.2.37

Intv	And would you find that you use the little clocks on the front of your microwave and stuff like that as a clock	
Sp2	Oh yeah, and on your TV, if you have sky,	2.2.39
Sp3	Most of the time the microwave isn't the right time though, but your phone is always on and the sky digital gets the time from the digital so it's always right, you can't really depend on your microwave.	
Intv	Ok, so what about, do any of ye have a blackberry or any of those kinds of iPhone phones...	
All	No.	
Intv	So how would you distinguish between someone has a high level and a low level of technology usage. You know the way, like when I'm here, I'm sitting in front of a computer for so many hours a day, but I still wouldn't think that I have a high level technology usage, because most of the time I'm not really doing much when I sitting there. Like when you're in your office, do you use your computer all day every day?	
Sp5	Well, yeah, I'd be using my emails, or I'd be working, using the computer, I mean, the length of time that I'd be doing other stuff would be very low in comparison to ...	
Intv	So would you imagine that it's solely just the length of time that you're spending in front of a computer that would make you a high level technology user, rather than a low level technology user?	
Sp5	Well, when it's just usage, not expertise that you're talking about, or is it both?	
Intv	Well, you see quality it important.	
Sp5	Well, I suppose if I had to do what I have to do without the computer I'd be in that little box 24/7.	2.3.48
Sp2	First of all, you have to sort out what you mean by technology, because even stone age man with his axes, that was technology...so, you know, ultra-modern technology??People who rely on ultra-modern technology the most as opposed to those who don't rely on ultra-modern technology. And I suppose then you could just define what you mean by ultra-modern technology. Computers, BlackBerrys, things like this, you know, maybe iPods would go in that category as well like you know? As opposed to, there are other people out there in the world and eh, my parents in law, the most modern technology that they use is the kettle you know?	2.3.49
Sp1	Eugene O Brien, in English he has the blackberry like and he has it all synced up to his office here so whenever he's away he can still access everything, you know.	2.3.50
Intv	A point that I've heard being made is along those lines, that it's not the amount of these things that you own, like if you have, like I have a laptop, a computer, a digital camera, a phone, an iPod, because I have all of these things this doesn't make me a high level usage person,	

	because someone who has an iPhone has all these things in one, so they were saying its almost the less of these things that you have the better because	
Sp1	There's that word, integrated.	2.3.52
Intv	Yeah exactly, so do you think that would be a way of distinguishing?	
Sp3	Ya, I think the more complicated the equipment maybe...I wouldn't be, like I can't use those IPhones, I think they're the most confusing things out on the earth like. But ya, I think the more complicated the...the gadget I suppose would kind of show how techy they are. I know very few people with those kinds of things. I couldn't have one because I'd lose it or I'd break it, I suppose I wouldn't use it to its advantage. I wouldn't be able to, I wouldn't use it the way it's meant to be used, just texts and phone calls, whereas other people would be there using it like to email and you know...	2.4.54
Sp5	But can that not be said for most of the phones and computers that are out there now, if you have somebody who merely wants a phone to use it to texting and calling you can't buy a phone that just does that, you can't buy a computer that just does what the majority of people I think use it for.	
Intv	Do your phones have mp3?	
Sp4	Yeah	
Intv	Do you use that?	
Sp4	No, I use my iPod.	
Sp2	But it might be a bit of a myth that the more integrated the device, the people who are using the integrated devices are the more better? I worked one time on a call line where people were using the first 3g phones, where people would ring this call line to give out about problems and after working there my conclusion was that those 3g phones that could do everything, they could do everything badly, whereas, somebody who went away and bought everything right ok, they were doing it the proper way. I don't kind of buy the whole idea that somebody who buys some little gadget that can do eh, take the photos play the music, ring, text, email and all that ok, a lot of the time you'll find that these integrated devices can do all these things badly. I've looked, I haven't found anything, believe me if I could find something that could do a lot that, I'd have it.	2.4.60
Sp1	They're tiny like, I don't understand how someone could say that looking at internet on a screen that size is saving you time.	
Sp4	It's the same as the phone, you wouldn't bring your phone out on a Saturday night to take pictures, you'd bring your digital camera. You're not going to use your phone to take pictures, never, unless you're somewhere and you're	

	just passing something. But if you're planning to take photos you'll bring your camera with you, even though you do have the device to take photos on your phone.	
Sp2	It's hard to get phones with very good quality anyway isn't it?	
Sp4	Or when you put them on to the computer from the phone their smaller, they're not good quality at all.	
Intv	So is there any way of kind of distinguishing between the different groups?	
Sp1	Well I think you can still, regardless of the technology, you can still distinguish between levels of usage. It'd be just a case of drawing up a scale and saying, this device, how much would you use it and so on.	
Sp5	The only other alternative, maybe in addition that that would be, asking, if you use a mobile phone, what level is it?	
Sp1	Yeah, what functionality does it have?	
Sp5	Yeah, then the same for a camera, the same of a computer, would that help in giving you an idea?	
Sp3	The expense as well, how much people are willing to spend.	2.5.70
Sp4	It's people's perceptions of technology as well like, I wouldn't consider myself to use it a lot but that's only because I don't use a computer a lot, but I'm still surrounded by it all the time and using it all the time. But yet I wouldn't consider myself high.	
Intv	So do you think it could be a thing of being conscious of how much you're using it?	
Sp2	Yeah, maybe you could ask people just, do they perform different kinds of - do you watch television, do you tape things on your recorder and then skip past the ads just to save time,	
Sp4	Oh on the box ya, sky plus, ya...	
Sp2	A friend of mine refuses to watch ads anymore so he'll fast forward.	
Intv	Ok so what about people who use technology for their work, and their social life, do you think that that would be an indicator of their level of usage? Say if you only use your computer when your inside in college and you only use your telephone when your inside in work and then when you go out of work you just turn it off	
Sp1	Well, I think it varies depending on the person,cos you'll have people who do it just for work and then they switch off, and then you have people, who also like, who when they go home in the evenings that's when they would use a lot of technology. And then you have the people who do the opposite. It's really case by case.	
Sp4	And then you have people who while they're in work use their phone for personal use and use their emails for	

	personal use, so how can you distinguish whether it's just for work or just for pleasure.	
Intv	But do you think the personal aspect of it would be a better indicator than the work aspect because in work you may not have the choice.	
Sp5	Well, it depends on what they do really.	
Sp3	Like, for us, two teachers, we don't use technology in the day because really, because we have our phones off and everything,	
Sp4	I use the computers though; we do the, the role call on the computer, in the classroom.	
Sp3	But then when we'd come home like we'd check our phones and our computers and we'd be online.	
Sp1	Yeah, so it's really job specific really.	
Sp2	Maybe you could section of the functions, do you watch television, do you listen to the radio, do you text, do you email, then have little questions afters saying like if you do watch television, you can ask them questions specifically on how they watch television, if they texts do they text using what kind of device, do they use a computer?. You have to just keep an open mind and not assume that everyone uses, a lot of people today assume that everybody is using this kind of modern technology but this isn't really the case. Just to keep it in mind that some people use very little technology	
Sp5	So I suppose it means you need to be aware of the people you'd be looking at.	
Intv	Do you think there'd be enough of a difference between college students just in general, would there be enough of a difference that you could split them in to categories.	
Sp1	Well, I won't use an iPod, I won't use iTunes because I disagree fundamentally with the whole kind of concept, so that would make me a low technology user even though I'm capable of using technologies, I wonder how you can define the high technology user.	
Sp2	Are you going to bring in things like Facebook and that? Do people use these and do they class them as being something that saves them time?	
Intv	I would imagine that these things and instant messaging and all that would be things that are affecting us, arousing our internal clocks, that's where the whole time saving area come in. It's just in trying to pin point it down because every single thing we use is some kind of time saving device. Like Atm cards, your laser card, online check in, online banking, online booking. Everything is technically time saving. Do we have to be conscious of that time saving aspect for it to be affecting us?	
Sp2	Well are you going to be asking if people are saving time, or are they trying to do as much with their time cos you hear about people using their laptops during ad breaks	

	and so on, so they're not really saving time, they're filling time?	
Intv	Yeah, so we think that all these devices are saving time and alleviating stress, we don't seem to be banking this saved time, like you said, when they ads are on, you check your emails to fill the time.	
Sp2	Yeah, if your waiting at the bus stop now you're using your phone, or your using your I pod, or maybe even people are looking at a film on their small little portable film player you know? That doesn't come under saving time, that just means that you're cramming as much stuff as possible in to your time.	
Intv	Yeah.	
Sp2	Cos we're saving time to do as much as we can,	
Intv	So we're filling our free time	
Sp2	No dead time anymore, we just have it all...occupied I suppose.	2.7.97
Sp4	But then if you go back to the point made at the start, if you didn't have your phone, you'd be saving more time. In the same way if you didn't have the internet if you didn't send back an email you wouldn't be getting back an email, and then you write back to that so maybe your losing time because of this technology rather than saving any time.	
Sp3	Obviously sometimes it's going to help us but then sometimes is it worse that we have it.	
Sp4	You know when someone leaves you a comment or a message on Facebook and then you reply and your checking that, and if you hadn't seen the first one you wouldn't have bothered going back to it.Your wasting time by sending it, and by looking at it when you receive it.	2.7.100
Intv	Ok, I'm going to wrap it up at that. Thank you so much for your time.	

