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The Impact of Smart Device Usability on individual Technostress

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Abstract

This study investigated if certain aspects of smart devices are causing Technostress to individuals. It also investigated what the current Technostress levels are using the General attitudes towards computers scale, in order to compare the results with the original Rosen & Weil (1995) study. The methodology chosen was an online survey, in order to get individuals thoughts and opinions on both smart device and computer stress. The results analysed from 180 participants showed that 91% of participants had some form of Technostress, with 52% showing moderate-high levels of Technostress. The knowledge gained from the literature review research would suggest that this is because of an increased over-reliance on computers. The research also showed that age range was an important factor in Technostress with the highest levels of low stress being present in the 0-18 age range and the highest levels of moderate-high stress being present in 19-30 age range. The research on stress suggested that this is due to how the age ranges use technology and also the psychological development of the age range. The smart device results showed that 80% of participants had some form of stress with the newly proposed smart device usability scale, with battery life, content creation and errors are all key stressors present in smart devices, showing low usability ratings in the key usability components. Over 60% of people agree to sending texts without proofreading and over 50% agree that they send texts that Autocorrect have changed. It raised the question, is it Autocorrects fault or Human error? Over 75% of people agree that they use their smartphone for more than just calls and texts. Since over a third of people charge their smart device more than once a day, it shows that battery technology needs to improve since these devices are being relied on more for daily tasks and interactions. Finally 80% of people state that they prefer creating content on their computer rather than their smart device, with over 50% of people stating that they find it difficult to create documents on smart devices. With suppliers focusing more on tablets instead of computers, and companies
increasing tablet use through the bring your own device (BYOD) scheme, is this
going to increase the stress levels of individuals until tablet technology is improved?

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1. Introduction

1.1. Project Rationale

Stress affects everyone at some point in life, with 40% of all work-related illness caused by it (HSE, 2013). Some stress is acute and short term, with symptoms that can be easily managed (APA, 2013). Unfortunately, stress can also be chronic and make people feel that they are emotionally unable to cope with the world around them (APA, 2013).

Although there are many causes of stress, the use of information communication technology (ICT) is a fairly unexplored area. Smart devices are being rapidly produced, each one with its own new exciting feature (Mack, 2011). Even though this emerging technology is exciting, there hasn’t been enough time to study how interacting with these new devices, on a daily basis, is affecting stress levels. The aim of this dissertation is to explore the level of stress caused by technology (Technostress) and also how new smart technologies are affecting these stress levels.

1.2. Project Aims and Objectives

The aim of this dissertation is to explore the level individual Technostress and to find out how much new smart technology contributes to this stress level. These smart technologies will be investigated in detail to see if a particular design or feature affects stress in a different way, and if so how can it be changed in order to prevent future stress. In order to examine this, an in-depth literature review will be carried out to see which current research has been done and what needs to be explored. Using the questions designed by Rosen and Weil, the aim will be to conduct an online survey in order to find out the current stress levels individuals have from the use of ICT. These questions will be accompanied by another set of relevant questions, created on smart devices, derived from the literature review focus. Once the data from these surveys has been collected, the final aim is to create a SAS system which can analyse the data...
in order to find trends in Technostress. Any useful trends found in the data can be reviewed and new recommendations for reducing the stress levels on individuals can be proposed.

2. Literature Review

2.1. Introduction

This literature review is based around the issue of Technostress, using academic research in order to investigate and understand the various topics surrounding it. This will be done by following certain goals.

The first goal is to research and understand what stress is. This is because Technostress is a type of stress and therefore the initial concept of stress must be understood as a result. For example, it is difficult to understand a study on computers and chronic stress when the concept of chronic stress isn’t thoroughly clear. The research will then expand and look into the causes of stress and if there are many different types. This is important as it will help identify what can trigger stress, helping to detect key problem areas when Technostress is explored. Finally the consequences of stress will be explored, to see how wide-spread and varied the symptoms are. Again this is useful to research as stress symptoms can easily be identified when reading and studying Technostress in detail.

With a clear knowledge on stress, the next goal is to research Technostress itself. The first section will be focusing on what Technostress actually is and learning how to measure it. This is important as it will build a foundation of knowledge on the subject, beginning to understand what the issue is about and how it has been detected in individuals. The research on stress will then be applied, to identify what the key causes of Technostress are and the consequences to people as well.

The final goal is to explore one of the key causes of Technostress in more detail, in the concept of usability. This is to see if usability has an impact on Technostress, and if so, how much is it an important factor.
2.2. **A World of Stress**

2.2.1. **What exactly is Stress?**

In order to understand how serious Technostress is, an initial understanding of stress and its consequences needs to be known. Firstly what is stress? Stress is defined differently in many academic fields, but with similarities between them (Cohen, 1995).

For example in Medicine, stress is defined as “an organism’s total response to environmental demands or pressures” (Younger, 1999). In Psychology, stress is “when an individual perceives that environmental demands tax or exceed his or her adaptive capacity” (Cohen, 2007). Finally the Health and Safety Executive (2013) states that stress is “the adverse reaction people have to excessive pressures or other types of demand placed on them”.

With multiple variations in definitions and with the use of complex terminology, it’s easy to get confused as to what stress really is. Stress needs to be defined from a source using simple terms. The NHS website (2013) helps provide complex medical information to anyone, in plain English. It defines stress as “the feeling of being under too much mental or emotional pressure. Pressure turns into stress when you feel unable to cope”. This is a useful definition as it provides a general overview to anyone of what stress is.

Now that stress has been defined, the next stage is to understand the main types of stress. The majority of literature suggests that stress can be acute or chronic (Filipovic, 2013, Pickering, 2013). Acute stress is usually short term (Bailey, 2008). Acute stress affects a person when they are under pressure from upcoming events or are dwelling on past events. It is highly treatable and manageable. If acute stress is built up over a long period of time, it can become chronic (Eggers, 2007). Chronic stress is long term and is usually harder to manage (Bailey, 2008). Chronic stress is a build-up of stress over a long period. It involves much more extreme symptoms than
acute stress (APA, 2013). The symptoms of acute and chronic stress will be discussed in section 2.2.3.

Finally some psychologists believe that two levels of stress are not enough and there is a third in-between stress. This is called episodic acute stress or repeated stress (APA, 2013). They argue that the gap between acute and chronic stress is large, so they should be a type of medium term stress. This is when acute stress occurs more frequently in a person’s life than average, but is not as extreme or damaging to an individual as chronic stress. Managing episodic acute stress is usually difficult as it is has become integrated into a daily routine. Professional help and therapy is usually required.

### 2.2.2. Understanding the causes of stress

Although slightly different, the above definitions all have the common theme of “demands” or “pressures” upon an individual. It raises the next question, what are these demands and pressures which cause acute and chronic stress? In psychology, these demands and pressures are called stressors (Lazarus, 1984, Mcleod, 2010). These stressors can be internal or external.

Internal stressors cause stress from our own thoughts and beliefs (Cooper, 2000, White, 2013). This is different for each person as everyone has their own unique set of morals and ideas. These morals and beliefs are formed due to multiple reasons.

Some Psychologists believe they are formed through operant conditioning. This is where human behaviour is learned through positive reinforcement and negative punishment (Skinner, 1938). For example, if a child was punished for breaking something, then that child would associate breaking as negative behaviour. Punishment can lead to fear of certain actions (Ohman, 2001). This fear can be of different levels, with greater fears leading to higher stress levels (Folk, 1987). This
development of fear (internal stressor) can occur at any time to anyone depending on how they were conditioned.

Another theory is called classical conditioning. This is where humans make an association between a stimulus and an involuntary response (Watson, 1920). For example, hearing a siren (stimulus) automatically makes people panic (involuntary response) and know danger is coming. Each person associates certain senses with different responses, which can cause stress in different ways (internal stressor).

Both behavioural theories show that internal stressors are based on individual past experiences. The literature suggests most internal stressors can be easily managed through stress management techniques (Campbell, 1997, Edelman, 2006). Relaxation techniques are a common method for short term stressors (NHS, 2013). These techniques can involve breathing exercises, meditation, fitness classes or even calm music sessions. More extreme internal stressors can be managed through long term solutions such as therapy (Jenni, 1979).

The other type of stressor is external. External stressors are caused by environmental factors which are out of our control (Cooper, 2000, White, 2013). As a result, it makes them difficult to predict and manage. The literature suggests that there are a variety of external stressors. The most common external stressors are shown below (Table 1).

Table 1: The most common external stressors

<table>
<thead>
<tr>
<th>External Stressor</th>
<th>Description</th>
<th>Examples</th>
</tr>
</thead>
</table>
| Major Life Changes      | Big events and changes in life that are occurring which are causing stress. | • Having a new baby (Cardwell, 2013)  
• Job Promotions (Johnston, 2013)  
• Death of relative (Stroebe, 2011) |
| Environmental events | Everyday situations going on in the world around us. | • Road Works  
  • Noisy Neighbours  
  • Traffic Jams  
  (Rowden, 2013) |
|-----------------------|--------------------------------------------------------|--------------------------------------------------|
| Unpredictable events  | Events that happen in life which can surprise a person or catch them off guard. | • Cost of living increase  
  (Sky News, 2013)  
  • Unexpected guests  
  • Theft  
  (Hansen, 2013) |
| Work place            | Any changes or commitments at work which are contributing to stress | • New IT Systems  
  (Amick, 1992)  
  • Budget Cuts  
  • Looming Deadlines |
| Social                | Any stress from friendships, relationships and family commitments | • Relationship troubles  
  (Heitler, 2013)  
  • Meeting new people  
  • Following family traditions |
2.2.3. Strain, the consequences of stress

The final key aspect of understanding stress is strain. The literature suggests strain is “a severe or excessive demand on the strength, resources, or abilities of someone or something” (Oxford Dictionary, 2009). There have been many studies on strain and stress, with most academics agreeing that there is a key correlation between them (Elitharp, 2005). A well-known study would be the research carried out by Koeske & Koeske (1993). Their research showed that stress can produce positive and negative consequences, with strain being a negative consequence of stress (Koeske, 1993).

Since strain is the negative consequences of stress, the next question would be what are these consequences? Research shows the negative consequences of stress (strain) can be split into the two categories, mental and physical.

Physical strain is the pain or damage caused to the body, due to the stress a person is under. Some symptoms can be seen physically, such as eye strain, damaged skin or weight loss (HSE, 2012). Others are more internal and hidden, such as migraines, high blood pressure or muscle pain. The image below shows an overview of the most common physical strain (figure 1).
Disease is a form of strain on the body. There has been a debate for years about if stress causes disease or not. Some psychologists and medics believe they do. They argue that stress can lead to an increase in blood pressure, and when that blood pressure gets too high (hypertension), it can cause kidney disease, coronary heart disease or even a stroke (Krants, 2002). Most recent studies have even found that stress may even lead to Alzheimer’s disease (Glynn, 2013). The flip side of the argument is that stress may be an indirect contributor, but not a sole cause of disease itself.

The next form of strain is mental. Mental strain is how stress is affecting the mind of an individual (MHF, 2010). The literature usually splits mental strain further into behavioural and emotional strain.

Emotional strain is the negative emotions which arise from being stressed. The most common emotional responses are anger, anxiety and sadness. The literature suggests these emotions are usually linked with acute stress (APA, 2013). For example, a person could get angry about being stuck in traffic, anxious about an upcoming...
deadline or sad about something read in a newspaper. With chronic stress, the emotional responses are the same, but are amplified (Naylor, 2011). Anger becomes rage, anxiety becomes fear and finally sadness becomes depression. Some psychologists believe that rage, fear and depression are separate emotions from anger, sadness and anxiety (Soloman, 2008), since they show a higher emotional response. Others believe it is just the same emotion, but on a higher scale (Lerner, 2009).

There are also studies that show emotional strain can lead to physical strain. A major area being studied is depression and self-infliction. This is where an individual is so overwhelmed by depression, rage, or fear, that they hurt themselves physically as a result (Toffhagen, 2010). Studies have shown that individuals punch walls to control rage, dig fingernails into their own skin in order to control fear and finally cut themselves with sharp objects in order to temporarily block out depression (Hawton, 2002, Freeman, 2010). The act of self-harming is caused by emotional strain but is a type of behavioural strain, which is explored next.

As previously mentioned, the other type of mental strain is behavioural. This is how stress changes an individual’s behaviour, making it different from a normal routine. There are many types of behaviour changes that have been explored (Ferretti, 1995). Some behaviour changes are minor, such as an increase in voice volume (anger) or walking on the opposite side of the road to avoid conflict (anxiety). Others changes can be more extreme, such as disturbed sleep patterns (Lee, 2013) or addictions to alcohol or food (Boyce, 2012). Research shows that there is a correlation here with emotional strain. Studies show higher levels of emotional strain leading to higher changes in behaviour (Baumeister, 2009).

### 2.3. The Stressors and Strain of Technostress

#### 2.3.1. What is Technostress?

This section of the literature review focuses on Technostress. It explores what Technostress is and the key stressors and strain that have been studied (applying and building on the knowledge of stress gained from the previous section).
Firstly, what is Technostress? A good way to start defining Technostress would be from Larry Rosen’s and Michelle Weil’s point of view, since they originally came up with the term. They define Technostress as “any negative impact on attitudes, thoughts, behaviours, or body physiology that is caused either directly or indirectly by technology” (Rosen, 1997). Looking back at the research on stress, these negative impacts are the consequences of stress, which is known as strain (Koeske, 1993). In other words, Technostress can be defined as any strain caused from the use of technology.

The word technology is usually misunderstood, with most people associating the word with computers (Wright, 2003). In order to really understand what Technostress is, the word technology needs to be defined. The Oxford dictionary (2013) defines technology as “machinery and devices developed from scientific knowledge”. This definition shows that technology can be any developed device or machine. A few examples include microwaves, washing machines, tablets, televisions, game consoles and much more! Coming back to the definition of Technostress, it can now be simply defined as any strain caused from the use of developed devices and machines.

Looking back at the research on stress, since these devices and machines (technology) are causing stress, psychologists would say that they are stressors. The next sections will look at these technology stressors in more detail.

Although Technostress is now defined, some academics use another term called Technophobia. Technophobia is technically defined as the fear of technology (Bozionelos, 2001) although a lot of academics use this term for the same meaning as Technostress (Ahmad, 2011). The research so far would suggest that Technophobia is in fact a type of Technostress. This is because Technostress is any strain caused by technology and Technophobia is just the fear of it, which is one form of strain (emotional) instead of several strains (physical and emotional). For the duration of this dissertation the word Technostress will be used only, with Technophobia referred to as the fear of technology.
With a clear idea of what Technostress is, the next thing to explore is how it has been measured. Rosen and Weil (1995) believed Technostress could be measured by people’s anxiety, cognition and attitudes towards computers. As a result they created three key instruments for measuring Technostress. These are the Computer Anxiety Rating Scale (CARS-C), Computer Thought Survey Scale (CTS-C) and the General Attitudes towards Computer Scale (GATCS-C). These surveys were combined with demographic information and a computer experience survey in order to measure Technostress. These tests have become a de facto standard for measuring Technostress levels and have been used in over 22 countries (Rosen, 2014).

2.3.2. The Stressors and Strain of Computers

Since the definition of Technostress has been evaluated, the next stage is to research which technologies (stressors) are causing stress (strain). Since the field of technology is too big to study, the focus will be on the field of computing.

2.3.2.1 Rosen & Weil and Librarian Studies

The first technology to explore is computers. Like the definition of Technostress, a good place to start would be through the work of Rosen & Weil. Rosen & Weil (1995) investigated how teachers across 54 schools in over 5 districts were stressed over the introduction and use of computers in classroom environments. The majority of teachers all showed signs of anxiety with computers. Their study along with previous academics such as Loyd and Loyd (1985) showed the world that computer experience was negatively related to computer anxiety. This research brought up the key issue that solely training a person to use a computer was not enough to make them feel comfortable around them.

Although Rosen & Weil originally called this anxiety Technophobia, it is very much a form of stress. From the previous research on stress, anxiety was seen as a key emotional strain. Since this research showed computers making people anxious, it is therefore a form of stress, showing that computers are stressors.
This research started to show that computers are a key Technostress stressor. Even today teachers are still having anxiety problems with computers and it seems the same mistakes are being made. This is shown with the government trying to introduce a new programming course (stressor) into secondary schools (Murray, 2013). The government assures that anxious teachers (Kobie, 2013) will be ok after the correct training (Murray, 2013). Unfortunately, according to Rosen & Weil (1995) training isn’t enough to remove anxiety (strain). This shows that even now the effects of Technostress still exist, as people are not learning from past experiences. This anxiety for the new course is based on the cliché of programming being difficult. The research on stress would suggest that this cliché has been classically conditioned into people (Watson, 1920). Hearing the word programming (stimulus) is causing the involuntary response of anxiety. Since this is based upon thoughts and beliefs, this form of Technostress is an internal stressor.

Another study on librarians showed anxiety and even fear with the use of computers (Aghwotu, 2010). The study showed that librarians were struggling to cope with the constant need to adapt to new software and hardware (Alquallaf, 2006). The librarians frequently went through the process of getting used to a computer system, and then soon after a new one was put into place. Lack of documentation, strange new interfaces and constant error messages caused librarians headaches, dizziness, frustration, anger and isolation (Aghwotu, 2010). The anxiety and fear of librarians was classically conditioned to the response of a new system, making computers again an internal stressor. This study not only shows anxiety associated with computers, but other emotions also, proving computers can cause a variety of emotional strain. The symptoms of headaches and dizziness from computer use also show that computers cause physical strain. Since the librarians had no choice over computer usage, and were forced to do so, computers can be seen as an external stressor. The constant error messages and confusing interfaces were design issues, showing that usability has a part in making computers external stressors.

2.3.2.2 Computers and Physical Strain
The last study showed that computers cause some physical strain. After exploring emotional strain based case studies, physical strain needs to be explored in more depth. Erik Peper (2008) wrote a paper that highlighted some of the frequent physical strain from computer use. Peper argued that people (especially young adults), are spending an increasing amount of time of computers, both at work, home and socially, without any substantial long and short term breaks. This is causing people to suffer with pain in their shoulders, neck, wrists, hands, legs, arms, head, back and eyes (physical strain). This was based on data collected from students who suffered these symptoms when using computers for a prolonged period, at the end of a semester (Peper, 1999). The most common form of physical strain from this study is eye strain and hand and wrist pain.

Eye strain and pain in the hands and wrists from computer use have been studied extensively. Studies show that pain in the hands and wrists from computers are commonly caused by RSI or repetitive strain injury (Chauhan, 2003). This is normally due to prolonged use of typing on computer keyboards.

The impacts of both RSI and eye strain from computer use have been so widespread and well known that frameworks and laws have sections included in order to help reduce these symptoms. This includes the Health and Safety Display Screen Equipment Regulations (1992), Management of Health and Safety at Work Regulations (1999) and Cobit 5 (2012). Research into ergonomics has been going on for years, in order to help reduce physical strain. Working postures, room lighting, monitor displays and ergonomic keyboard design have all been discovered to be important in reducing physical computer strain (Makalakshmi, 2011).

2.3.2.3 Information Overload

The final concept to explore with computers is information overload.
First of all, what is information overload? Information overload is defined as a situation where the information available is too great for an individual’s capacity to process it (Eppler, 2004). Having too many things to take in at once and process can causes several emotional responses, which the above research shows can lead to stress.

An example of information overload could be an employee in an office, who is receiving over 2000 emails a day, and not having the time to reply to them all. This could lead to the employee feeling anxious (emotional strain) about the email overhead. On the other hand, the employee may finally reply to 100’s of emails only to refresh his inbox and receive another 200, causing frustration (another emotional strain). Finally, repeating this process of constant email build up day in, day out could lead to depression (chronic stress).

Another simpler example could be a college student at a UCAS fair, trying to take in over 100 different university locations, courses and options, which can be overwhelming.

There have been many studies with information overload and computers. One major topic area is that information overload leads to a psychological condition called continuous partial attention. Continuous partial attention is where a person has a constant desire to always be connected with everyone and everything all the time (Stone, 2013).

With the introduction of computers and the internet, a huge amount of people can be connected easily via social networking and other blogging sites, providing interesting and exciting opportunities and information. The trouble is that there are too many options (information overload). Individuals become members of so many digital communities, following multiple sources, that it takes control of their lives, and make them very difficult to manage (Bawdon, 2009). This constant chaos of trying to do everything causes stress.
The research in this section show that computers can cause both physical and emotional stress, which the literature suggested are two separate types of strain. This makes computers a key stressor, which is cause for concern.

2.3.3. The Stressors and Strain of Smartphones and Tablets

In the field of computing desktops and laptops are not the only major technology which is used. This past decade has seen a rapid development of portable smart technologies, with smartphones and tablets being the most well-known. The percentage of smartphones owned (compared to basic mobile phones) in the UK has increased from 48% to 58% of the market and is forecast to keep increasing (Gee, 2013). In fact smartphones have become so popular that there will soon be 1 smartphone for every 5 people on the planet (Leonard, 2013).

Since these devices are regularly used every day, it is important to know if they are affecting stress levels in any way. This section of the literature review will explore how this new technology affects the levels of stress, in both negative and positive ways.

2.3.3.1 Touchscreens and Stress

The first key aspect of smartphone technology is the introduction of the touchscreen. Touchscreens have brought a variety of benefits to the world of computing, and has changed the way users interact with devices.

The main benefit is that anyone can easily learn how to use a touchscreen without much training, making its appeal very high (Bhalla, 2010). This would make touchscreens reduce stress as a result. As seen in the library case studies above (section 2.2), regularly having to adapt to new IT systems caused a variety of Technostress. If new IT systems were as easy to learn as a touchscreen, then stress levels would have been lower and anxiety of new touch screen interfaces would reduce in further updates. This is further proven with the second touchscreen
advantage of having less physical peripherals, such as a mouse or keyboard (Bhalla, 2010). The case study showed that learning to use CD’s and other new hardware was giving Liberians headaches. If touchscreens were present at the time, the amount of hardware to adapt to would be lower and stress would have decreased as a result.

An example of where touchscreens have reduced training stress would be IBM’s SurePoint. SurePoint is used in retail stores for a variety of functions including self-service point of sale and quick search for products that are in stock (IBM, 2011). Due to basic touch functions, training to staff to use them is simple and quick, which has reduced stress as a result (IBM, 2011).

Although touchscreens can potentially reduce stress at the training stage, do they reduce stress when using them? The following research suggests they aren’t.

Most people would think that using touchscreens would reduce RSI (which research suggests is a common form of physical strain), since there is less hand/finger movement from button clicking on a keyboard or mouse. Unfortunately, this is not the case and touch screen devices have been shown to cause RSI with prolonged use (Adams, 2012), which is at times worse than using a standard GUI (graphical user interface) and mouse.

Medical and ergonomic experts say touchscreens are worse than a mouse/keyboard as heavy tapping on a screen (due to lack of tactical feedback) causes strain on the nerves in your fingers (Knibbs, 2012). They also say since most touchscreen use is portable and not done sitting in the correct position, it causes muscle fatigue in the hands, arms, shoulders, back (hunched forward) and even neck (looking down onto the device). A chiropractor even reported that out of 340,000 RSI patients, over half of them were there due to touchscreen use (Petrou, 2010). This shows that touchscreens are a key Technostress stressor, as they have been causing a variety of physical strain.

RSI isn’t the only physical strain that has been recorded for smartphone and tablet use. Large cases of eye strain are starting to be regularly reported, with recent studies showing 70% of US adults experiencing digital eye strain (Naftalovich, 2013).
Medical experts say that this is due to user’s eyes constantly staring at the devices smaller screens at awkward angles, regularly throughout the day. These devices are usually held too close to the eyes, which cause the eyes to focus harder, resulting in strain (Gardner, 2011). The eyes are further damaged with the use of the devices at night (Wen, 2013), in low lighting (and sometimes none at all). Aside from eye strain, users have been known to show other symptoms such as headaches, dry eyes and even blurred vision (Wen, 2013). Again this research shows that Smartphones and Tablets cause physical strain, further proving that they are Technostress stressors.

**2.3.3.2 Smart Devices and Information Overload**

Aside from physical strain, do Smart devices cause any other form of strain? Research suggests that they are causing a variety of emotional stress, due to information overload.

So how do smart devices cause information overload? One main issue is the opposite of the above research on continuous partial attention. Whilst continuous partial attention makes a person always want to be connected, there are a huge amount of people who are stressed because they don’t want to be always connected. Smart devices have allowed humanity to stay connected with anyone, anywhere at any time (with an internet connection). Nobody has to be restricted to a computer or workstation anymore. People can talk to their friends on social networks on the bus or sitting in the park, using a 3G/4G connection on their smartphone. It has changed the way the world interacts with each other.

Although a lot of people believe this is great, it can start to become overwhelming. For example, international behavioural expert Jamie Smart (2013) writes that employees are wielded to their smartphones, always receiving emails and social networking messages, causing a saturated mind 24/7. Even at home and on breaks they are constantly staying connected. A saturated mind means that the mind is so full of information that it never rests, causing severe stress via information overload (Smart, 2013).
Information overload from smartphones and tablets is not just affecting individuals, but businesses as well. Recently there has been a huge increase of bring your own device to work (BYOD), with 89% of organisations globally allowing employees to do it (Bradley, 2013). Although BYOD is known to increase productivity (Bradley, 2013), it also distracts employees with access to even more information on the go. A survey from Xerox showed that their employees spent 26% of their time managing information overload (Gantz, 2009). This is stressful for both the employee and also the business as precious time is wasted every day.

**2.3.3.3 Smart Devices and Addiction**

Another issue is that Smartphones and tablets are catalysts for all sorts of addictions, which comes with a variety of emotional stress.

One main addiction that smart devices have helped increase is virtual gambling. Computers helped move all kinds of gambling out of the casino and into the home, with the use of an internet connection. The ability to gamble online has increased the amount of addictions, with Gambler addiction helpline Gamcare reporting an 8.1% increase from 2011-2012 (Dawson, 2013). Smart devices have made addictions worse as it has allowed people access to these sites anytime, anywhere, with an internet connection (Carter, 2013). There have even been applications developed so that users can instantly start betting with the touch of an app icon (Wyher, 2013).