Appendix C: Code Book for Pilot Questionnaire

Code Book
Focus groups data on everyday technology

Type of Technology:

Computer/Internet:	First example given	1:1:2:1
	Second example	2:1:3:1
	Email	1:1:12:1
		2:1:20:1
	Time saving device	1:2:36:1
		2:3:48:2
	Microsoft Word	1:2:40:1
		2:2:31:7
	Search engine	1:2:41:1
	Time keeping device	1:3:48:5
		2:2:37:1-4
Phone:	First example given	2:1:2:1
	Second example given	1:1:3:1
	Text messages	1:1:13:2
	Time saving (instant communication)	1:2:34:1 2:1:19:1
	Reliance as a Time keeping device	1:3:48:1
		1:3:50:1
	Calendar	1:3:52:3
		2:2:37:1
	Time saving (Integration)	1:4:70:1
		2:3:50:3

		2:3:52:1
Household appliances:	Microwave	1:1:6:1
		2:1:5:1
	Cookers	1:1:8:1
		2:1:10:1
	Washing Machine	
		2:1:11:1
	TV	1:1:15:1
		2:2:39:1

Ambiguous aspects of Technology:

What is technology?	Abstract term	1:1:10:1
	Where do you draw the line	2:2:25:1
	Ultra Modern technology	2:3:49:3
	Sprawling answers	
		1:5:86:2
		2:1:21:1
		2:2:23:2
Generational Effect:	Not our generation	1:2:23:1
		1:2:28:1
	Twin tub	1:2:26:3
	Sliced pan	1:2:26:5
	Dependence	1:3:55:1
	Fridge	2:2:23:2
	Find it hard to remember not having these technologies	

		2:2:27:1-3
	Sign of age	2:2:34:3
		2:3:49:10

How to determine level of usage of technology:

	Dependence	1:3:54:1
	Integrated technologies	1:3:59:4
		1:4:61:1
		2:5:52:1
	Expense	1:4:63:1
		2:5:70:1
	Quality of work	1:4:68:1
	Length of time	2:3:48:2
	Functionality/capability	2:4:54:8
		2:9:68:1
		2:9:73:3
	Constant unconscious usage	2:9:70:3

Effects of technology

Pro's:	Convenience	1:1:20:1
		1:2:31:1
		1:2:41:1
		2:3:50:3
	Saved time	1:2:29:3
		1:3:59:5
		2:1:19:1
		2:3:48:2
	Won't even have to leave bed	1:5:83:2

Con's	People chose it because it's the easy option	1:5:85:4
	Puts pressure on people	1:5:82:3
		2:1:21:7
		2:7:100:3
	Filling time rather than saving time	1:5:78:1
		2:7:100:4
		2:7:97:1
	Integrated devices do things badly	2:4:60:13
		2:4:61:2

Appendix D: Piloted version of the Everyday Technology Use Questionnaire

ID________

Everyday Technology Usage

The following questionnaire contains relates to your level of usage of modern technology, in this case personal computers and mobile devices (for example mobile phones, PDA's, MP3 players etc). Please answer all questions as truthfully as possible, and check or circle the answer that applies most closely to you in your **current** situation. Your responses to this questionnaire will be kept anonymous.

Demographic information:

Sex:

Male ☐

Female ☐

Age Group:

Under 21 ☐

21 – 30 ☐

31 – 41 ☐

41 – 50 ☐

51 – 60 ☐

Over 60 ☐

Highest level of education completed:

Primary education ☐

Leaving Certificate ☐

Certificate ☐

Diploma ☐

Primary Degree ☐

Masters Degree ☐

Doctorate ☐

Current Employment:

Employed	☐
Retired	☐
Self employed	☐
Student	☐
Not employed	☐

Other (Please explain): ____

Personal Computers:

1) How often do you use a personal computer (your answer should reflect your overall computer use including at home, work and elsewhere)?

Daily	☐
Weekly	☐
Monthly	☐
Rarely	☐
Almost Never	☐

2) If you answered daily to Q1, how long (in hours) to you spend on the computer on an average day (not including Internet use)?

_____ hours

3) If you answered daily to Q1, how long (in hours) do you spend on the Internet on an average day?

_____ hours

4) Is the time you spend on the personal computer directly related to your employment?

Not at all	*Slightly*	*Moderately*	*Considerably*	*Entirely*
1	2	3	4	5

5) Is the time you spend on the Internet directly related to your employment?

Not at all	*Slightly*	*Moderately*	*Considerably*	*Entirely*
1	2	3	4	5

6) How dependent do you believe you are on personal computers?

Not at all	*Slightly*	*Moderately*	*Considerably*	*Severely*
1	2	3	4	5

7) How aware do you feel you are of the features, functions and capabilities of personal computers?

Not at all	*Slightly*	*Moderately*	*Considerably*	*Completely*
1	2	3	4	5

8) When using a personal computer to what extent do you feel you make use of its more advanced features, functions and capabilities?

Not at all	*Slightly*	*Moderately*	*Considerably*	*Completely*
1	2	3	4	5

The following questions are based on the frequency at which you perform certain tasks using a personal computer. Please indicate your answer by circling the number which closest represents your usage.

1= Less than once a week
2= Once a week
3= Several times a week
4= Once a day
5= Several times a day
6= Constantly throughout the day

	< once a week					Constantly
9) Checking email (work related)	1	2	3	4	5	6
10) Checking email (personal)	1	2	3	4	5	6
11) Creating databases	1	2	3	4	5	6
12) Creating to-do lists	1	2	3	4	5	6
13) Writing documents	1	2	3	4	5	6
14) Writing programmes	1	2	3	4	5	6
15) Playing video games	1	2	3	4	5	6
16) Watching DVD's	1	2	3	4	5	6
17) Uploading music/photos/videos	1	2	3	4	5	6
18) Downloading music/video	1	2	3	4	5	6
19) Streaming music/ video	1	2	3	4	5	6
20) Shopping online	1	2	3	4	5	6

22) Banking online	1	2	3	4	5	6
23) Accessing social networking sites	1	2	3	4	5	6

Mobile Devices

24) From the following list please tick all the mobile devices that you own, or have regular access to.

Mobile phone	☐
PDA	☐
Mp3 player	☐
Digital camera	☐

With reference to the devices you have ticked in Q9 please indicate the frequency at which you use these devices to perform the following tasks. If you perform tasks on multiple devices, for example if you take photos on both your digital camera and mobile phone then the frequency of usage of both devices should be taken in to account. Please indicate your answer by circling the number which closest represents yourself.

1= Less than once a week
2= Once a week
3= Several times a week
4= Once a day
5= Several times a day
6= Constantly throughout the day

25) Making phone calls (work)	1	2	3	4	5	6
26) Receiving phone calls (work)	1	2	3	4	5	6
27) Making phone calls (pleasure)	1	2	3	4	5	6
28) Receiving phone calls (pleasure)	1	2	3	4	5	6
29) Sending and receiving SMS	1	2	3	4	5	6
30) Checking the time	1	2	3	4	5	6
31) Setting alarms/reminders	1	2	3	4	5	6
32) Creating to-do lists	1	2	3	4	5	6

33) Taking photos	1	2	3	4	5	6
34) Browsing the internet	1	2	3	4	5	6
35) Checking email	1	2	3	4	5	6
36) Listening to Mp3 files	1	2	3	4	5	6
37) Storing/ checking friends', family and colleagues' contact information	1	2	3	4	5	6

Appendix E: Finalised version of Everyday Technology Use Questionnaire (ETUQ)

ID_______

Everyday Technology Usage

The following questionnaire relates to your level of usage of modern technology, in this case personal computers and mobile devices (for example mobile phones, MP3 players etc). Please answer all questions as truthfully as possible, and check or circle the answer that applies most closely to you in your **current** situation. Your responses to this questionnaire will be kept anonymous.

Demographic information:

Gender: Male ☐
Female ☐

Age : _____

Highest level of education completed:

Primary education ☐
Leaving Certificate ☐
Certificate ☐
Diploma ☐
Primary Degree ☐
Masters Degree ☐
Doctorate ☐

Current Occupation: ___________________

If you answered STUDENT above please state the occupation of the chief wage earner in your household: ____________________

Personal Computers:

1) How often do you use a personal computer (your answer should reflect your overall computer use including at home, work and elsewhere)?

Daily ☐

Weekly (if ticked proceed to Q.3) ☐
Monthly (if ticked proceed to Q.3) ☐
Rarely (if ticked proceed to Q.3) ☐
Almost Never (if ticked proceed to Q.3) ☐

2) How long (in hours) to you spend on the computer on an average day?