These applications accessed on smart devices have helped increase these addictions, causing lots of stress and ruining lives. The NHS (2013) says that addicted gamblers are twice as depressed and suicidal than the national average. Since Smart devices are helping to increase addictions, it again shows that it is a key Technostress stressor.

**2.4. Usability and Smart Device Stress**

From the above research, there is clear evidence that smartphones and tablets are key stressors, causing a variety of emotional and physical stress onto individuals. A lot of physical strain from the devices was caused by the use of the touchscreens, in order to
do certain tasks. The tasks which users do with devices are called interactions. Each interaction that a user does with a device is developed from a designer’s idea. A part of this designer’s job is to make these smart devices as user friendly as possible. If a smart device isn’t user friendly, it frustrates a user, which our research shows is a form of emotional strain. The librarian study also showed that poorly designed systems can lead to anxiety of future systems, another form of emotional strain.

The research so far suggests that how a smart device is designed could be an important factor which contributes towards stress. As a result, this section of the literature review will be focusing on usability, stress and smart devices, to continue seeing how these popular devices are affecting stress levels.

2.4.1. What is Usability?

In order to fully understand how the design of a smart device could lead to stress, the concept of usability needs to be understood.

Firstly, what is usability? There is some debate around what usability means. Some designers believe usability means how easy to use a device is and how useful that device is, agreeing with the technology acceptance model (Davis, 1993). Other designers believe that this is too broad, and that usability is split into more components (Katz-Haas, 1998, Nielsen, 2012). These components vary per designer, but are all based around Learnability, Efficiency, Memorability, Errors and Satisfaction (Table 2).

<table>
<thead>
<tr>
<th>Usability Component</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learnability</td>
<td>How easy is it for the user to learn</td>
</tr>
<tr>
<td>Efficiency</td>
<td>How quickly can users perform tasks</td>
</tr>
<tr>
<td>Memorability</td>
<td>How does the design reduce memory load</td>
</tr>
<tr>
<td>Errors</td>
<td>How well does a system cope with user</td>
</tr>
</tbody>
</table>
errors and how frequent are these

| Satisfaction | How appealing is the system to use? |

Although there is a debate in defining usability, they are essentially the same but expanded in more detail. For example, a designer can see how useful a device is by seeing how efficient it is or how satisfied the user is with it.

Coming back to the research on stress, if a smart device design or function has low ratings on the above usability components, it is more likely to have negative responses (behavioural and emotional) from a user, which the research suggests is stress.

Many academics/developers carry out usability tests as they are designed to make their products less stressful and more user friendly to use (Schrier, 1992, UG, 2012, NNG, 2014). Table 2 shows the key components which are usually tested. Since usability tests are carried out to reduce stress by increasing each usability component, it shows that usability is an important factor for detecting/showing stress.

The next few sections will explore the research into particular smart device usability design, to see if it is causing stress.

### 2.4.2. Precision and Accuracy Issues

The first thing to explore is precision and accuracy issues. The research above on RSI and touchscreens stated that users heavily tap the screen (Knibbs, 2012). This is because touch icons are often small and user’s fingers tend to miss touching the icon precisely. Users tap even further due to lack of tactual feedback, to inform them an icon has actually been clicked on.

This problem of user’s fingers and touch icons has been studied in detail. The technical term is called fingertip blob recognition (Ravoor, 2012). The concept is to extract a fingertips touch on a screen and see which co-ordinate it has touched. The problem is that the sensors which do this are not accurate enough, causing people to rapidly tap the screen until a fingertip is recognized. Another issue is that sometimes
fingers are so big that they touch multiple co-ordinates at once, confusing the device into what has been pressed (Ahsanullah, 2010).

A study by Holz and Baudisch (Barras, 2009) showed that on a typical smartphone where icons are 10mm across, some co-ordinates for recognition were only 3mm apart, causing exact icon touches to be difficult.

The research would suggest that this is seen as poor usability. Since touchscreens make users tap icons more than once (due to overlapping co-ordinates), it makes a user’s task slower, which is poor efficiency. Having to tap multiple times also is frustrating (Kadansky, 2012), reducing the satisfaction of using a Smartphone, which is another usability issue. Although this is a common issue, academics and developers are trying to solve this problem. Examples include new finger blob recognition techniques (Ravoor, 2012) and Coordinated Gestures for One-Handed Mobile Interaction (CoGMI) (Rohani, 2012).

2.4.3. Battery Life

The research in this section is on the battery life of Smartphones. Smartphones have now become the number one device for keeping track of everything in a person’s life. With an internet connection and an application for almost anything, Smartphones are being relied on more and more (Fisher, 2009). A list of regular usage would be for online banking, keeping in touch with friends/relatives/colleagues (via texts or calls or social networking), navigation, games, music, email, watching films and even dating (Metri, 2012b). Although it is efficient and enjoyable to be able to do all of this on one device, the trouble is that the battery life is poor and doesn’t last long.

This is a major usability problem. Having to charge a Smartphone multiple times a day is extremely frustrating (emotional strain) and decreases the satisfaction of using the device. This problem is extremely common, with multiple online forums/blogs/articles filled with people complaining about this issue (Logic, 2012, Helsby, 2013, Snyder, 2013, Williams, 2013).
The problem is that Smartphone batteries cannot keep up with Moore’s law (every two years processing power doubles (Mack, 2011)). This means that the world has powerful Smartphones with high processing power, but with battery technology that is lagging behind. A report by J.D Power (2012) shows that Smartphone battery life has become a significant satisfaction factor when choosing a Smartphone and brand. This is because users are getting more frustrated with poor battery life. As Smartphones get even more powerful over the years, this usability issue will have to change. If it persists people will get more stressed with both the devices and companies who produce them.

Several developers and academics have already proposed/developed solutions, in order to try and solve this usability issue (Metri, 2012a). Examples include installing power saving applications in order to manage power use (Zahid, 2011), encouraging programmers to program more efficiently in order to save memory (Jae, 2011) and finally hardware which is more energy efficient (Kosner, 2014).

2.4.4. Content Creation

This section on Technostress focuses on the stress caused by Tablets and Smartphones from creating content. Content creation can be anything from creating word documents, drawing pictures, updating spread sheets or even developing presentation slides.

A report by Tactus Technology (2013) provides a good introduction of common creation problems. They say that data entry errors, poor typing speeds and lack of tactual feedback are all greatly reducing the user’s satisfaction of using these devices for creating content. These three issues will be researched in more detail.

The first issue to explore is data entry errors. How common are these on these devices and what are the consequences as a result? An article in the Daily Mail showed that the autocorrect function usually creates more errors than it saves to oblivious users, with some creating emotional stress (Edwards, 2011). Figure 2 shows some of these errors and the emotional responses from people.
So why aren’t people noticing these errors before they send a message? The problem is that the majority of the screen display is blocked out by an on-screen keyboard (Figure 3), making it difficult to see what has been typed (Claburn, 2012), especially for a long message. This makes creating content such as word documents and spreadsheets difficult. For example, trying to type out a sum function on a tablet spreadsheet would be difficult when you can’t fully see the range of cells that need to be entered in the equation. This can be frustrating and waste time, turning the on-screen keyboard on and off. Developers have realized this issue and have spent time trying to redesign Touchscreen keyboard layouts, such as the Minuum layout (Martin, 2013) and embedded laser keyboards (CTX, 2013). This section shows that touchscreen devices have poor usability in error handling, making them again a frustration for users.
The next issue to focus on is typing speeds. Research from 243 survey respondents showed that they found it difficult to type on a touchscreen (Claburn, 2012). The researchers proved that on average a touchscreen was 2.72 times slower on words per minute typed (Claburn, 2012). Several other researchers have found the same results, with touchscreen QWERTY layouts producing only up to 20 words per minute (BBC, 2013). This makes creating documents less productive and efficient (usability issue). Combining this issue with the above research (Knibbs, 2012) showing touchscreen increasing RSI (physical strain), it makes content creating slow and frustrating (emotional strain).

The final issue to look at is lack of tactual feedback. The above research on Technostress already stated that this was a major problem causing a variety of stress. The Tactus report (2013) stated that due to lack of physical buttons, any touchscreen creation is incredibly difficult for the elderly, the visually impaired and people lacking motor skills (due to conditions such as arthritis or Parkinson’s disease).

Devices are supposed to be available for all users, regardless of disability (DDA, 1995). Since these Touchscreen devices hinder these users, they aren’t user friendly. This could cause a variety of emotional stress, including depression (feeling left out of using such a widespread technology (Simpson, 2009)) and frustration (reminding people of their limitations caused by their disability).
This section has showed that touchscreen devices have a lot of usability issues in terms of errors, efficiency and user satisfaction, which further shows that they are key Technostress stressors.

2.5. Conclusions

2.5.1. Key Issues

Through researching Technostress this literature review has identified some major issues. The first issue that was discovered is that stress is more in-depth than originally thought. Emotionally stress and Physical stress are the main types which influence people on multiple levels. Case studies show that both stress types can occur at the same time, further increasing the level of symptoms. Anything that triggers these types of stress are called stressors, with the physical and emotional consequences known as strain.

Technostress was explored in depth, showing that both computers and smart devices are key stressors, since they both cause people emotional and physical strain on multiple levels. The research suggests Touchscreen devices cause a higher level of strain than computers. Physical strain is higher due to awkward positions, poor keyboard layouts, overuse and use in lowly lit environments. Emotionally strain is higher due to portability (easier access to negative interactions (gambling)) and a variety of usability issues (including battery life, typing speeds, error handling, precision issues and poor content development tools).

Smart devices may be exciting and provide a variety of benefits, but the variety of stress that comes with it is staggering, especially regarding usability. This makes them a key stressor in this research on Technostress and a major issue.

2.5.2. Refined Research Questions

After researching in depth into Technostress, it has become very clear that smart devices are a main concern regarding stress. Since they are so frequently used and
widespread globally, the research questions will focus on these devices, to see how stressed they are making individuals. The literature review section on Usability was particularly interesting, seeing how various designed interfaces, interactions and hardware was affecting stress.

They were various techniques, such as new virtual keyboard layouts, finger blob recognition and battery technology that have been proposed in order to prevent these usability issues. It would be interesting to see if any of these techniques have reduced stress levels.

As a result, the research questions will focus on usability and smart devices, to see how influential it is on people today and if these usability problems are still causing stress.

3. **Research Methodology**

   3.1. **Introduction**

In order to conduct good research, a clear and justified research methodology needs to be in place (Jonker, 2009). This section of the dissertation will aim to do just that, through six important sections. These are the research strategy, data generation methods, data analysis, sampling, ethics and limitations.

Before any of these sections begin the aim of the research needs to be known. The literature review concluded that smart devices and usability came across as important factors in influencing Technostress. It also mentioned the fact that various techniques have been proposed in order to solve these problems (which would reduce stress). Therefore, the aim of this research is to see the level of stress which usability problems on smart devices are causing on individuals.

This is important as it will provide a useful insight on how influential these problems are today. If the stress levels are high, designers/developers can look into how to solve these issues and help reduce stress worldwide. This is also a good opportunity to see if
a certain usability feature is causing more stress than another. If so that feature can be a top priority for designers to fix, leading to a smart device which is more user-friendly and less stressful to use.

### 3.2. Research Strategy

The first stage in planning a research strategy is deciding which research style is best for the study. There are two styles, qualitative (more personal) and quantitative (more statistical).

The research style chosen for this study is a qualitative approach. This is best for this study as qualitative research is useful for studies on an individual level, seeing how people think and feel about certain issues (Mcleod, 2008, Minichiello, undated). In this case, the research needs to see how people feel about smart device usability issues, with the negative responses being associated with stress (Koeske, 1993).

Although the study will be qualitative, the results can be displayed in a quantitative way (CCU, 2010). For example, if 70 out of 100 individuals strongly dislike their smart device battery life, then a quantitative answer of 70% could be displayed.

Since the style of the research has been picked, the next factor to decide would be the method of study. There are a wide range of options including surveys, questionnaires, solo interviews, group interviews and observations (Mcleod, 2008, Winch, undated). The method of study which will be used for this research will be an online survey.

An online survey has been chosen as it is the quickest way to send out questions to multiple individuals at once, across multiple locations (wider participants), via the internet (Zhang, 2000, Granello, 2004, Wright, 2005). It is also more convenient and flexible for individuals, as they can answer the survey at any time they are free and submit it digitally, without the need to post it/physically hand it in. Online surveys also benefit the researcher as all questions can be organised in one place, making it easier to manage any necessary changes (Granello, 2004). Costs are also reduced (Wright, 2005) due to less printed material (surveys). Finally the survey results are
3.3. Data Generation Methods

Since online surveys have been chosen as the data generation tool to collect primary data, the next stage is to decide on the method/design of them. The online survey will be split into three parts: Demographical information, Rosen & Weil’s GATCS and finally 20 new questions on smart device usability and Technostress.

3.3.1. Rosen & Weil Question Justification

The Rosen & Weil GATCS question set has been chosen as it is the most relevant and useful out of the three measuring tools. This is because the other two sets (CTS & CARS) use terminology and questions which are outdated, and not relevant in modern times. For example, in CARS it is difficult for a person to record their anxiety for the question “Visiting a computer centre” since they don’t really exist anymore. Another example from CTS is the question “I am willing to give it a try”. This is irrelevant as more than 50% of jobs require you to use a computer (Microsoft, 2013) showing that people don’t have the option of “trying”.