____

3) Is the time you spend on the personal computer directly related to your current occupation (if you are currently a student is the time you spend on the personal computer directly related to your studies)?

Not at all	*Slightly*	*Moderately*	*Considerably*	*Entirely*
1	2	3	4	5

4) Is the time you spend on the Internet directly related to your current occupation (if you are currently a student is the time you spend on the internet directly related to your studies)?

Not at all	*Slightly*	*Moderately*	*Considerably*	*Entirely*
1	2	3	4	5

5) How dependent do you believe you are on personal computers?

Not at all	*Slightly*	*Moderately*	*Considerably*	*Severely*
1	2	3	4	5

6) In the past week have you used a personal computer for any of the following activities? Please tick all that apply.

Watching DVD's ☐
Uploading music/photos/videos ☐
Downloading music/video ☐
Streaming music/ video ☐
Banking online ☐
Shopping online ☐

The following questions are based on the frequency at which you perform certain tasks using a personal computer. Please indicate your answer by circling the number which closest represents your usage.

1= Never
2= Less than once a week
3= Once a week
4= Several times a week
5= Once a day
6= Several times a day

	Never					Several times/day
7) Checking email	1	2	3	4	5	6
8) Creating databases	1	2	3	4	5	6
9) Creating to-do lists	1	2	3	4	5	6
10) Writing documents	1	2	3	4	5	6
11) Playing video games (online or other)	1	2	3	4	5	6
12) Accessing social networking sites	1	2	3	4	5	6

Mobile Devices

13) From the following list please tick all the mobile devices that you own, or have regular access to.

Mobile phone	☐
PDA (Blackberry/ iPhone etc)	☐
Mp3 player	☐
Digital camera	☐

With reference to the devices you have ticked in Q13 please indicate the frequency at which you use these devices to perform the following tasks. If you perform tasks on multiple devices, for example if you take photos on both your digital camera and mobile phone then the frequency of usage of both devices should be taken in to account. Please indicate your answer by circling the number which closest represents yourself.

0= Never
1= Less than once a week
2= Once a week
3= Several times a week
4= Once a day
5= Several times a day
6= Constantly throughout the day

	Never						Constantly
14) Making/ receiving phone calls	0	1	2	3	4	5	6
15) Sending / receiving SMS	0	1	2	3	4	5	6
16) Checking the time	0	1	2	3	4	5	6
17) Setting alarms/reminders	0	1	2	3	4	5	6
18) Creating to-do lists	0	1	2	3	4	5	6
19) Taking photos	0	1	2	3	4	5	6
20) Browsing the internet	0	1	2	3	4	5	6
21) Checking email	0	1	2	3	4	5	6
22) Listening to Mp3 files	0	1	2	3	4	5	6
23) Storing/ checking friends', family and colleagues' contact information	0	1	2	3	4	5	6

Appendix F: Full Experiment booklet as given to Participants in Study 1

COLÁISTE MHUIRE GAN SMÁL
OLLSCOIL LUIMNIGH
MARY IMMACULATE COLLEGE
UNIVERSITY OF LIMERICK

IRCHSS

The Time of Our Lives

An investigation into the effects of technological advances on our temporal experience.

To whom it may concern,

You are invited to participate in a study currently being undertaken by Aoife McLoughlin, a Doctoral candidate in Mary Immaculate College, Limerick. This study aims to investigate individuals' personal experiences in their daily lives, along with the technology which they use.

You will be asked to complete two questionnaires on these topics. This should take no longer than 10- 15 minutes of your time.

All information gathered in this study will be deemed confidential. Data will only be viewed by the researcher, her supervisor and external examiners. Information will not be passed on to a third party without your consent. Should you consent to participation data gathered may be held on file for up to five years.

You are free to decline participation in this study or to withdraw participation at any time without being obliged to give justification for your action. At your request any information regarding your participation will be removed from the study.

If you have any queries please contact the researcher at aoife.mcloughlin@mic.ul.ie

If you have concerns about this study and wish to contact someone independent, you may contact:
MIREC Administrator
Mary Immaculate College
South Circular Road
Limerick

BRIATHAR DÉ MO LÓCHRANN

COLÁISTE MHUIRE GAN SMÁL
OLLSCOIL LUIMNIGH
MARY IMMACULATE COLLEGE
UNIVERSITY OF LIMERICK

IRCHSS

The Time of Our Lives

An investigation into the effects of technological advances on our temporal experience.

Informed Consent for participation in research conducted by

Aoife McLoughlin, PhD candidate.

Dear Participant,

Please indicate that you have read and agree with the following statements by signing below:

I have read and understood the participant information sheet

I am aware of what will be asked of me with regard the methodology of this study

I know that my participation is voluntary and that I can withdraw from the project at any time without the need to give a reason or any justification

I am aware that my results will be kept confidential

I am over 18 years of age

To indicate your willingness to participate in this study by signing below:

Name (PRINTED): ______________________________

Name (Signature): ______________________________

Date: ______________________________

ID________

Everyday Technology Usage

The following questionnaire relates to your level of usage of modern technology, in this case personal computers and mobile devices (for example mobile phones, MP3 players etc). Please answer all questions as truthfully as possible, and check or circle the answer that applies most closely to you in your **current** situation. Your responses to this questionnaire will be kept anonymous.

Demographic information:

Gender:	Male	☐
	Female	☐

Age : _____

Highest level of education completed:

Primary education	☐
Leaving Certificate	☐
Certificate	☐
Diploma	☐
Primary Degree	☐
Masters Degree	☐
Doctorate	☐

Current Occupation: ___________________

If you answered STUDENT above please state the occupation of the chief wage earner in your household: ___________________

Personal Computers:

1) How often do you use a personal computer (your answer should reflect your overall computer use including at home, work and elsewhere)?

Daily	☐
Weekly (if ticked proceed to Q.3)	☐
Monthly (if ticked proceed to Q.3)	☐
Rarely (if ticked proceed to Q.3)	☐
Almost Never (if ticked proceed to Q.3)	☐

2) How long (in hours) to you spend on the computer on an average day?

____

3) Is the time you spend on the personal computer directly related to your current occupation (if you are currently a student is the time you spend on the personal computer directly related to your studies)?

Not at all	*Slightly*	*Moderately*	*Considerably*	*Entirely*
1	2	3	4	5

4) Is the time you spend on the Internet directly related to your current occupation (if you are currently a student is the time you spend on the internet directly related to your studies)?

Not at all	*Slightly*	*Moderately*	*Considerably*	*Entirely*
1	2	3	4	5

5) How dependent do you believe you are on personal computers?

Not at all	*Slightly*	*Moderately*	*Considerably*	*Severely*
1	2	3	4	5

6) In the past week have you used a personal computer for any of the following activities? Please tick all that apply.

Watching DVD’s	☐
Uploading music/photos/videos	☐
Downloading music/video	☐
Streaming music/ video	☐
Banking online	☐
Shopping online	☐

The following questions are based on the frequency at which you perform certain tasks using a personal computer. Please indicate your answer by circling the number which closest represents your usage.

1= Never
2= Less than once a week
3= Once a week
4= Several times a week
5= Once a day
6= Several times a day

	Never					Several times/day
7) Checking email	1	2	3	4	5	6
8) Creating databases	1	2	3	4	5	6
9) Creating to-do lists	1	2	3	4	5	6
10) Writing documents	1	2	3	4	5	6
11) Playing video games (online or other)	1	2	3	4	5	6
12) Accessing social networking sites	1	2	3	4	5	6

Mobile Devices

13) From the following list please tick all the mobile devices that you own, or have regular access to.

Mobile phone	☐
PDA (Blackberry/ iPhone etc)	☐
Mp3 player	☐
Digital camera	☐

With reference to the devices you have ticked in Q13 please indicate the frequency at which you use these devices to perform the following tasks. If you perform tasks on multiple devices, for example if you take photos on both your digital camera and mobile phone then the frequency of usage of both devices should be taken in to account. Please indicate your answer by circling the number which closest represents yourself.

0= Never
1= Less than once a week
2= Once a week
3= Several times a week
4= Once a day
5= Several times a day
6= Constantly throughout the day

	Never						Constantly
14) Making/ receiving phone calls	0	1	2	3	4	5	6
15) Sending / receiving SMS	0	1	2	3	4	5	6
16) Checking the time	0	1	2	3	4	5	6
17) Setting alarms/reminders	0	1	2	3	4	5	6
18) Creating to-do lists	0	1	2	3	4	5	6
19) Taking photos	0	1	2	3	4	5	6
20) Browsing the internet	0	1	2	3	4	5	6
21) Checking email	0	1	2	3	4	5	6
22) Listening to Mp3 files	0	1	2	3	4	5	6
23) Storing/ checking friends', family and colleagues' contact information	0	1	2	3	4	5	6

Personal Attitudes and Experiences

This questionnaire consists of questions about experiences that you may have had in your life. I am interested in how often you have these experiences. It is important, however, that your answers show how often these experiences happen to you when you are ***not*** under the influence of alcohol or drugs.

Please indicate your agreement which each statement through use of the following scale:

1= Never
2= Rarely
3= Sometimes
4= Always

	Never			Always
1) Sometimes I feel and experience things as I did when I was a child.	1	2	3	4
2) I can be greatly moved by eloquent or poetic language.	1	2	3	4
3) While watching a movie, a TV show, or a play, I may become so involved that I may forget about myself and my surroundings and experience the story as if it were real and as if I were taking part in it.	1	2	3	4
4) If I stare at a picture and then look away from it, I can sometimes "see" an image of the picture almost as if I were still looking at it.	1	2	3	4
5) Sometimes I feel as if my mind could envelop the whole world.	1	2	3	4
6) I like to watch cloud shapes change in the sky.	1	2	3	4
7) If I wish I can imagine (or daydream) some things so vividly that they hold my attention as a good movie or story does.	1	2	3	4
8) I think I really know what some people mean when they talk about mystical experiences.	1	2	3	4

9) I sometimes "step outside" my usual self and experience an entirely different state of being.	1	2	3	4
10) Textures -- such as wool, sand, wood -- sometimes remind me of colours of music.	1	2	3	4
11) Sometimes I experience things as if they were doubly real.	1	2	3	4
12) When I listen to music I can get so caught up in it that I don't notice anything else.	1	2	3	4
13) If I wish I can imagine that my body is so heavy that I could not move it if I wanted to.	1	2	3	4
14) I can often somehow sense the presence of another person before I actually see or hear her/him.	1	2	3	4
15) The crackle and flames of a wood fire stimulate my imagination.	1	2	3	4
16) It is sometimes possible for me to be completely immersed in nature or in art and to feel as if my whole state of consciousness has somehow been temporarily altered.	1	2	3	4
17) Different colours have distinctive and special meanings for me.	1	2	3	4
18) I am able to wander off into my thoughts while doing a routine task and actually forget that I am doing the task, and then find a few minutes later that I have completed it.	1	2	3	4

19) I can sometimes recollect certain past experiences in my life with such clarity and vividness that it is like living them again or almost so.	1	2	3	4
20) Things that might seem meaningless to others often make sense to me.	1	2	3	4
21) While acting in a play I think I could really feel the emotions of the character and "become" her/him for the time being, forgetting both myself and the audience.	1	2	3	4
22) My thoughts often don't occur as words but as visual images.	1	2	3	4
23) I often take delight in small things (like the five-pointed star shape that appears when you cut an apple across the core or the colours in soap bubbles).	1	2	3	4
24) When listening to organ music or other powerful music I sometimes feel as if I am being lifted into the air.	1	2	3	4
25) Sometimes I can change noise into music by the way I listen to it.	1	2	3	4
26) Some of my most vivid memories are called up by scents and smells.	1	2	3	4
27) Some music reminds me of pictures or changing colour patterns.	1	2	3	4
28) I often know what someone is going to say before he or she says it.	1	2	3	4
29) I often have "physical memories", for example, after I have been swimming I may still feel as if I am in the water.	1	2	3	4

30) The sound of a voice can be so fascinating to me that I can just go on listening to it.	1	2	3	4
31) At times I somehow feel the presence of someone who is not physically there.	1	2	3	4
32) Sometimes thoughts and images come to me without the slightest effort on my part.	1	2	3	4
33) I find that different odours have different colours.	1	2	3	4
34) I can be deeply moved by a sunset.	1	2	3	4

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IRCHSS

The Time of Our Lives

An investigation into the effects of technological advances on our temporal experience.

Debriefing

Dear Participant,

Thank you for your participation in this study. The data which you have contributed is to be included in the thesis entitled *The Time of our Lives: An investigation into the effects of technological advances on temporal experiences,* which is being carried out by Aoife McLoughlin.

The first questionnaire you completed is a measure of the amount of technology you use in your daily life. The second questionnaire is called the Tellegen Absorption Scale (Tellegen & Atkinson, 1974), and measures your susceptibility to cognitive absorption, which is linked to an individual's responsiveness to engaging stimuli, responsiveness to inductive stimuli, ability to think in images, tendency to have cross-modal experiences, the ability to become absorbed in their own thoughts and imaginings, the tendency to have episodes of expanded experiences and the ability to experience altered stated of consciousness. Absorption has been shown to correlate positively and strongly with an individual's perceived ease of use of information technology and perceived usefulness of information technology (Agarwal & Karahanna, 2000). What the researcher is interested in, in the study you have just participated in, is whether it also correlates with the *amount* of technology which we use in our daily lives.

The researcher has previously found that individuals who use more technology in their daily lives experience the passage of time differently to those who use less technology. This research aims to examine why this is the case, and whether cognitive absorption also plays a role in this effect.

If you have any further questions about your own data, the research itself, or the overall area of Time Psychology feel free to contact the researcher at aoife.mcloughlin@mic.ul.ie.

Appendix G: ETUQ and Time Pressure Questionnaire from Study 2

ID________

Everyday Technology Usage

The following questionnaire relates to your level of usage of modern technology, in this case personal computers and mobile devices (for example mobile phones, MP3 players etc). Please answer all questions as truthfully as possible, and check or circle the answer that applies most closely to you in your **current** situation. Your responses to this questionnaire will be kept anonymous.

Demographic information:

Gender: Male ☐

Female ☐

Age : _____

Highest level of education completed:

Primary education ☐

Leaving Certificate ☐

Certificate ☐

Diploma ☐

Primary Degree ☐

Masters Degree ☐

Doctorate ☐

Current Occupation: ___________________

If you answered STUDENT above please state the occupation of the chief wage earner in your household: ____________________

Personal Computers:

1) How often do you use a personal computer (your answer should reflect your overall computer use including at home, work and elsewhere)?

Daily	□
Weekly (if ticked proceed to Q.3)	□
Monthly (if ticked proceed to Q.3)	□
Rarely (if ticked proceed to Q.3)	□
Almost Never (if ticked proceed to Q.3)	□

2) How long (in hours) to you spend on the computer on an average day?

____

3) Is the time you spend on the personal computer directly related to your current occupation (if you are currently a student is the time you spend on the personal computer directly related to your studies)?

Not at all	*Slightly*	*Moderately*	*Considerably*	*Entirely*
1	2	3	4	5

4) Is the time you spend on the Internet directly related to your current occupation (if you are currently a student is the time you spend on the internet directly related to your studies)?

Not at all	*Slightly*	*Moderately*	*Considerably*	*Entirely*
1	2	3	4	5

5) How dependent do you believe you are on personal computers?

Not at all	*Slightly*	*Moderately*	*Considerably*	*Severely*
1	2	3	4	5

6) In the past week have you used a personal computer for any of the following activities? Please tick all that apply.

Watching DVD's	□
Uploading music/photos/videos	□
Downloading music/video	□
Streaming music/ video	□
Banking online	□
Shopping online	□

The following questions are based on the frequency at which you perform certain tasks using a personal computer. Please indicate your answer by circling the number which closest represents your usage.

1= Never
2= Less than once a week
3= Once a week
4= Several times a week
5= Once a day
6= Several times a day

	Never					Several times/day
7) Checking email	1	2	3	4	5	6
8) Creating databases	1	2	3	4	5	6
9) Creating to-do lists	1	2	3	4	5	6
10) Writing documents	1	2	3	4	5	6
11) Playing video games (online or other)	1	2	3	4	5	6
12) Accessing social networking sites	1	2	3	4	5	6

Mobile Devices

13) From the following list please tick all the mobile devices that you own, or have regular access to.

Mobile phone	□
PDA (Blackberry/ iPhone etc)	□
Mp3 player	□
Digital camera	□

With reference to the devices you have ticked in Q9 please indicate the frequency at which you use these devices to perform the following tasks. If you perform tasks on multiple devices, for example if you take photos on both your digital camera and mobile phone then the frequency of usage of both devices should be taken in to account. Please indicate your answer by circling the number which closest represents yourself.

1= Less than once a week
2= Once a week
3= Several times a week
4= Once a day
5= Several times a day
6= Constantly throughout the day

	< once a week					Constantly
14) Making/ receiving phone calls	1	2	3	4	5	6
15) Sending / receiving SMS	1	2	3	4	5	6
16) Checking the time	1	2	3	4	5	6
17) Setting alarms/reminders	1	2	3	4	5	6
18) Creating to-do lists	1	2	3	4	5	6
19) Taking photos	1	2	3	4	5	6
20) Browsing the internet	1	2	3	4	5	6
21) Checking email	1	2	3	4	5	6
22) Listening to Mp3 files	1	2	3	4	5	6
23) Storing/ checking friends', family and colleagues' contact information	1	2	3	4	5	6

ID_________

Time Pressure

The following questionnaire relates to how you experience the passage of time and how pressured by time you feel in your daily life. Please answer all questions as truthfully as possible, and check or circle the answer that applies most closely to you in your **current** situation. Your responses to this questionnaire will be kept anonymous.