The second reason why CARS and CTS will not be used is that in two recent Technostress studies (Mlotswa, 2013, Pusey, 2013) the majority of participants showed low levels of stress from these measuring scales. This means that reusing these scales would be wasting participant’s time, which would have been better spent on answering more useful questions.

3.3.2. Demographical Question Justification

The use of Demographical questions has been chosen as it provides a better insight to general information about a participant, which can help find useful trends in collected data. For example, knowing a participants gender can help identify if a certain stressful smartphone feature affects girls more than boys (or vice visa). This provides
not only an interesting statistic, but a foundation for further studies to be carried out to see why this feature is stressing a certain gender more, and how to solve this issue.

Another useful reason to collect demographical data is to show that a wide spread of international/national data has been collected. This can show interesting trends such as a certain region or even country having different or even the same levels of stress. If a different country isn’t as stressed with a feature, why is that the case? Have they been conditioned differently than other countries? Can we learn something from this? Many different relevant questions can be produced which could again be used for further study.

Finally demographical data shows the range of study and therefore the validity and veracity of the study. Validity & Veracity are some of the V’s of big data analytics (IBM, 2013) but it would be good practise to apply these to any data study. Validity is all about if the data is correct and justified (IBM, 2013). If the collected results have shown stress from international locations, the evidence is justified from the demographical data. Veracity is all about trusting the data (is the data complete, legal, consistent and from a quality source (IBM, 2013)). Demographical data acts as veracity based evidence as it helps to show consistency and completeness through the individual’s general data.

3.3.3. Custom question set Justification

The final set of questions to justify is the twenty custom created set. Although Rosen & Weil’s GATCS combined with demographical data is useful, it doesn’t go into enough depth into usability and smart devices. The GATCS questions itself are over 20 years old, meaning that it wasn’t designed with future smartphone technology in mind. As a result, it wouldn’t be an accurate indicator alone of measuring individual stress levels with usability and smart devices.

In order to solve this problem a custom set of twenty questions will be developed. Twenty questions have been chosen as it is the same amount that the GATCS has on its survey. This allows the question sets to keep consistency between them, which is
good survey design (Kelley, 2003). It is also good practice to follow a de facto standard (Nielsen, 1999), meaning that if twenty questions worked for Rosen & Weil, in theory it will work for this study also.

3.4. **Survey Design**

In order to have a good survey design, and ensure that primary data is collected in an effective way, a reliable scale needs to be followed. As mentioned above, consistency between question sets is good design (Kelley, 2003). As a result, the custom twenty questions will follow the Likert scale, the same way that GATCS does. This means that each question can have five possible answers. These are Strongly Agree, Agree, Neutral, Disagree and finally Strongly Disagree.

The Likert scale was developed in order to measure a person’s attitude (Mcleod, 2008). Since the questions on usability need to see how people feel about smart device features, it makes this scale most relevant to use.

The custom twenty questions themselves will be based on the key Smart device usability issues which were explored in the literature review. These are precision and accuracy issues, battery life, errors, health issues and content creation.

The GATCSs Questions will use an algorithm created by Rosen & Weil to work out the Technostress levels (Figure 5).

\[
\text{GATCS (Form C):} \\
\text{No Technophobia} & 64-100 \\
\text{Low Technophobia} & 56-63 \\
\text{Moderate/High Technophobia} & 20-55
\]

Figure 5: The GATCS Algorithm (Rosen, 1997)
3.5. **Data Analysis**

In order to find trends and patterns in the data (levels of stress), some form of data analysis will need to be carried out. This will have to be done on a protected IT system, since any personal data collected needs to be secure under the data protection act (1998). As a result all analysis will be carried out in the University of Derby’s labs. The data itself will need to be shown in a format which can be understood easily and quickly by anyone (SAS, undated). The best way to do this is to present it in a graphical way such as on a pie chart or bar graph. Data visualisations are an art (SAS, undated) and should display data in a way which is most helpful and not misleading, which is what this study will do.

All of the analysis process (from importing data to usefully displaying it) is made easier with the aid of computer software. There are many available which can do the job but specialist analyst software is usually the way forward. As a result the software chosen to analyse and display the data will be SAS.

3.6. **Sampling**

In order for this study to be useful, there needs to be a decent sample size. Ideally, 200 participants would be the minimum to see the level of stress across individuals. The exact amount of results which will comeback is unknown. This is because the survey will hopefully be shared around the internet, across multiple networks, in order to increase the sample size. The bigger the sample size, the more valid the data will be (UFS, 2011). Another benefit of the survey ending up anywhere is that it is true randomisation. Randomisation helps prove that a study has got a big enough range of population factors (location, gender, age, and culture), which decreases the studies bias and increases its validity (Nelson, 2011, UFS, 2011).

The samples taken will be mostly from the UK, but the online survey may be passed around international territory (which is why country will be included in the demographic questions).
3.7. **Ethics**

This study will follow the University of Derby’s Code of Ethics for Research (see URL below).

http://www.derby.ac.uk/research/uod/ethics/

3.8. **Limitations**

Although this methodology has been based on academic theory, the study could have been better if it wasn’t for a certain limitation.

This limitation is contacts. This survey will be spread out to the population via friends and relatives. This is very helpful and appreciative but it is not certain that everyone will fill in the survey and send it on (Snowball effect). It would be more beneficial to have contacts in big organisations. These contacts could send the surveys out to their employees and their families (since employees only would be a biased sample) in order to help increase the sample size.

3.9. **Conclusions**

This study’s success rate will rest upon the amount of participants who fill in the online surveys. As long as the sample size is adequate there is a good chance that this study will be a very useful indicator to current Technostress levels, and more importantly, if usability and smart devices are in fact a major factor.

4. **Findings and Analysis**

4.1. **Introduction**

In this section the findings and analysis results will be shown and explained. In total, 207 participants responded to the survey, with 180 usable results. The 200 usable results aim was unfortunately not met. However, psychologist show that a study is
useful with a minimum of 100 useful results, which means this study is still credible and can show some useful data.

These 180 usable results will be visually shown on several graphs (created in SAS), each displayed in the best way to show the type of stress (if any) which is occurring. The analysis results will be split into two main sections. The first will be the GATCS results and the second will be the Smart Device Usability and stress results. Any useful demographical information that has been found through analysis will also be shown. Although ethnicity and country were included in the demographics section of the survey, around 95% of participants were white and from England. As a result these demographic factors are not useful and won’t be displayed.

4.2. Analysis

4.2.1. GATCS FINDINGS

This section shows the GATCS findings. Four pie charts have been created in order to visually show the data. The charts show GATCS results by overall participants, gender, age range and computer experience.
Graph 1: GATCS by overall participants

This graph shows that over half of participants are experiencing moderate-high levels of Technostress and around 90% of participants are feeling some form of Technostress. With only 8.89% showing no technophobia (Technostress), this is a huge increase from Rosen and Weil’s (1995) study showing 64% of participants with no Technophobia.

Graph 2: GATCS by Gender
This graph shows that males are showing higher levels of Technostress than females. This is unique as normally females show higher levels of Technostress (Smith, 2013, Pusey, 2013). Females are showing more low stress than males.

This graph shows that the 19-30 Age range are showing the highest levels of Technostress, with the 31-50 Age range being second highest. As a result, 19-50 is when an individual is most likely to show high stress levels. The 51-70 age range is more likely to be highly Technostressed than
the 0-18. Interestingly, 0-18 are showing the highest levels of low stress, when the
group hits 18 the stress levels hit a critical point and become high. 51-70 show the
second highest low stress, showing that after 50, the levels of Technostress start to
reduce. The highest group with no Technostress is the age range 51-70. It is important
to note that low responses from the 51-70 and 0-18 age groups make the data not
reliable for any correlation to be based on.

Graph 4: GATCS by Computer Experience

“General Attitudes Towards Computers Scale”
*(Percentage of TechnoStress level from participants by Computer experience)*

Graph 5: GATCS by Computer Experience

“General Attitudes Towards Computers Scale”
*(Percentage of TechnoStress level from participants by Computer experience)*
This graph shows that intermediate computer experience users are the most likely to get high Technostress levels. This is followed by Expert users and then basic users. Interestingly, low stress is high for basic users, with expert having the second highest in this factor. Expert users have the lowest No Technostress percentage, meaning there are more likely to have some form of Technostress compared to the other types of computer experience. Again it is important to note that expert response levels are low the data isn’t reliable enough for any correlation to be based upon.

4.2.2. **Smart Device Usability and Stress Results**

This section shows the smart device usability and stress results. The results are shown on bar charts using percentages, in order to effectively display the participant’s answers in detail for each question. There are 20 main bar charts, one for each questions’ overall participant results. A few additional charts are displayed with demographic data, which have shown some interesting results.
Graph 5: I am happy with my Smartphones battery life

This graph shows that most people disagree with the statement, and are unhappy with their battery life. It is important to note that a lot of people are happy with their battery life though. The deciding factor would rest on the strongly columns. Since more people are strongly disagreeing with the statement, it shows that most people aren’t happy with their smartphones battery life. Since the results are very close, the data isn’t reliable to provide any useful correlations.
Graph 6: I am happy with my Smartphones battery life (Age Range)

This graph shows that the age range most likely to be happy with their battery life is 19-30, who have high percentage responses of agree and strongly agree. It is interesting that 31-50 has a higher percentage of disagree responses than 19-30, showing that this age group are less happy with their battery life than the others. 0-18 have a high percentage for liking their battery life, although responses are too low to create useful correlations. The 51-70 results have an even percentage on both like and dislike. Since the response levels are low, this isn’t a very reliable indicator, meaning that correlations will not be accurate.
Graph 7: I am happy with my Smartphones battery life (Gender)

This graph shows that the range between like and dislike is higher on males compared with females which is rather close. As a result, males in this survey sample are more likely to be unhappy with their smartphones battery life.

Graph 8: I am happy with my Smartphones battery life (Computer experience)
shows that Intermediate computer experience users are more likely to dislike their battery life, with higher percentage responses for both disagree and strongly disagree. Overall intermediate users agree that they like their battery life the most, but it is isn’t credible due to low percentage responses for the other experiences.

Graph 9: I charge my smartphone more than once a day

This graph shows that most people do not charge their smartphone more than once a day. The level of people strongly agreeing with the statement though is higher than those strongly disagreeing with the statement. There is only a 10% difference between liking and disliking battery life, showing that there isn’t enough to suggest a correlation.
Graph 10: When choosing a new smartphone, battery life is an important factor

This graph shows that the majority of participants agree with the statement, and look for a smartphone which has decent battery life. It is even more interesting that more people strongly agree with the statement than disagree or strongly disagree. Since over 50% of participants either agree or strongly agree with the statement, there is a good chance that this result is reliable and represents how people truly feel.
Graph 11: I use power saving apps to increase my smartphone’s battery life

This graph shows that most people disagree with this statement and do not use power saving apps. More people strongly disagree than agree or strongly agree with this statement, showing that the amount of people who actually use power savings apps are few. Since over 50% of participants either disagree or strongly disagree with the statement, there is a good chance that this result is reliable and represents how people truly feel.
Graph 12: I feel disconnected from the world when my smartphone battery is dead

This graph shows the most people agree with this statement and feel disconnected when their phone battery is dead. It is interesting that the second highest response is strongly agree, showing that smartphones are now a key tool that people are stressed without. The percentage of respondents who disagree with the statement is only 9% lower than agree, showing that this might not be an accurate indicator. This can be counteracted though since 27% strongly agree and only 8% strongly disagree, showing that the majority of people agree, so there could be a good correlation.
Graph 13: I tap the screen multiple times in order to open an app on my smartphone

This graph shows that the majority of people disagree with the statement, and that they can open an app on the first try. It is interesting as a previous study in the literature review showed that it took people multiple attempts (Barras, 2009). The agree and strongly agree answers still combine to 27% though, showing that nearly a third of people are still having difficulty with small icons on smartphones.
Graph 14: Tapping small icons on my smartphone does not frustrate me

This graph shows that most people agree with the statement, and are not annoyed with tapping small icons on smartphones. It correlates nicely with graph 13, showing that small icons are not a majorly important factor in Technostress and usability. This is reliable since the agree percentage is very high, compared to the relatively low disagree.
Graph 15: I find it easy to type quickly on my smart device

This graph shows that most people (57% when strongly agree and agree are totalled) find it easy to type quickly on their smart devices. This high amount of percentage responses shows that this could be a reliable correlation.

Graph 16: I can quickly go where I want to on my smart device
This graph shows that most people think smart devices are good for navigation, a key usability feature. More people strongly agree than disagree and strongly disagree combined, showing that navigation is widely accepted as good by the majority, making it a reliable percentage of responses.