1) Do you feel that life moves at an increasingly fast pace?

Yes ☐
No ☐

2) Do you feel that you have enough time to do what you need to do in an average day?

Yes ☐
No ☐

3) What item do you use most frequently to tell the time? (Please tick only one)

Watch ☐
Clock ☐
Phone ☐
Computer Screen ☐
Digital displays on household appliances ☐
TV (Digital guide/Teletext) ☐

4) How frequently do you check the time on an average day?

Less than once an hour ☐
Once an hour ☐
More than once an hour ☐

5) How would you rate your level of reliance on time keeping devices in order to know what time it is accurately (these include watches and all forms of clocks such as those on your PC, mobile phone, blackberry, mp3 player, household appliances etc.)

Not at all	*Slightly*	*Moderately*	*Considerably*	*Severely*
1	2	3	4	5

6) How aware do you feel you are of the passing of time throughout an average day?

Not at all	*Slightly*	*Moderately*	*Considerably*	*Severely*
1	2	3	4	5

Please read the following statements and circle the number that best represents your level of agreement.

1 = Disagree completely
2 = Slightly disagree
3 = Neither agree nor disagree
4 = Slightly agree
5 = Agree completely

	Disagree				Agree
7) You never seem to have enough time to get everything done.	1	2	3	4	5
8) You feel pressed for time.	1	2	3	4	5
9) You are never in a hurry.	1	2	3	4	5
10) You feel rushed to do the things you do.	1	2	3	4	5
11) You have enough time for yourself.	1	2	3	4	5
12) You feel too much is expected of you with regard to deadlines.	1	2	3	4	5
13) You worry about how you are using your time.	1	2	3	4	5
14) You never run out of time.	1	2	3	4	5
15) You are always late, even when meeting friends.	1	2	3	4	5

Appendix H: Information Sheet and Consent given to participants in Study 2

ID.NO:

To Whom it Concerns,

You are invited to participate in research being carried out by Aoife Mc Loughlin a Masters by research student (psychology) in Mary Immaculate College, Limerick. The research aims to investigate how individual's with different levels of usage of time keeping and time saving technologies experience the passage of time in their daily lives.

The overall study will include 4 separate elements. You will complete a brief questionnaire on level of technology and everyday time pressure. You will also complete a number of trials where you will be asked to produce certain time intervals. There will be a number of trials where you will be asked to estimate the duration of a tone. And also a brief task which you will be asked to complete while connected to a Heart Rate, and Galvanic Skin Response monitor. This procedure is non invasive.

Your participation in this study should not take more than 30 minutes of your time. Depending on the data that your participation adds to this study you may be asked to attend for a follow up interview at a point in the near future that is suitable for you, in order to ascertain your subjective experience of the passage of time in your day to day life. You will however be asked to once again give consent should this occur.

All information gathered in this study will be deemed confidential and your participation will be strictly anonymous. No data gathered will be passed onto a third party without your consent. Should you consent to participation data, gathered would be stored on file for 12 months.

You are free to decline participation in this study or to withdraw participation at any time without penalisation. At your request any information regarding your participation will be removed from the study and destroyed.

If you have any further questions please ask the researcher.

Please indicate your willingness to participate in this study by signing below:

Name: ____________________

Signed: ____________________ Contact No. ___________________________

Appendix I: Debriefing from Study 2

Debriefing

Dear Participant,

The study which you have just participated in aims to investigate whether there is a relationship between individual's everyday technology and how they experience time on a daily basis. Although we do not appear to have any one single "time organ" in the same manner that we have skin for or sense of touch, it is widely believed that our ability to quantify time is governed by some form of internal clock within ourselves.

Research has supported the idea that this clock is extremely sensitive to any form of arousal and it can speed up when arousal is increased. In today's modernised, westernised world individuals are constantly being bombarded with information about time and the passage of time. People are shown exactly what time of day it is on watches, phones, computers, televisions, wall clocks and so on throughout the day. Likewise, today's people are being informed about different ways in which they can save time through use of faster technologies or faster food. However, for some reason, people today rate themselves as being under more time pressure than ever before, and thus are under an increasing amount of stress in their day-to-day lives. The current research hypothesises that the constant arousal of the senses with information on the passage of time has caused the clock to speed up, in turn creating a dissonance between the amount of time that has passed subjectively versus the amount of time that has passed in objective real time, this is turn could cause the time pressure that people experience on a daily basis.

If you have any further questions about this research, or about your own results do not hesitate to contact the researcher at aoife.mcloughlin@mic.ul.ie.

Appendix J: Information Sheet for Study 3

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IRCHSS

The Time of Our Lives

An investigation into the effects of technological advances on our temporal experience.

To whom it may concern,

You are invited to participate in a study currently being undertaken by Aoife McLoughlin, a Doctoral candidate in Mary Immaculate College, Limerick. This research explores how individuals interact with technology.

Should you consent to participation, you will be seated in front of a computer and asked to pop onscreen balloons. This should take no longer than 5 minutes of your time.

All information gathered in this study will be deemed confidential. Data will only be viewed by the researcher, her supervisor and external examiners. Information will not be passed on to a third party without your consent. Should you consent to participation data gathered may be held on file for up to five years.

You are free to decline participation in this study or to withdraw participation at any time without being obliged to give justification for your action. At your request any information regarding your participation will be removed from the study.

If you have any queries please contact the researcher at aoife.mcloughlin@mic.ul.ie

If you have concerns about this study and wish to contact someone independent, you may contact:
MIREC Administrator
Mary Immaculate College
South Circular Road
Limerick
061-204515
mirec@mic.ul.ie

Appendix K: Consent Form used in Study 3, 4 and 5

COLÁISTE MHUIRE GAN SMÁL
OLLSCOIL LUIMNIGH
MARY IMMACULATE COLLEGE
UNIVERSITY OF LIMERICK

IRCHSS

ID No: ______

The Time of Our Lives

An investigation into the effects of technological advances on our temporal experience.

Informed Consent for participation in research conducted by

Aoife McLoughlin, PhD candidate.

Dear Participant,

Please indicate your agreement with the following statements by ticking the box available:

I have read and understood the participant information sheet ☐

I am aware of what will be asked of me with regard the methodology of this study ☐

I know that my participation is voluntary and that I can withdraw from the project at any time without the need to give a reason or any justification ☐

I am aware that my results will be kept confidential ☐

I am over 18 years of age ☐

Please indicate your willingness to participate in this study by signing below:

Name (PRINTED): ______________________

Name (Signature): ______________________

Date: ______________________

Appendix L: Information Sheet for Study 4

BRIATHAR DÉ MO LÓCHRANN

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IRCHSS

The Time of Our Lives

An investigation into the effects of technological advances on our temporal experience.

To whom it may concern,

You are invited to participate in a study currently being undertaken by Aoife McLoughlin, a Doctoral candidate in Mary Immaculate College, Limerick. This research explores how individuals interact with onscreen computer images.

Should you consent to participation you will be seated in front of a computer. You will then watch either a series of still images from an animation, a muted animation or an animation with sound. You will then be asked a few questions on what you have seen. This should take no more than 5 mins.

All information gathered in this study will be deemed confidential. Data will only be viewed by the researcher, her supervisor and external examiners. Information will not be passed on to a third party without your consent. Should you consent to participation data gathered may be held on file for up to five years.

You are free to decline participation in this study or to withdraw participation at any time without being obliged to give justification for your action. At your request any information regarding your participation will be removed from the study.

If you have any queries please contact the researcher at aoife.mcloughlin@mic.ul.ie

If you have concerns about this study and wish to contact someone independent, you may contact:
MIREC Administrator
Mary Immaculate College
South Circular Road
Limerick
061-204515
mirec@mic.ul.ie

Appendix M: Information Sheet for Study 5

The Time of Our Lives

An investigation into the effects of technological advances on our temporal experience.

To whom it may concern,

You are invited to participate in a study currently being undertaken by Aoife McLoughlin, a Doctoral candidate in Mary Immaculate College, Limerick. This research investigates our individual memory for durations.

Should you consent to participation, you will be seated in front of a computer. You will hear a tone of a set duration repeated 10 times, until you have committed it to memory. You will then hear a series of tones of different durations and will be asked if each is the original duration. There will then be a brief interval where you will be given a short article to read. After this interval you will once again hear a series of tones of varying duration and asked if each is the original duration. This should take no longer than 10 minutes of your time.

All information gathered in this study will be deemed confidential. Data will only be viewed by the researcher, her supervisor and external examiners. Information will not be passed on to a third party without your consent. Should you consent to participation data gathered may be held on file for up to five years.

You are free to decline participation in this study or to withdraw participation at any time without being obliged to give justification for your action. At your request any information regarding your participation will be removed from the study.