Graph 17: The autocorrect feature on my smart device is very helpful

The majority of people agree that autocorrect is useful on their smart devices. With the amount of errors shown by autocorrect in the daily mail (Edwards, 2011), this is strange that people think this. Oddly, a large majority of participants stated neutral as a response. Whether this means that they find some aspects of it good and some bad, or that they don’t know what autocorrect is, is currently unclear.
Graph 18: I often send a text without double checking what I typed

This graph shows that most participants agree, and send texts without checking what they typed. The strongly agree response is higher than the disagree response, showing that most people in this study do send texts without proof reading. It would explain why the high levels of texts sent contain errors (Edwards, 2011). Since the percentage response is high for the agree columns, this data is likely to be reliable.
These graphs show interesting results in that regardless of age or gender, most people send a text without proofreading.
Graph 20: I frequently send texts with words that autocorrect changed

This graph shows that most people agree that autocorrect has changed words in texts that they send frequently. What is strange about this is that graph 17 showed that most people find autocorrect useful. A high number of people disagree with the statement, meaning that it is not a highly reliable that autocorrect is a usability issue.
Graph 21: I frequently send texts with words that autocorrect changed (Age Range)

This graph shows that the 19-30 age range are the most to agree with sending words which autocorrect changed. Interestingly, the 31-50 age range is even on both agree and disagree, showing that these mistakes are reduced for some reason at this age. The 51-70 age range shows that they disagree more than agree with the statement. As a result, they send the least errors that autocorrect has changed. This graph shows that age is a factor in errors, and that as a person gets past 50, the errors decrease. Although it is interesting to see this, the results are too few in 51-70 to be seen as reliable.
Graph 22: I frequently send texts with words that autocorrect changed (Gender)

This graph is interesting as it shows that females are most likely to send words that autocorrect has changed compared to males. The range between agree and disagree is bigger with females (12%), whereas with males the range between these responses is smaller (1%). The Males disagree response is highest, although the agree percentage is very close in responses, meaning that the data is not reliable enough to suggest that men are less likely send autocorrected changed words.
Graph 23: I frequently send texts with words that autocorrect changed (Computer experience)

This graph shows that participants with basic computer experience send less autocorrected changed texts than those with intermediate experience. This is interesting as most would think that the more experience, the less errors would be made. This is further shown with experts sending more autocorrected changed texts than basic participants. The responses for computer experience are too few for expert, meaning that a reliable correlation cannot be made.
Graph 24: I rely on my smartphone for more than just calls and texts

This graph shows that participants strongly agree with this statement the most, and use their smartphones for more than just calls and texts. The second highest response is agree, showing that the levels of using smartphones for multiple tasks is very high. Around 80% of participants use their smartphone for more than calls and text, which is a highly reliable source of data.
Graph 25: I find it difficult to create a document with lots of text on my smart device

This graph shows that most people either agree that it is difficult to create documents with lots of text on their smartphone, or are neutral on the subject. The strongly agree response is high, showing that overall combined, people think that it is difficult to create the documents with lots of text. The neutral column being high could show that participants do not create any documents on their smart device.
Graph 26: My smart devices on-screen keyboard often gets in the way

This graph shows that most people disagree overall that on-screen keyboards get in the way. The results are very close though, with agree and neutral being at very high response levels. Strongly agree and strongly disagree are also the same on responses. The fact that the levels are so close means that there isn’t a high enough correlation to prove that the statement is agreed or disagreed by people overall.
Graph 27: I prefer texting on my smartphone in landscape rather than portrait

The graph shows that most people disagree and strongly disagree with this statement, and prefer texting with their smartphone in portrait. This makes sense as the screen size is bigger, and allows the participant to see the screen easier. This is interesting as graph 18 shows that most people don’t proofread whilst texting, so it raises the question, would the screen display size even matter?
Graph 28: I prefer creating a document on my smart device rather than my computer

This graph shows that participants mostly strongly disagree or disagree with the statement, and prefer creating documents on their computers rather than smart devices. There are high enough results to suggest this correlation to be true for this study.
Graph 29: My fingers/hands hurt after using my smart device for long periods

The graph shows that most people disagree with this statement, and do not experience forms of RSI from using smart devices. This is very strange considering that the amount of RSI has been increasing rapidly since smart devices came out. This graph shows that there is a negative correlation with RSI and smart devices. Looking closer at the data, there is a 10% difference between disagree and agree, which isn’t a high enough to suggest that this correlation is reliable.
Graph 30: My fingers/hands hurt after using my smart device for long periods (computer experience)

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This graph shows that participants with expert computer experience have the same responses for agree and disagree. It is unusual as most people would think expert users would suffer RSI more as they have been on computers longer than others. The majority of results for each computer experience on this graph show that computer experience doesn’t seem to have a correlation with RSI.
Graph 31: I rarely get eye strain from using my smart device

This graph shows that most people agree with the statement, and rarely get eye strain from using smart devices. This is interesting as the number of eye strain cases being reported since smart devices were released have increased. This graph would show negative correlation between eye strain and smart devices.
Graph 32: I rarely get eye strain from using my smart device (computer experience)

This graph shows that the levels of agreeing with the statement are high, regardless of computer experience. Like graph 30, this is interesting as most people would think that eye strain would be higher with experts, since they are using the devices more.
Graph 33: I use my smart device at night in the dark or lowly lit rooms

This graph shows that the majority of people agree or strongly agree with the statement, and use their smart devices at night or in low lighting. This is very interesting as graph 31 shows that the levels of eye strain by these participants are low, yet in this graph, the majority of participants are using the devices in dark locations. There is high enough percentages for the agree columns to suggest that this is a reliable response.

4.2.3. GATCS and Smart Device Comparison

This section compares the smart devices results with the GATCS scale to see if smart devices and usability have an impact of Technostress levels (according to the GATCS scale).
Graphs 34: GATCS V Smart Devices and Usability Comparison

1. I am happy with my smartphone’s battery life
   (Regression Line with GATCS)
   - Levels of happiness: Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree

2. I charge my smartphone more than once a day
   (Regression Line with GATCS)
   - Levels of high and low technology

3. When choosing a new smartphone, battery life is an important factor
   (Regression Line with GATCS)
   - Levels: More people prefer high technology

4. I use power-saving apps to increase my smartphone’s battery life
   (Regression Line with GATCS)
   - Levels: More people prefer high technology

5. I feel disconnected with the world when my smartphone’s battery is dead
   (Regression Line with GATCS)
   - Levels: More people prefer high technology

6. I tap the screen multiple times in order to open an app on my smartphone
   (Regression Line with GATCS)
   - Levels: More people prefer high technology

7. Tapping small items
   (Regression Line with GATCS)
   - Levels: More people prefer high technology

8. I find it easy to type quickly on my smartphone
   (Regression Line with GATCS)
   - Levels: More people prefer high technology

9. I find it difficult to create a document with lots of text on my smartphone
   (Regression Line with GATCS)
   - Levels: More people prefer high technology

10. I prefer creating a document on my smartphone rather than my computer
    (Regression Line with GATCS)

11. I prefer texting on my smartphone in landscape rather than portrait
    (Regression Line with GATCS)

12. My fingers/hands hurt after using my smartphone for long periods
    (Regression Line with GATCS)
All of these graphs show that there are no Technostress levels associated with these questions, according to the GATCS. This is interesting as the smart device and usability questions very much show levels of traditional stress, according to all of the literature review research and the individual bar chart results. For example, the question “I am happy with my Smartphones’ battery life” shows that 43% of participants are unhappy with battery life. The literature suggests that unhappiness is a negative emotion and is therefore a form of emotional strain (APA, 2013). As a result, Battery life is showing stress according to academic Psychology theory. The literature review also states that satisfaction is a key usability factor (Katz-Haas, 1998, Nielsen, 2012). Since 75% of participants find it difficult to create documents on smart devices, it shows that smart devices have low satisfaction on this usability component scale. The literature suggests that having low ratings on this scale causes stress to individuals (Katz-Haas, 1998, Nielsen, 2012). Since stress is shown from these smart device and usability questions according to academic psychological theory and the usability components, it raises the question, is GATCS a reliable indicator for researching stress levels with regards to usability and smart devices? As a result, using the GATCS algorithm, a new stress scale will be tested, totalling all of the smart device and usability questions (taking into account positive and negative scoring), in order to work out a new stress score. This new score will be compared to GATCS, to show if it is still reliable.
4.2.4. The new smart device usability question score (SDUS)

This section displays the analysis results for the new smart device usability scale.

Graph 35: SDUS

The new stress scale shows that 80% of participants are showing some form of stress from the use of smart devices. 40% of participants are showing medium-high stress and another 40% are showing low levels of stress. As a result, smart devices and usability can be seen as Technostress stressors. Again it is interesting that when compared to GATCS originally (graphs 34), there was no correlation between smart devices and stress levels, yet here it shows that stress levels are as high as 80%. This again raises the issue of GATCS as a reliable measuring tool for smart device and
usability stress levels. The GATCS pie chart (graph 1) shows that the Technostress levels are interesting similar to the results in this graph. 40% of participants showed low levels of Technostress in both GATCS and SDUS. 52% of participants showed moderate to high levels of Technostress in GATCS whereas the levels are lower in SDUS at 40%. This shows that there are similarities between the two.

Graph 36: GATCS V SDUS Line graph

This line graph shows that there are huge differences between GATCS and the new SDUS scale. It is interesting as they are both showing levels of stress in participants, but with no correlation between them when compared. As a result, it further shows that GATCS alone isn’t reliable enough to detect Technostress levels for Smart devices.
This scatterplot shows that there is no correlation between the GATCS score and the SDUS score. It shows similar results to when GATCS was compared to each SDUS question individually (graphs 34). It is strange as both the GATCS and SDUS individually show high levels of stress, but when compared there is no correlation. It again shows that GATCS may have become an unreliable indicator.

4.3. **Result Conclusions**

4.3.1. **GATSC RESULTS**

This conclusion summarises the key GATCS results. The overall percentage for GATCS participants with some form of Technostress is 91.11%. Out of that 91.11%, 52.78% of participants are showing moderate to high levels of Technostress. This is a high number and shows a positive correlation between technology and stress. As a result this is worrying, as the stress levels are high which means that lots of individuals will be showing all sorts of strain (negative consequence of stress). Males are experiencing a higher level of Technostress than females, with 59% of males
showing moderate-high levels compared to 50% female. This is unusual as most previous studies show females having the higher levels of Technostress. Regarding age groups, 19-30 shows the highest percentage of stress with 59.9% moderate to high, with 31-50 having the second highest level at 56.36% moderate to high. As a result, adults are experiencing the most Technostress between ages 19-50. Interestingly, 0-18 has the highest percentage of low Technostress at 64.71%. Some important life change around 18-19 is occurring which is turning these low stress levels to high. The highest moderate-high Technostress percentage by computer experience is the intermediate user at 60.58%. Although the expert user is second highest in moderate-high (50%), it is not an accurate indicator due to the low response rate for expert users. Finally basic users have the highest low Technostress percentage at 50%. For some reason this level turns moderate to high when the computer experience turns to intermediate. All of these interesting results will be explored in detail the discussion section.

4.3.2. Battery life Results

The first set of questions was on battery life. Overall most people in this study aren’t happy with their battery life, although the results are close so the reliability isn’t high. The age range most likely to be happy with their battery life is 19-30 whereas 31-50 are the ones most likely to dislike theirs. Males also dislike their battery life more than females. Most people do not charge their smartphone more than once a day, although around a third of participants charge their smartphone more than once a day, which is very high, and would explain why most people dislike their battery life. It is no surprise after these results that over 50% of participants choose a new smartphone based on battery life, showing it is now an important usability feature. Over 50% of participants do not use power saving app, showing that these stress levels can be limited if more people used them. Finally the majority of participants agree or strongly agree that they feel disconnected from the world when their battery is dead, further proving that battery is a key usability stressor.
4.3.3. **Precision and accuracy issues Results**

The second set of questions was on precision and accuracy issues. Over 55% of participants do not tap smartphone screens multiple times to open applications. Around a third of people still have issues with multiple taps though. Next over 50% of participants are not frustrated by tapping small icons. 57% of people can navigate to wherever they want to go on their smartphone easily. 57% of people also find it easy to type quickly on their smartphones. These results are all high percentages, with most people happy with their smartphone accuracy/precision. As a result, accuracy and precision are not high usability stressors.

4.3.4. **Error results**

The majority of people agree that autocorrect is very helpful on their smart device. Strangely the levels of neutral were 1% lower than agree. Whether this means that participants find some aspects of autocorrect good and some bad, or that they don’t know what autocorrect is, is currently unclear. As a result this response is too unclear to provide any useful knowledge. Over 60% agree/strongly agree that they send a text without checking what they typed. Gender and age have no effect on this. This shows that human error is high and more proofreading needs to be carried out. The majority of people send texts which autocorrect have changed. This shows that errors are high on smart devices, both by human error and by autocorrect itself. As a result, errors are a stressor, but is this the users fault or the device? The age range which send the most autocorrected changes are 19-30, whereas 31-50 are even on disagree and agree for this statement, showing that something changes participants when they hit 30. Interestingly females are more likely to send these changes than males, with males in fact having not sent errors more than sent overall. Ironically it is the basic user who sends the less errors in texts, compared to the other computer experienced users. Due to all of these factors errors are a key stressor, but it is unknown whether this is because of users or the devices.
4.3.5. **Content Creation Results**

80% of participants use their smartphones for more than calls and texts, showing that these devices are now being relied on more and more for different interactions. Over 50% of participants find it difficult to create documents on their smart device, making it a key stressor if people are forced to use it. There is a 5% range between participants being annoyed, neutral and happy with on-screen keyboards, which shows that this study isn’t accurate enough to make any correlations on this point. Over 60% of participants prefer typing in portrait rather than landscape, which shows developers which usability orientation, is best for users. It is interesting that people prefer more screen space for texting yet do not look over at what they are typing. Over 80% of participants prefer creating documents on computers rather than smart devices. This means people would be stressed if forced to use a smart device for creating content.