If you have any queries please contact the researcher at aoife.mcloughlin@mic.ul.ie

If you have concerns about this study and wish to contact someone independent, you may contact:
MIREC Administrator
Mary Immaculate College
South Circular Road
Limerick

Appendix N: Debriefing used in studies 3, 4, and 5

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IRCHSS

The Time of Our Lives

An investigation into the effects of technological advances on our temporal experience.

Debriefing

Dear Participant,

Thank you for your participation in this study. The data which you have contributed is to be included in the thesis entitled *The Time of our Lives: An investigation into the effects of technological advances on temporal experiences,* which is being carried out by Aoife McLoughlin.

The researcher has previously found that individuals who use more technology in their daily lives experience the passage of time differently to those who use less technology. Why this is the case, however, remains to be seen. The society in which we live has become extremely techno-centric; likewise time has become a precious commodity. Many different aspects of technology may be affecting how we experience the passage of time in our daily lives. This research aims to investigate the effect that the amount of actions available to us at any one time, the complexity of the world around us and the priming of time as a commodity are having on our temporal experience.

If you have any further questions about your own data, the research itself, or the overall area of Time Psychology feel free to contact the researcher at aoife.mcloughlin@mic.ul.ie.

Appendix O: Time Pressure and Physiological Stress Study.

It was decided by the researcher not to include this study in the main body of the thesis as it was felt that the data was too open to biased interpretation and that perhaps GSR and HR are not adequate resources for measuring "time stress"

Physiological Responses to Time Pressure

The following section looks at a further study conducted within this doctoral research. This addressed the issue of time pressure, and whether it is exhibited as a physiological stress.

Physiological Responses to Time Pressure

This experiment aimed to investigate the physiological reactions involved when a person is placed under time pressure. Galvanic Skin Responses and heart rate were measured in order to examine the physiological responses the body has when it is put on a deadline. The aims of this experiment were two fold. Firstly it was an exploratory investigation of physiological reactions. Secondly, if, as was suggested in Chapter Five, individuals who surround themselves with more technology on a day to day basis have a faster pulsing internal clock than those who use less technology, then these individuals should believe that the allotted time is passing more rapidly and therefore should engage in stress responses sooner in the task than others. That is, if the pressure we feel from time is a physiological pressure at all.

Participants:

Forty seven members of the general public participated in this study. They were selected using mixed purposeful sampling methods, mainly through maximum variation and chain sampling. The occupations of these participants varied dramatically from the unemployed, retired, part time workers and students, to video game designers, artists and clerical workers, to lecturers, air traffic controllers and engineers. This diversity in participants' occupations was specifically targeted by the researcher in order to get as wide a sample as possible. The age of participants ranged from 19 -38 years (*m*= 26.85, *SD*= 4.02yrs). Twenty seven participants were male.

Design:

This study utilised a quasi-experimental, independent groups design.

Materials and Equipment:

The data acquisition hardware Power lab, with GSR finger electrodes and an electric Pulse transducer attached was utilised. An old fashioned hour glass style egg timer was used in order to subconsciously evoke the idea of time running out during the experiment as opposed to time adding up in the participant. A modified *Where's Wally* cartoon was also used. Once again the Everyday Technology Usage Questionnaire and the modified Time Pressure Scale were used in order to group the participants.

Procedure:

The researcher first modified a *Where's Wally* cartoon, removing Wally from the crowd scene. Participants were approached and the researcher gave a brief outline of what would be expected of them before obtaining written consent. Once the participant had consented to participation they completed the two questionnaires as in Chapter Five. The researcher then showed them the devices that would be used to monitor their heart rate and galvanic skin response. Once the researcher had attached the devices to each participant's fingertips it was explained that the devices would not harm them in anyway, but that it was important to keep the hand as still as possible and not to laugh or talk too much during the trial as this could affect the reading. Participants were then given verbal instructions about the experiment. The researcher showed them a visual of "Wally" and asked if they were familiar with the concept of "Where's Wally". If the participant responded "no" the basics of Where's Wally were explained to them (That it is a cartoon drawing of a crowd scene. Somewhere in the picture Wally is hiding and their objective is to find him. In these instances the researcher showed them an example of Wally hiding in another cartoon).

Participants were informed that they would have 3 minutes during which to locate Wally, which was the length of time of the egg timer which had been shown to them. They were told however that they would not be able to see this egg timer during the experiment. In order to motivate the participants further to find Wally they were told that if they could not find him in the allotted time the researcher would not be able to use their data, but were assured that almost every participant so far had located him. This was of course untrue as the cartoon had been modified to not include Wally.

Participants' galvanic skin response and heart rate were monitored over the course of the three minutes of searching. Once each participant had completed the task the researcher showed them their individual output on the computer monitor and explained what each was monitoring. The researcher also told each participant that Wally was not actually on the page and that they had specifically been put under time pressure to find him.

Data Analysis:

As in Experiment 1 and 2 data from the questionnaires was entered in to PASW17. The data output by the Ad instruments Power lab package was entered in to a data chart, at 30 second intervals, this gave an average reading for each participant from 0-30 seconds, 30- 60 second 60-90 seconds and so on. This data was then transferred to the same PASW17 database as data from the questionnaires. The researcher split the participants in this experiment in two ways, firstly they were into groups of high and low technology use, and secondly they were split into groups of high and low self-reported time pressure.

***Results*.**

The aim of this experiment was to explore whether there is physiological stress on the body when under time pressure, whether individuals who previously exhibited results consistent with an increase in the speed of the internal would exhibit stress responses sooner into a timed task, and whether those who self-report as being under a lot of time pressure in their daily lives will have different physiological responses to those who self-report as being under less time pressure. The results from this experimental session will therefore be reported in three sections, firstly the overall HR and GSR trend lines over the session will be looked at, secondly the HR and GSR trend lines of participants grouped by their technology usage will be examined, and finally participants will be grouped by their daily level of time pressure and the trend lines of HR and GSR from this groups will be investigated. Results from this experimental session are mainly visual and observational as opposed to statistical.

Overall GSR and HR

We can see from Fig.1 that galvanic skin response increases over the course of the experimental session. One would expect that this would happen when an individual is put under time pressure. What is interesting in this is *when* the GSR begins to increase. GSR levels are stable for the first thirty seconds of the experimental trial, and then steadily increase. Figure 2 appears to show something different entirely. When GSR is at its lowest, in the first few second of the experimental session, the heart rate of participants is at a high point and actually declines. For the middle two minute section of the experimental session it rises from it's lowest to its highest peak and then comes back down. The reactivity of these increases, although apparent in the graphs, was not statistically significant.

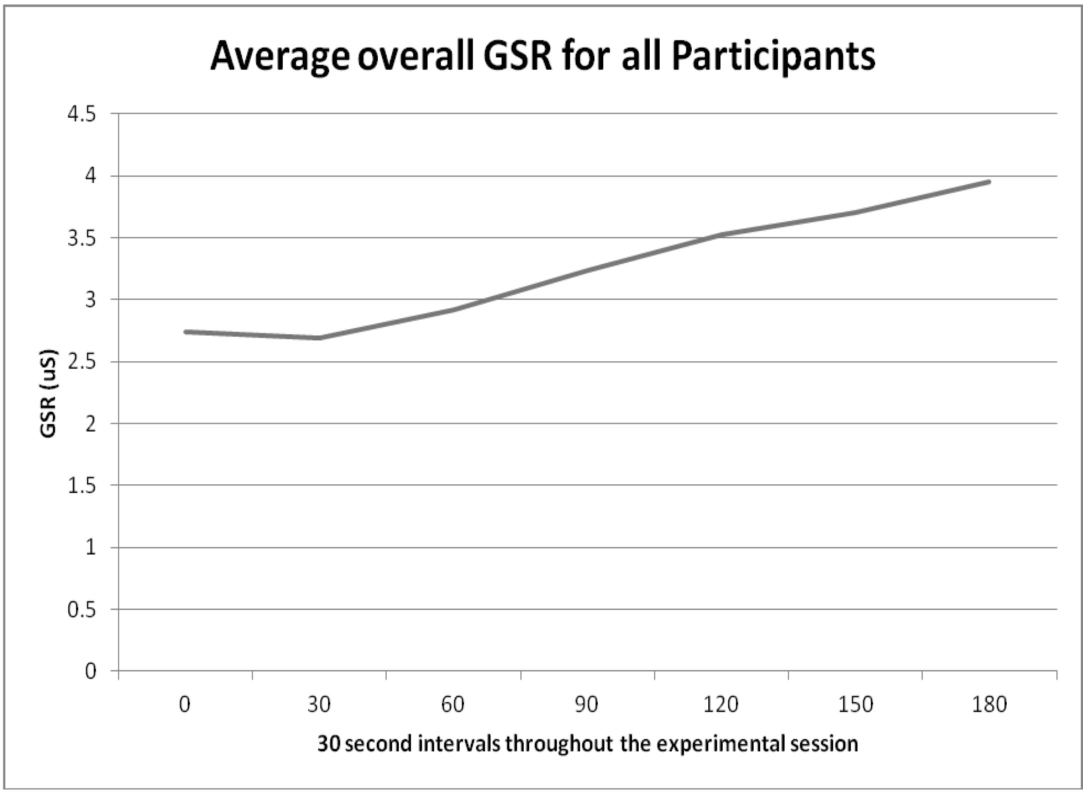

Figure 1: Shows average GSR in all participants

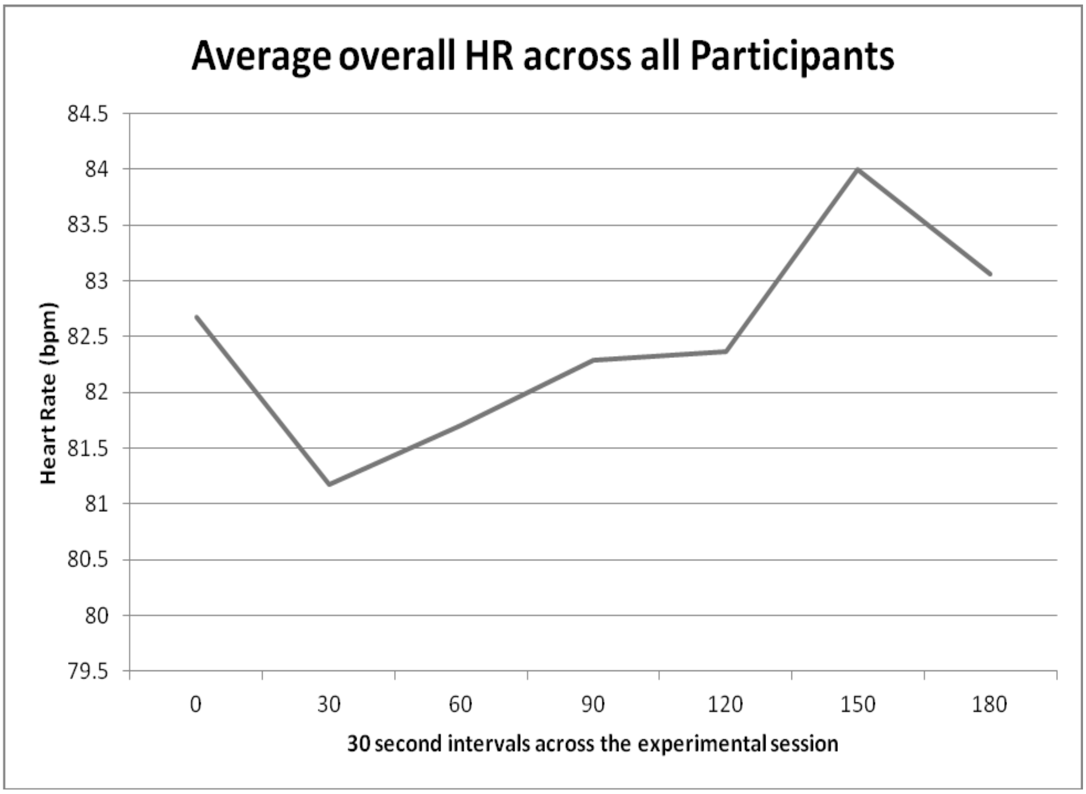

Figure 2: Shows average HR in all participants

GSR and HR (split by technology use)

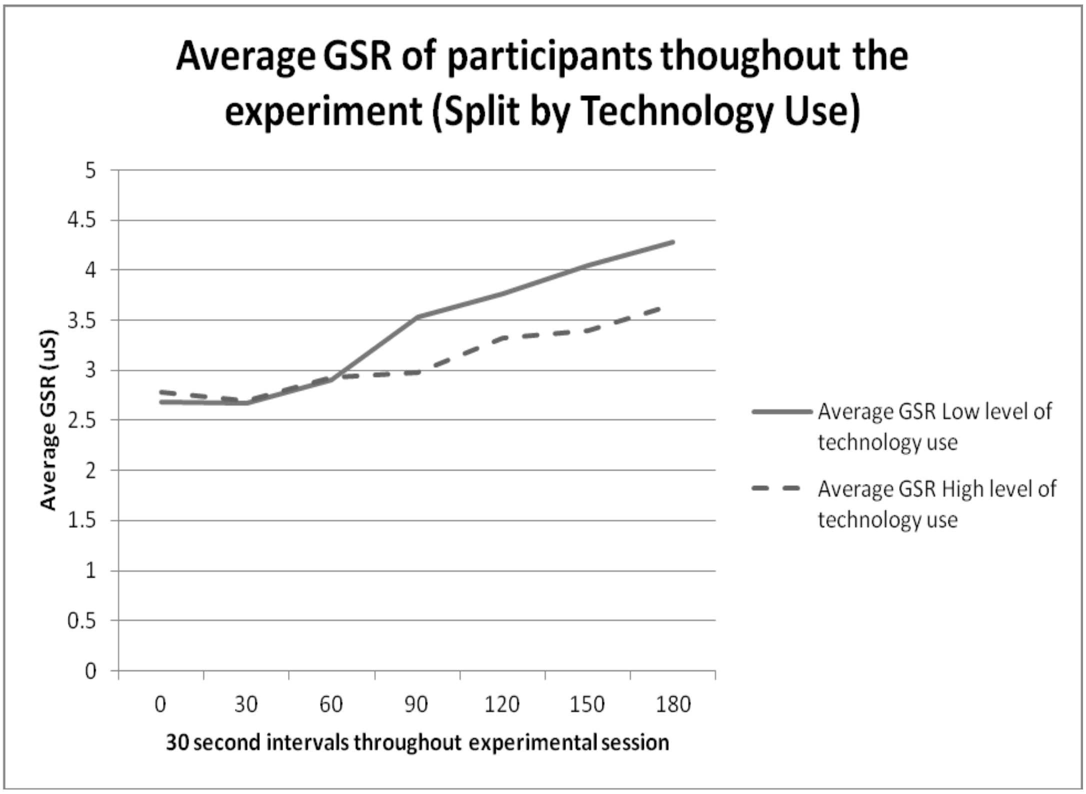

Figure 3: Ave GSR split by technology use

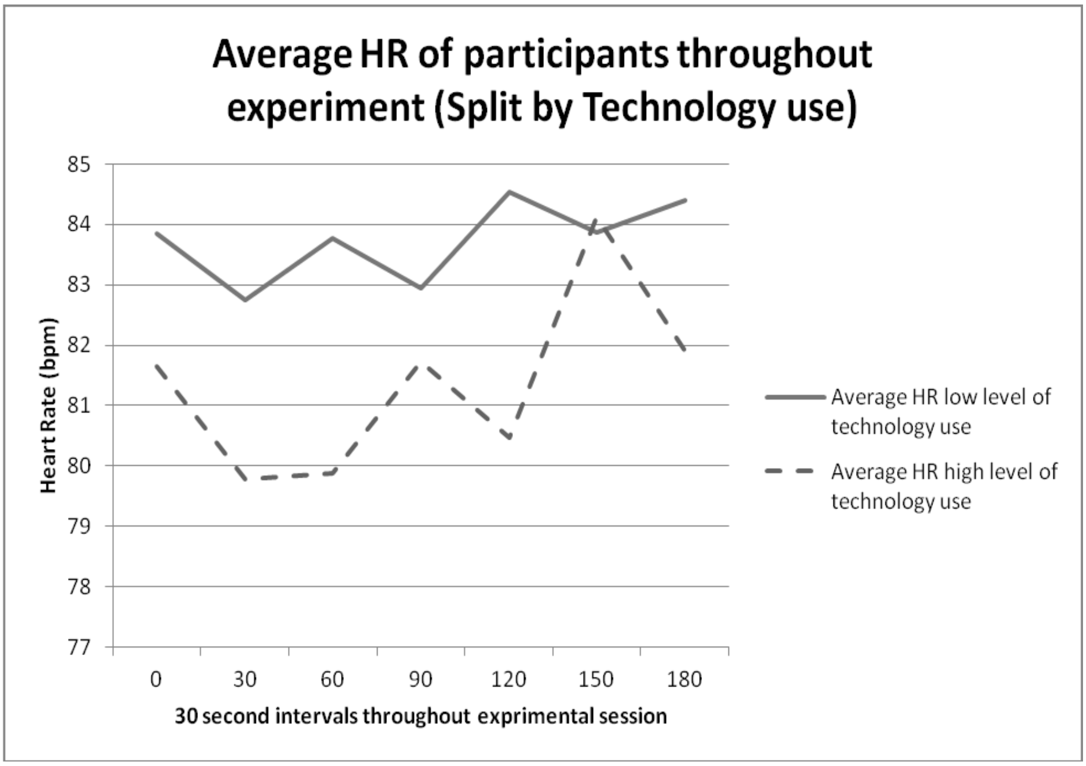

Figure 4: Ave HR, split by technology use.