4.3.6. **Health Issues**

Strangely, most participants disagree with their fingers/hands hurting after using smart devices, despite the increase since smartphones were released. The difference between agree and disagree is only 10%, showing that it is not accurate enough to make any hypotheses. Computer experience doesn’t seem to have a correlation with RSI. The results for eye strain are similar, with the majority of percentages disagreeing with having it after using their smart device. The difference between agree and disagree is much higher though than the previous RSI question. Again computer experience had no effect on the eye strain results. Finally over 75% of participants use their smart devices in low lighting or dark rooms. It is strange that the percentage of eye strain is low since this questions numbers are high. The health issue with smartphones in this study seem to be low, as a result they are not a key Technostress stressor for this study.

4.3.1. **GATCS and Smart Device Comparison**

The results show that there are no Technostress levels with smart devices and usability according to GATCS. However, since stress is shown from the smart device and
usability question bar graphs, according to academic psychological theory (APA, 2013) and the usability components (Katz-Haas, 1998, Nielsen, 2012), and with the new SDUC scoring, it raises the question, is GATC a reliable indicator for researching stress levels with regards to usability and smart devices? The discussion shall explore this in more detail.

4.3.2. The new Smart device and usability scale (SDUS)

The new scale showed that 80% of participants are showing some form of stress with smart devices. As a result usability issues and smart devices can be seen as stressors, agreeing with the literature research. It is interesting that the results levels are similar to GATCS, with 40% of both studies showing low levels of Technostress. When compared on a scatterplot, there is no correlation between GATCS and SDUS, even though they both show high levels of stress individually, using the same GATCS algorithm. It again raises the question, is GATCS a reliable indicator?

5. Discussion

5.1. Introduction

This section will discuss the 6 key areas of results in more detail (GATCS, Battery life, precision and accuracy, errors, content creation and health), using previous knowledge gained from the literature review, in order to see the impact smartphone features have on this studies individual stress levels.

5.2. Discussion: GATCS

This section will be discussing GATCS and what the results really mean. The first issue to discuss would be the high change in Technostress levels since the Rosen and Weil study (1995). The Rosen & Weil study showed that 64% of participants had no Technostress, whereas in this study only 8% of people show no Technostress. In 19 years the levels of Technostress have increased by 56%, so what could be causing this increase? The second issue to discuss would be the age range of which stress is
occurring. 0-18 year olds have the highest levels of low Technostress, and for some reason it is turning to moderate - high levels at 19-30 onwards until 50-70. Why is this happening? The final issue to discuss will be the link between Technostress and computer experience. Basic experienced users are showing the highest levels of low Technostress, which is turning to moderate – high levels as an intermediate. Is this important?

5.2.1. **GATCS Technostress increase: Over Reliance on Computers**

The main reason for the increase in Technostress levels could be that the reliance on computers has increased since 1995. Computers are not just a tool for work anymore, but a device which is used in every aspect of life (Venkatesh, 2011). This includes games, communication, content creation, research, banking, shopping, analysis, entertainment and much more. As a result, the numbers of people who own a device has increased from 22% in 1995 to 75% in 2011 (figure 4).
Since people are now relying more on computers for everyday tasks, they are more likely to experience new ranges of stress (emotional and physical) associated with tasks, which weren’t present before computer reliance.

For example, take a secondary school student with an essay to write. Most school essays now have to be written in a digital format. The student can come across several common problems which can hinder the essay process which didn’t exist previously with pen and paper. These include computer crashes, the device already being used by another family member, no ink left to print the essay or even power cuts (to name a few). As a result, the student can experience frustration until the problems are solved and anxiety whilst waiting. The literature review suggests these negative emotions are emotional strain (Koeske, 1993), which is a consequence of stress. On the other hand, what if the student had constant computer access to write the essay? According to

Figure 4: US Computer Ownership between 1984-2011 (File, 2013)
Peper (1999) prolonged use on computers can cause physical strain such as eye strain and RSI. This is another strain, further showing that the increased reliance on computers since 1995 is causing more stress.

This is only one example, other stress associated with reliance on computers include information overload (Stone, 2013), additional costs (hardware, software, internet providers), health issues (Pepper, 1999), increased addictions (Dawson, 2013), obesity (Boreland, 2011) and more.

Computers are a great tool for many tasks, but people are so keen on the benefits of the digital age, that they have become oblivious to the stress which has clearly been added by this overreliance on computers, leading to both physical and mental strain. More tasks and interactions are becoming digitalized every year (Green, 2010) with the internet of things connecting every device (Brewster, 2014). This will only increase humanities reliance on technology. It raises the question, if stress levels have increased by 56% since 1995, how much will it increase in another 19 years with further technology reliance?

### 5.2.2. GATCS Technostress: The Age Range Factor

The next issue to discuss would be the interesting age range correlation which is shown in the results. The results showed that 0-18 had the highest levels of low Technostress and that 19-30 had the highest levels of moderate – high Technostress levels. First of all, why is the highest level of low Technostress in the 0-18 age range?

The literature would suggest that it is because this group is part of the digital generation, growing up with technology since a young age (Gros, 2012). This generation has used technology frequently at every stage of their development (Coughlan, 2011), but since they use it so frequently, why are the stress levels only low instead of moderate to high?

One reason could be the way in which this age group uses technology and is conditioned to it. As a teenager or child, technology is used for more entertainment
and social purposes than anything else (Nielsen, 2013, Rowan, 2013, Perle, 2014,).
Whether it’s playing video games between school, communicating with friends over
social networks or listening to music on YouTube, this age range uses technology
mostly for entertainment/social reasons. The only work related technology would be
essays/research for school or college projects, which aren’t on a daily basis.
Entertainment and social communications are generally considered as positive
interactions (Perle, 2014). As a result, the knowledge gained from the literature review
would suggest that teenagers/kids are operant conditioned to associate technology
with positivity (Skinner, 1938). Although these interactions are generally positive,
stress does exist in these areas. For example, a teenager could be frustrated when he
can’t complete a level on his PlayStation or his YouTube video is buffering slow due
to poor connectivity. Another example could be a girl feeling anxious because the boy
she likes isn’t messaging her back as quickly as before. These are all common teenage
problems associated with technology on a daily basis. Since the negative emotions are
in low form (e.g. anxiety not fear), the literature would suggest the stress is acute
(Bailey, 2008, APA, 2013). As a result, the GATCS levels are high on low
Technostress levels, due to acute stress associated with technology being present
regularly in teenagers. Since this is the case, the term “Acute Technostress” will be
proposed for low Technostress.

As a result of the above “Acute Technostress”, the level of stress could be higher in
the 19 - 30 age range because the way they use technology is causing either episodic
acute or chronic stress. This is because at this stage in life technology isn’t just used
purely for entertainment or social reasons. These kids/teenagers are older and are now
in the world of higher education or the work place, where technology is used on a
daily basis for more complex tasks such as dissertation research, daily document
creating, constant email replying and report writing. There are many studies/articles
showing that using technology at work increases stress levels (Mill, 2010, Burley,
2011, Simoes, 2013). The use of technology for more than just fun and
communication would likely increase the stress levels from low to moderate – high
when teenagers enter the world of work. As a result, the knowledge on stress from the
literature review (Skinner, 1938) would suggest that technology is operant conditioned as a negative reinforcement, forming internal stressors in this age ranges minds.

Another reason for the high percentage of low stress levels could be the psychological development of this age group. Since 0-18 year olds are young, they are still developing mentally (emotionally & behaviourally). They are learning everyday through educational and social interactions. As a result, most have never experienced “true” stress as their life experiences are minimum compared to those aged 19-30 and 30-50, who experience higher levels of stress. Age range 19-30+ have to worry about paying bills, finding jobs, work deadlines, in-depth relationships and other daily worries that most 0-18 year olds are too young to experience. These anxieties individually are all forms of acute stress (Bailey, 2008, APA, 2013). As a result, any acute stress gained from technology in adults, would be higher than teenagers and kids as it is combined with these other anxieties, creating higher forms of acute stress, which is known as episodic acute stress (APA, 2013).

5.2.3. GATCS Technostress: The Computer Experience Factor

The next GATCS result to discuss would be the fact that intermediate computer experience shows the highest levels of moderate – high Technostress (60%). Why is this? Intermediate experienced users are likely to have the highest stress levels, as they are the most common user out there and have varied experience levels. Expert users are used to computer systems and can usually adapt quite quickly to new changes, whereas basic users are just happy enough to achieve a simple task, regardless of how long it takes (Galitz, 2007). As a result, these experience groups are less likely to be as stressed as the intermediates in between who differ greatly in computer knowledge. In the literature review, Loyd & Loyd (1985) and Rosen & Weil (1995) showed that computer experience is negatively related to computer anxiety. This study agrees with their findings as it shows intermediate and expert users are
more stressed than basic users. As a result, it is important to recognise that training an 
individual to use a computer is not enough to remove their anxiety of them.

The literature review suggests that internal stressors are formed by our own thoughts, 
beliefs and experiences (Cooper, 2000, White, 2013), through classical (Watson, 
1920) and operant conditioning (Skinner, 1938). As a result, each individual 
regardless of experience will only decrease their anxiety of computers due to their 
own positive reinforcement. Whether this is through years of personal experience, a 
certain feature or concept just “clicking” or explanations from the right person 
(friends, relatives, colleagues or teachers), it will take time to condition positivity into 
people’s minds.

5.3. Discussion: Battery Life

This section will be discussing and exploring the battery life associated question 
results in more detail, seeing if battery life is causing stress any way, even though the 
comparison shows it is not causing technostress.

5.3.1. Battery Life: Happiness Factor

Overall, the results showed that 38% of participants are happy with their battery life, 
and 43% of them dislike their battery life (with the rest responding neutral). These 
results are very close showing that there isn’t a big enough gap to suggest that the 
majority of people dislike their battery life. However, 43% is still a high percentage of 
people who dislike their battery. That is still over a third of people who are unhappy. 
The knowledge gained from the literature review suggests that satisfaction is a key 
usability component (Katz-Haas, 1998, Nielsen, 2012). As a result, since over a third 
of people are unhappy with battery life, it is a poor usability feature. The literature on 
stress also suggests that unhappiness is a negative emotion, which as a result is 
emotional strain (Soloman, 2008, Naylor, 2011, APA, 2013). Since battery life can 
causes emotional strain, the literature would suggest it is a stressor (Lazarus, 1984, 
Mcleod, 2010).
The results also showed that nearly a third of participants charge their smartphone more than once a day. Although this isn’t the majority, it is still a lot of people who use their smartphones so much, that the battery life drains regularly. 56% of participants agreed that they feel disconnected from the world when their smartphone is dead. With more people increasingly relying on their smartphones for all aspects of life (Fisher, 2009, Metri, 2012b), this number is likely to increase unless battery life can keep up with Moore’s law. As a result, it is no surprise that over 50% of participants purchase a new smartphone based on how good its battery life is, agreeing with the report by J.D Power (2012).

5.3.2. Battery Life: Controlling Stress Factor

With battery life now seen as a stressor, the question would now be who can control this stress? The results showed that only a third of people use power saving applications on their smartphones. This shows that the majority of people do not use these power saving applications. Why aren’t people using them? One reason could be that they are not promoted enough, and that their awareness needs to increase. Another reason could be that most of these apps are created by third party developers, and with so much trust issues associated with apps these days (MC, 2012), people are too anxious (more acute stress) to use them, in case any extra unwanted content is installed with the app. As a result should mobile phone providers such as Samsung, Sony and Apple, be developing and promoting these apps themselves, in order to reduce stress?

The literature review stated that developers/academics had come up with several solutions to save power on smartphones. These were power saving apps (Zahid, 2011), encouraging programmers to program more efficiently in order to save memory (Jae, 2011) and finally hardware which is more energy efficient (Kosner, 2014). Mobile phone providers should be exploring these solutions, in order to help their customers have the highest satisfaction with their devices. If they don’t stress levels are likely to increase.
5.4. Discussion: Precision and Accuracy

This section will discuss the precision and accuracy results further. In the analysis, it was concluded that precision and accuracy issues are not a usability stressor. This is because 57% of participants can navigate wherever they want to go quickly on their smartphone, and also 57% of people find it easy to type on their smartphone. It was further disproved as a usability stressor since over 50% of participants were not frustrated by small icons and do not tap them multiple times to open an app.

It is interesting that small icon on smartphones were not causing problems in this study. This is because the literature review explored several studies on fingertip blob recognition (Ravoor, 2012, Ahsanullah, 2010, Barras, 2009), which stated that users found touching small touchscreen icons difficult and frustrating. This could mean two things. The first could be that the new fingertip recognition techniques (Ravoor, 2012, Rohani, 2012) or existing techniques have been implemented/improved on since the previous studies, decreasing user’s frustration levels. The second could be that this survey sample collected participants who generally didn’t have this problem. Until a larger survey is carried out with more participants, it is currently unknown if stress levels with touchscreen precision has decreased.