From inspection of Figure 3 we can see that over the course of the first 90 seconds of the experimental session there was no discernible difference between the two groups, as split by technology use. Participants with lower levels of technology usage then begin to increase in their GSR measurement and continue to do so steadily to the end of the experimental session. The GSR levels of participants with higher levels of technology use also increase steadily from this point, but the gradient of the increase is much flatter. It would appear that those with a lower level of everyday technology use actually experience more physiological stress responses to those with higher levels of use. In order to test this a number of independent subjects T-Tests were conducted, however it was found that there was no significant difference between the GSR response of the participants in both groups at any point during the 3 minute session.

Inspection of the average HR of both groups across the task (Fig.4) shows that those with lower levels of technology use have a consistently higher heart rate than those with higher levels of technology use. In order to see is this difference between the groups was significant a series of T-Tests were conducted on the data, however, as above the HR responses from both groups did not differ significantly from each other at any point during the 3 minute session. The HR of those participants who use more technology appears to increase dramatically from 120 – 150 seconds into the experimental session and then drops off before the end of the session. This could be an indication that they felt the session was about to finish, leading to a sharp increase in their HR, which then decreased again as they felt there was no point in continuing to put pressure on themselves as the experiment was about to finish and they had "failed" the task.

GSR and HR (split by time pressure)

From observing figure 5 we can see that both participants with high and low levels of time pressure begin the first 60 seconds of the experimental session with quite stable GSR. This GSR begins to rise for both after the 60 second mark, with those with a lower self-reported level of time pressure having a steeper increase than those with a higher level. This difference between the two groups continues and the deviation between them actually grows larger over time. This is again in opposition to what may have been expected. It would easily be expected that individuals who self-reported as being more susceptible to time pressure in their daily lives would give a stronger physiological response to the time restraints in this study. Once again, in order to assess the statistical significance of this difference between the groups a series of T-tests were conducted, and it was found that the GSR responses from both groups did not differ significantly from each other at any point during the experiment. Therefore it can be concluded, that during this experiment, there was actually no difference in the skin conductivity of the two groups.

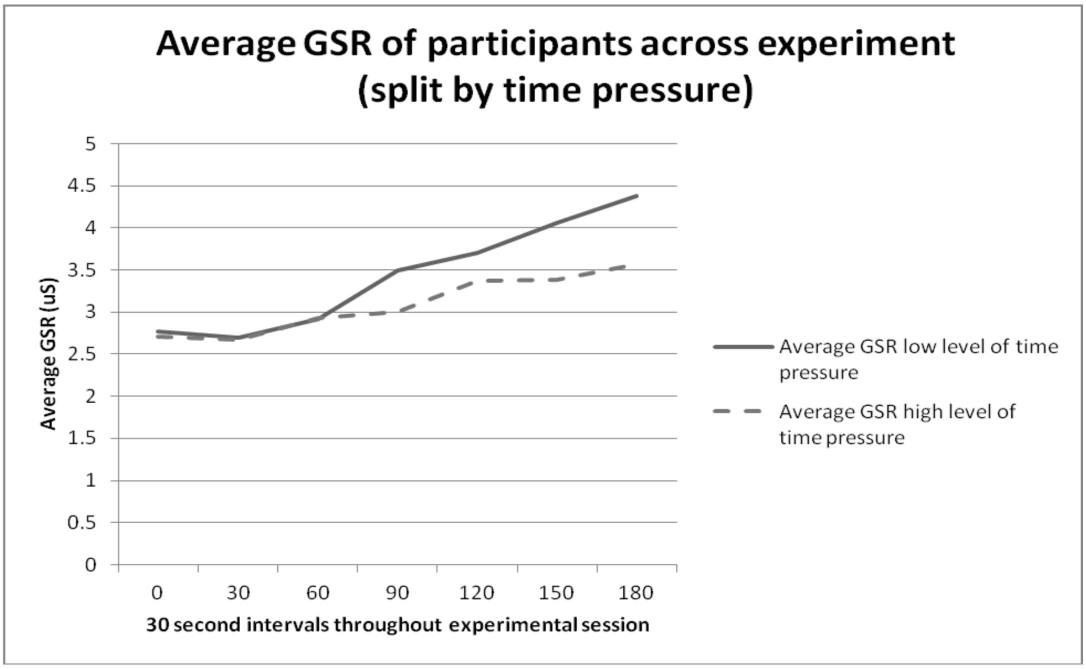

Figure 5: Ave GSR, split by level of time pressure

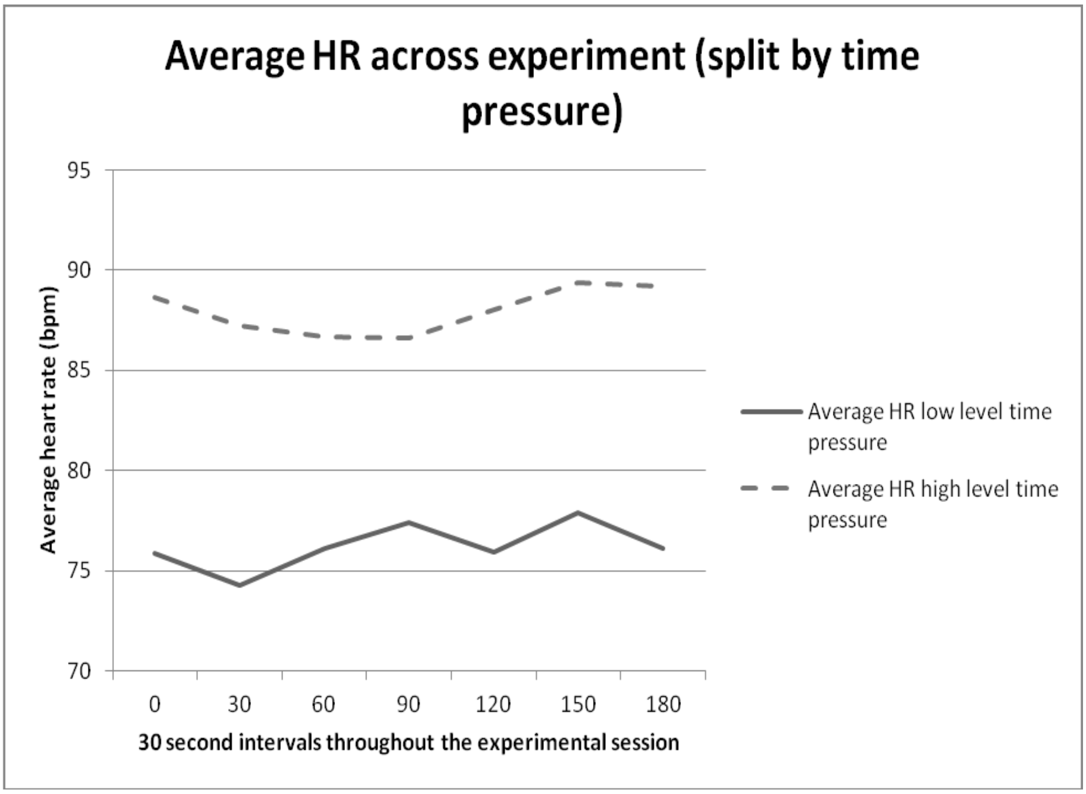

Figure 6: Ave HR, split by level of time pressure.

It is quite clear from figure 6 that those who self-reported as being more susceptible to time pressure in their daily lives had a much higher heart rate, than those who experience less time pressure in their daily lives, during this experimental session. In order to examine whether this difference between the two groups was significant a series of T-test were conducted. The two groups differed significantly from each other on each interval data point except the 180 second point. *P* values ranged from .003 to .05.

Discussion:

Within this experiment the researcher explicitly said to the participants that they had loads of time in the 3 minutes and so, they should not feel pressure by it. The fact that simply having a deadline by when attempting to locate a cartoon character managed to illicit any form of stress response at all is interesting. There are many possibilities which can be highlighted from the results just presented. Figures 1 and 2 highlight that there does appear to be a physiological stress response when individuals are put under time pressure. However, GSR does not seem to pick up on this response in the same way as HR does. HR appears to be variable and does show some increases over the course of the experimental session for all participants. Again in figures 3 and 4, we see a lack of a significant difference between participants in regards GSR or HR between participants when split by level of technology use; however we do see different trends emerge from the HR within groups. Participants in the high technology use group appear more susceptible to the imminent end of the session, and even appear to give up 30 seconds before the end of the trial.

Figures 5 and 6 show the most interesting data in this experiment. Although the data was split according to level of susceptibility to time pressure the GSR data shows no difference in the responses of those with high or low levels of time pressure. However the difference in HR is statistically significant, with does who reported as experiencing more time pressure in their daily lives exhibiting a higher HR. The possibilities here are two fold. Either HR is a much more accurate way of reading the physiological responses caused by time pressure, or individuals who experience time pressure on a daily basis have built up some form of tolerance to this stress, and although their HR betrays them, their fingertips do not.

This experiment definitely highlights the need for more research to be conducted into the area of physiological time pressure and also the ramifications of internal clock speed effects on this. However, at this point this type of physiological testing is beyond the scope of the current thesis.