The second interesting point is that since 57% of people can navigate where they want to easily on their smartphone, it shows that touchscreens are a good interface for navigation. The literature on usability suggested that quickly preforming tasks is part of efficiency, a main usability component (Katz-Haas, 1998, Nielsen, 2012). As a result, since the navigation is good on smartphones it is a good usability feature, showing touchscreens actually reduce stress since they save users time. This agrees with IBM (2011), who states that their SurePoint retail system is quick to navigate, due to its touchscreen interface.

The final point would be that 57% of people find it easy to type on their smartphone. The literature on usability states that learnability is a key usability component (Katz-Haas, 1998, Nielsen, 2012). As a result, since smartphone typing is easy to learn, it
reduces stress as no training is needed. Finally this study contradicts a report by Tactus Technology (2013) and another online research survey (Claburn, 2012), which state that most people aren’t satisfied with data entry on their smartphones. Further studies should be carried out to really see if these precision/accuracy issues are really important, as this studies comes to different conclusions than the other two.

5.5. Discussion: Errors

This section will discuss the error question results. Over 60% of participants agreed that they send a text without checking what they typed. This provides a useful insight to how people send messages. Since the majority of people don’t proofread, it would explain the high amounts of errors shown in the literature review (Tactus Technology, 2013, Edwards, 2011).

The article in the daily mail suggested that autocorrect causes more errors than it saves (Edwards, 2011). This study backs this up since the majority of people send texts which autocorrect has changed, showing that there are issues with the feature. The literature review suggests that error handling is a key usability component (Katz-Haas, 1998, Nielsen, 2012). Since there are frequent errors being sent, this is a poor usability feature and is likely to cause stress. The amount of stress is likely to be acute in most cases, only causing the minimum stage of negative emotional responses such as frustration or anxiety instead of anger and fear. However, the emotional stress level would ultimately depend on who the changed word was sent to and also if that word changed the context of the message.

Finally, comparing autocorrected errors with the first response, if people aren’t proofreading, then isn’t it their fault the message was sent with errors and not autocorrects? A good example of this would be the latest social media trend where girls have been donating money to cancer research for uploading “selfie” photos with no makeup. Thousands of girls made the mistake of donating the money to WWF and adapting a polar bear, since they claimed autocorrect changed the word “beat” to
“bear”, causing stress (Lee, 2014). The text only contained one word, so surely it wasn’t difficult enough to proofread?

This is further proved by the fact that autocorrect is an optional feature. People can switch it off so that words are not changed, which can eliminate their frustration with it completely.

All of these points raise the question, are most errors autocorrects fault or due to human error? This would be an interesting study for an academic to carry out in the future.

5.6. **Discussion: Content Creation**

This section will discuss the results for the content creation questions. The first point to discuss is that 80% of participants are using their smart device for more than just calls or texts. The discussion on GATC talked about the over reliance of technology, and that it is causing physical and emotional strain. This 80% result coincides nicely with that discussion, showing that people are relying on technology for more tasks and interactions. One of these tasks that developers are trying to incorporate into smart devices is content creation.

Unfortunately, the literature review showed that smart devices are causing more stress than success in this department (Claburn, 2012; Tactus Technology, 2013). This is backed up in this study, which shows over 50% of participants finding it difficult to create content on their smart device. As a result, it is no surprise that over 80% of participants stated that they prefer creating content on their computer rather than their smart device. This is a large percentage of participants, showing that people would be stressed if they were forced to create content on their smart device, rather than a computer.

Knowing this point, it raises the issue of bring your own device (BYOD). The literature suggests that 89% of organisation globally allow employees to do so (Bradley, 2013). Would organisations allow employees to work off of their smart
devices, if they knew that it is more difficult for their employee to create content on them, reducing efficiency and wasting valuable employee time? Organisations are investing more into tablets, with some even debating replacing their PC with them. A recent survey of 299 tablet owners showed that only 8% would replace their laptop with a tablet (Hamblen, 2013). Combined with this studies results showing 80% of people prefer creating content on a computer, why are companies thinking of doing this? If they force their employees to make the change, they will be causing more stress than benefits and reduce productivity as a result.

It isn’t just companies deciding to invest in smart devices, but suppliers also. Big companies are starting to reduce the range of laptops they sell, with a focus more on tablets. A good example of this would be Sony, who recently announced to stop making their Vaio laptop range, in order to focus on their Xperia smartphone/tablet market (Hornyak, 2014). Should technology suppliers be doing this if their customers find it difficult to create content on these devices and prefer computers? If tablets are going to dominate the market and be used for everything, they need to be as good at content creating otherwise the stress rates of users will soar.

5.7. Discussion: Health

This section will discuss the health related question results. The first factor to discuss is that most participants disagreed that their fingers/hands hurt after using smart devices. This is interesting as research/studies in the literature review suggested that RSI was increasing (Petrou, 2010, Kinbbs, 2012, Adams, 2012) due to smart device use, showing that this study contradicts previous findings. A chiropractor reported that out of 340,000 RSI patients, over 50% of them were there due to touchscreen use (Petrou, 2010). As a result, it is interesting that only a third of people in this study are showing pain in their fingers/hands after touchscreen use, which is clearly a decrease.

It is important to note that a third of participants showing signs of pain are still an indicator that there is a problem with RSI and touchscreens. Since the results had only a 10% range between pain and feeling ok, it is not a reliable indicator, and that a few
more results could have showed RSI being higher. A further study with higher participant numbers needs to be carried out, with a focus on health issues.

The final interesting point on RSI in this study is that computer experience did not have an effect on the results. This is strange as most people would think experts/intermediates were more likely to show RSI, since they use computers more than basic users. As a result, it raises the point that this health issue can affect anyone, regardless of experience.

The second health issue to discuss is eye strain. The results were interestingly very similar to RSI, showing a slight 10% difference between agree and disagree. Overall the study shows that the most people do not get eye strain from the use of their smart devices. This contradicts a previous study (Naftalovich, 2013) showing that 70% of US adults are experiencing digital eye strain. This study shows only 30% of participants showing eye strain, which is a 40% difference. What is even more interesting is that over 75% of participants in this study use their smart device in low lighting or dark rooms. The literature review suggested that eyes are being damaged in these conditions, as they are focuses harder, resulting in strain (Gardner, 2011, Wen, 2013). This study shows no correlation between the two. As a result further research needs to be carried out in this area, in order to see what is really happening.

5.8. GATCS and Smart Device Comparison

The scatter graph results showed that the smart device and usability questions showed no correlation with Technostress according to GATCS. This is extremely interesting as this entire discussion based on the bar graph results shows that content creation, battery life and errors are all stressors according to academic psychology theory and usability test components used in other studies. The literature review suggests that Technostress can be defined as any strain caused from the use of technology (Section 2,3,1). As a result, since content creation, battery life and errors are all stressors associated with the use of technology, they are in fact Technostress. The new SDUS scale also shows that 80% of participants have some form of stress associated with
smart devices. This again is contradicted by the no correlation on the scatter graphs between smart device and Technostress. It raises the reliability of GATCS as an indicator for Technostress levels for smart devices since other theories and scales are showing stress from these devices.

5.9. **New Smart Device and Usability Scale (SDUS)**

The new scale shows that 80% of participants are showing some form of stress levels. This shows that Smart devices are a stressor and that stress levels are incredibly high. Despite not agreeing with GATCS on the scatter graphs/plots, it is alarming that stress levels are so high. So why are these stress levels so high? The discussion showed that errors, battery life and content creation are all key usability stressors, causing the most stress from the findings and analysis. Whereas health issues and precision and accuracy issues showed no stress. As a result, errors, battery life and content creation issues are the cause of the stress levels being so high in this study. The health and precision/accuracy issues would mostly fall into the 20% no stress category. Since smart devices are causing high levels of stress, should they be developed and released so rapidly before the problems are solved? The smart device question themselves have been designed based on academic theory, with the SDUS based on the GATCS algorithm. They have showed stress levels which are similar to GATCS but with no correlation between the two. As a result, it shows this new scale is a reliable indicator for showing stress and should be proposed for future use.

6. **Conclusions and Recommendations**

6.1. **Conclusions**

The aim of this dissertation was to explore the level of individual Technostress and to find out if new smart technology and their certain features contribute to stress levels in any way. This section highlights the key issues/points learnt from this study, leading on to recommendations for improving/studying individual Technostress levels further.
6.1.1. Individual Technostress Levels

The research conducted shows that individual Technostress levels are very high, with 91% of participants showing some form of Technostress and 52% of participants showing moderate to high levels of Technostress. This is a big increase from the Rosen & Weil study (1995), which showed that 64% of participants had no Technostress, compared to only 9% in this study.

This drastic change in Technostress levels is most likely due to the increase in the number of people who own computers, which has increased from 22% in 1995 to 75% in 2011 (File, 2013) and also the way computers are used. Computers are not just a tool for work anymore, but a device which is used in every aspect of life (Venkatesh, 2011). This includes socialising, playing games, content creation, researching, banking, shopping, analysis and entertainment. Since computers are now used for more tasks/interactions, they are being relied on a lot more since 1995.

This over-reliance in computers is causing new ranges of stress (emotional and physical) with these tasks/interactions, which previously didn’t exist. Previous tasks such as writing an essay with a pen and paper have now become more complicated with digital format requirements, introducing added stress which did not exist previously. The literature review research suggested that computers use for these daily tasks/interactions is causing information overload (Stone, 2013), physical and mental health issues (Pepper, 1999) and increased addictions (Dawson, 2013). As a result, over reliance on computers is the proposed cause for the increase in Technostress levels.

The research showed that age range is an important factor in Technostress. 0-18 year olds have the highest levels of low Technostress whereas 19-30 have the highest levels of moderate to high Technostress, followed by 31-50.

The proposed reasons why the stress levels are different between age groups is the way in which they use technology and their psychological development.
Teenagers and children use technology for more entertainment and social purposes than anything else (Nielsen, 2013, Rowan, 2013, Perle, 2014.). The stress from these uses is normally acute (low levels of stress). As a result the low Technostress levels are high due to the stress levels being acute, causing acute Technostress (new proposed term). Adult stress levels (19-30 + 31-50), are much higher as they have to use technology for reasons other than social/entertainment use. The use of technology at work is operant conditioning them to associate higher levels of negativity with the devices, causing episodic acute or chronic stress. As a result, the terms episodic acute Technostress and chronic Technostress shall be proposed as terms.

Regarding psychological development, 0-18 year olds are still developing emotionally and behaviourally. As a result, most do not have the life experience to understand “true” stress caused from a working life, in-depth relationships and bills. Since this is the case, the stress they experience with technology is acute (low stress), as it is not combined with any other worries. Whereas adults have to combine technology stress with other life issues (Mill, 2010, Burley, 2011, Simoes, 2013), which is a build-up of acute stress, also known as episodic acute (high stress).

Finally computer experience has an effect on Technostress levels. 60% of intermediate computer users showed moderate to high Technostress which is much higher than expert of basic experience. This is likely to be higher in these users since their experiences with the devices are varied compared to basic and expert. Expert users are better at adapting to technology (lower stress). Basic users are happy to get a task done with technology regardless of how long it takes (lower stress). Intermediate users are in-between these bands, and as a result have higher expectations of what they what to do, but are still in the learning process, causing higher stress.

### 6.1.2. Smart Device Usability Impact on stress

The research conducted shows that 80% of participants showed stress from smart devices, with certain smart device features having poor usability, and as a result are causing stress.
This study shows that battery life is a key usability stressor, as nearly half of participants (43%) dislike their battery life and over a third of people charge their smart devices more than once a day. Since satisfaction is a key usability component (Katz-Haas, 1998, Nielsen, 2012), battery life is considered poor usability since people aren’t satisfied. The key factor that makes battery life a stressor is that since people use their smart devices for nearly every aspect of life (Fisher, 2009, Metri, 2012b), it is crucial that this one device is available for frequent use (which isn’t possible if the battery is dead). This is further proved by the fact that over 50% of participants purchase a new smartphone based on how good its battery life is.

Precision and accuracy issues in this study have shown low stress levels in participants, providing evidence that it is not a key stressor. Over 50% of people are not frustrated by small icons on smartphones. This has increased since previous studies (Ravoor, 2012, Ahsanullah, 2010, Barras, 2009), showing that this technology has improved, and new implemented fingertip recognition techniques are working. Since over 57% of participants find it easy to navigate quickly and easily type on their smartphone, it shows that touchscreen technology is actually reducing stress in this area (since no training is needed), agreeing with IBM (2011). Satisfaction is also a key usability component (Katz-Haas, 1998, Nielsen, 2012), showing that if people are satisfied, their stress level will be low.

Errors have shown to be a key stressor on smart devices in this study. The majority of participants stated that Autocorrect is frequently changing their words. Since error handling is a key usability component (Katz-Haas, 1998, Nielsen, 2012), smart devices have poor usability in this area and as a result are causing stress. The level of stress from autocorrect errors depends on the word that was changed and the context of the message. The study also found that over 60% of participants agreed that they send messages without proofreading. Since most people do not proofread messages, it can be argued that it is the users fault and not autocorrects.

Content creation on smart devices has shown to be a key usability stressor in this study. 80% of participants stated that they prefer creating documents of their computer
rather than their smart device and also over 50% find it difficult to create documents on their smart device.). Satisfaction is a key usability component (Katz-Haas, 1998, Nielsen, 2012), showing that if people are finding it difficult to create content, their stress level will be high. Companies and suppliers are focusing more and more on tablet investment instead of laptops and computers (Hornyak, 2014). Unless tablets become more user friendly for content creation, stress levels will increase if people are forced to use them.

Finally this study shows that smart devices are low stressors with regards to RSI and eye strain. The majority of participants agreed that they do not suffer from these symptoms after using their smart devices. This disagrees with the majority of existing studies (Petrou, 2010, Gardner, 2011, Knibbs, 2012, Adams, 2012, Naftalovich, 2013, Wen, 2013), which is unique. An interesting point raised is that eye strain is low even though over 75% of participants regularly use their smart devices in poorly lit/dark rooms.

6.2. Recommendations

6.2.1. Technostress levels recommendation

There are several recommendations to make based on the findings from this study. The first would be research based. The idea was proposed that the Technostress levels are high due to over reliability on computers and technology. A study should be carried out to see if this is true, and if this over reliance on technology for nearly every task/interactions is causing stress levels. As a result, academics can start researching how to minimise the stress by digitising these interactions.

Another potential study would be the effect of age on Technostress levels. This study proposed that the stress levels differed due to the way different age groups interact with technology and their psychological development. As a result, carrying out a research survey would provide a useful insight to what is really happening, and if this theory is correct. This could potentially show what interactions are causing the highest
levels of Technostress, and as a result, target them in order to reduce the strain they are causing.

The second recommendation would be to limit the amount of technology use if possible. There is more than one way to do a task, and exploring alternative options will be worth it to reduce individual stress levels. For example, phone a friend for a call in the evening instead of spending hours texting them in dark rooms. It may reduce eye strain.

6.2.2. Battery Life recommendation

Battery life has been shown to be a key stressor. As a result, these recommendations will be to individuals, technology companies and academics.

The first recommendation is for individuals. Most participants stated that they purchase a new smartphone based on battery life, but for the ones who didn’t, a strong recommendation would be to do so as it will reduce the stress of charging multiple times a day. Secondly, look into power saving applications. Most participants stated that they did not use them. Look at reviews before downloading apps in case there are any unwanted add-ons which are installed with the application.

The second recommendation is for technology companies. There have been many academic articles proposing how to reduce battery life, which I strongly recommend should be experimented with. Efficient programming to save memory, new hardware designs and power saving applications are all potential options to explore. Smart devices will be used more and more for everyday interactions, so ensuring that the battery life on these devices lasts can reduce stress.

Finally academics/developers should continue to explore new creative ways in which smart device battery life can be improved. The more research/experimentation that is explored, the more likely a solution can be found to improve battery life and decrease stress levels associated with the device dying.
6.2.3. **Precision and Accuracy recommendation**

The results in this study show that precision and accuracy issues were not a key stressor. This contradicted previous studies. The proposed theory for this decrease in these issues is that the new fingertip recognition technologies have been implemented, which has reduced stress levels. Research should be carried out to see if this is true, and if so, focus more research into the areas which are causing more stress, such as battery, content creation and errors.

6.2.4. **Errors recommendation**

These recommendations are for individuals, academics and technology companies. Firstly it is strongly recommended that individuals proof read their messages before sending. It would save a lot of stress to spend 10 seconds or so rereading a text before it is sent with an incorrect context due to a word being changed. Secondly, if autocorrect is frustrating and sending constant errors, turn it off! A quick Google search on the owned smart device and how to turn it off will display plenty of results. Why suffer any longer, don’t let technology be in control.

This recommendation is for technology companies. Firstly it is strongly recommended that the feature to turn off autocorrect is easily located. Many people on forums complain that it is difficult to find. Secondly, continue to research how autocorrect can be improved so that users aren’t sending texts with errors in them.

Finally, academics should research if most errors are caused by the Autocorrect feature or by human error. Knowing this will show the world if the solution to these errors are technological or psychological (changing users behaviour or technologies).

6.2.5. **Content Creation recommendation**

This recommendation is for companies in general and technology companies.

This study has shown that people prefer creating content on computers rather than smart devices. It also shows that people find it difficult to create content on smart
devices. As a result, companies should think twice before choosing to invest into tablets. Using tablets instead of laptops and PC’s will most likely reduce productivity of employees and cause them stress also. Smart devices should be an aid, not a replacement to PCs and laptops.

Technology companies should continue to research how to make content creation better on tablets and smartphones as currently most people consider it difficult. Another recommendation is to think twice before solely focusing on selling tablets. Most people prefer creating content on computers, so removing that option for customers would actually hinder them, and most likely cause them more stress. Until tablet technology is at a stage where creating content is as effective as or better than a computer, both options should be available for consumers.

6.2.6. Health issues recommendation

This study shows that smart devices are causing low physical strain (RSI and eye strain), contradicting the majority of previous studies. As a result, it would be recommended to research further in order to see how much damage smart devices are really having on people’s health.

As for individuals, even though this study shows that eye strain and RSI are low on smart devices, it would be strongly recommended to play it safe and follow the NHS recommended guidelines. Try to use smart devices in rooms which are well lit, and take regular breaks, to rest joints and reset vision.

6.2.7. Smart device and usability scale recommendation

This study shows that GATCS is an unreliable indicator for showing smart device and usability Technostress levels as it contradicts the results shown in the bar graphs, new SDUS scale and academic theory. As a result it would be strongly recommended to either use the new SDUS scale to analyse smart device and usability stress levels, or create another one which has been derived from academic literature on stress,
technostress and modern smart device technology. This should increase the reliability of detecting individual Technostress levels in modern devices.

7. Personal Reflection

7.1. Literature Review

This section of the dissertation was my favourite. I really enjoyed researching and discovering what was out there and comparing it to what I had learnt during my university studies. The psychology aspects particularly interested me, with operant and classical conditioning opening my mind to some exciting theories. I also enjoyed redefining the definitions of Stress, Technology and Technostress, to explain to the reader in simple terms what they actually mean.

As for timing, I wrote this section without rushing, at a relaxed pace. I spent most of first semester and the Christmas period ensuring that it was accurate, flowed well and was to a good quality. I wouldn’t change my literature review, I am very proud of it and know it is some of the best work I’ve done.

7.2. Methodology

I was happy with the methodology overall. The online survey approach worked well and got me 150 results within the first day. From previously watching over the years, I noticed that many people put up Facebook statuses asking for people to fill in their surveys. Most people actually ignore them so I figured it was best to individually ask people on my Facebook one by one with personal messages. Although it was time consuming and took an entire day of message composing, it worked extremely well and is why I got the majority of my responses in the first day. After I exhausted my social network it was difficult to get more responses, so I wish I had a bigger contact base.

I think it would have been useful if I arranged a group meeting to discuss smart device stress levels with individuals. It would have provided a useful insight to common
issues and would have allowed me to refine my questions more. The questions themselves I was mostly happy with. If I could change anything it would be to reword the autocorrect question stating “Autocorrect changes texts I send incorrectly” instead of just “Autocorrect changes texts I sent”. It was a silly error and I should have thought about it.

7.3. **Analysis and Findings**

The analysis section was both exciting and frustrating. I found it extremely fun to look at all of the results and see what sorts of stress was occurring. I was shocked at how health issues were incredibly low considering how much they have increased over the years. The frustrating part was using SAS. Although it is a powerful tool and one of the best for analysis, my skills in it were basic and it took me a while to adapt to using it. It was agonising when originally comparing results, since the GATCS and Smart device questions contradicted each other but individually showed stress. The solution of creating a new scale was very novel, and helped to show that combined with academic literature, that GATCS isn’t reliable alone anymore.

If it wasn’t for Alex and Liam helping me with some code, it would have been even more stressful. I learnt the true nature of working in a team from the last few weeks of this project, with Alex, Liam and I bouncing code off of each other to figure out how to produce certain graphs in SAS. It isn’t about Belbin roles, but the motivation, experimentation, support and dedication effort that is put in, which really defines a team.

I must have bothered Richard quite a bit over the analysis section, asking for SAS advice and to check my work. I thank him for being understanding and patient with me.

Regarding the write-up, it was my least favourite section. Stating what over 30 graphs meant was very tedious and at times seemed soul destroying. On the bright side it was easy to generate the graphs for the write up (once I knew the code!), since SAS and
Minitab have some pretty good tools for this. I would recommend anyone to look into Minitab for quick, easy analysis if they have little SAS experience.

7.4. Discussion

I enjoyed this section quite well. It was interesting and fun making links between my literature review and my results. Again, I was happy to apply some of the new psychological theories that I learnt, and proposing my own terms made me smile. I would strongly recommend anyone to reread their literature review before writing their discussion. It not only refreshes all of the content researched, but provides a useful opportunity to proofread this section. I think the saying is two birds one stone. I found it easy and natural to compare my findings with the literature review, due to the corporate governance and big data gaming reports I wrote previously. It has become almost second nature now.

7.5. Conclusions and Recommendations

This section I was happy with also. I highlighted the key issues found in easy to read sections. The amount of times I have read a journal article and couldn’t find a point I previously saw was very frustrating. As a result, I thought it would be useful for the reader to give my conclusions clear header names, to save them time looking for a point I made. I hope more people proofread their texts after reading this dissertation, as I strongly know it will save a lot of stress.

7.6. Project Overview and Final Comments

Overall I can honestly say I am proud of this project. I have put an incredible amount of time and effort into it at all stages. I again want to thank everyone who helped and supported me in this project, I couldn’t have done it without you.
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9. Appendices

9.1. Survey Questions

9.1.1. Smart Device Usability and Stress Questions

<table>
<thead>
<tr>
<th>Question</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I am happy with my smartphone’s battery life</td>
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<td>2. I charge my smartphone more than once a day</td>
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<td>3. When choosing a new smartphone, battery life is an important factor</td>
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<td>4. I use power saving apps to increase my smartphone’s battery life</td>
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<td>5. I feel disconnected from the world when my smartphone battery is dead</td>
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<td>6. I tap the screen multiple times in order to open an app on my smartphone</td>
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<td>7. Tapping small icons on my smartphone does not frustrate me</td>
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<td>8. I find it easy to type quickly on my smart device</td>
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<td>9. I can quickly go where I want to on my smart device</td>
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<td>10. The autocorrect feature on my smart device is very helpful</td>
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<td>11. I often send a text without double checking what I typed</td>
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<td>12. I frequently send texts with wrong words that autocorrect changed</td>
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<td>13. I rely on my smartphone for more than just calls and texts</td>
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</tbody>
</table>
9.1.2. Demographical questions

Please state the following

Your Gender

☐ Male  ☐ Female  ☐ Do not wish to answer

Your Age

☐ 0-18  ☐ 19-30  ☐ 31-50  ☐ 51-70  ☐ 70+  ☐ Do not wish to answer

Your Country

☐ England  ☐ Ireland  ☐ Scotland  ☐ Wales  ☐ Germany  ☐ Spain  
☐ France  ☐ USA  ☐ Other  ☐ Do not wish to answer

Your Ethnicity

☐ White  ☐ Hispanic or Latino  ☐ Black or African  ☐ Indian  ☐ Asian
☐ Other  ☐ Do not wish to answer

Your Computer Experience

☐ Basic  ☐ Intermediate  ☐ Expert
9.1.3. GATCS

GENERAL ATTITUDES TOWARD COMPUTERS SCALE (Form C)

The following statements address general attitudes toward computers. Place a check (✓) under the column that describes your level of agreement (Strongly Agree, Agree, Neutral, Disagree or Strongly Disagree) to each statement.

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Computers can save people a lot of work.</td>
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<td>2.</td>
<td>It takes a good math background to learn to use a computer.</td>
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<td>3.</td>
<td>You need to know how to use a computer to get a good job.</td>
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<td>4.</td>
<td>Computers can help solve society’s problems.</td>
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<td>5.</td>
<td>Computers are taking over.</td>
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<td>6.</td>
<td>Computers can increase control over your own life.</td>
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<td>7.</td>
<td>Computers increase the amount of time we have for other activities.</td>
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<td>8.</td>
<td>Men are better with computers than women.</td>
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<td>10.</td>
<td>In the future there will still be jobs that don’t require computer skills.</td>
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<td>11.</td>
<td>Computers are good teaching tools.</td>
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<td>12.</td>
<td>Use of computers can cause physical health problems.</td>
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<td>13.</td>
<td>Computers prepare students for the future.</td>
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<td>14.</td>
<td>Computers are taking jobs away from people.</td>
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<td>15.</td>
<td>Some ethnic groups are better with computers than others.</td>
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<td>16.</td>
<td>There is an overemphasis on computer education in this society.</td>
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<td>17.</td>
<td>Computers can ruin interpersonal relationships.</td>
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<td>18.</td>
<td>In five years everyone will need to know how to operate a computer.</td>
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<td>20.</td>
<td>Computers will never be smarter than people.</td>
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