Computer anxiety: The development of tools to measure severity and type, and offer appropriate mitigation strategies

By

Sarah Jane Crabbe

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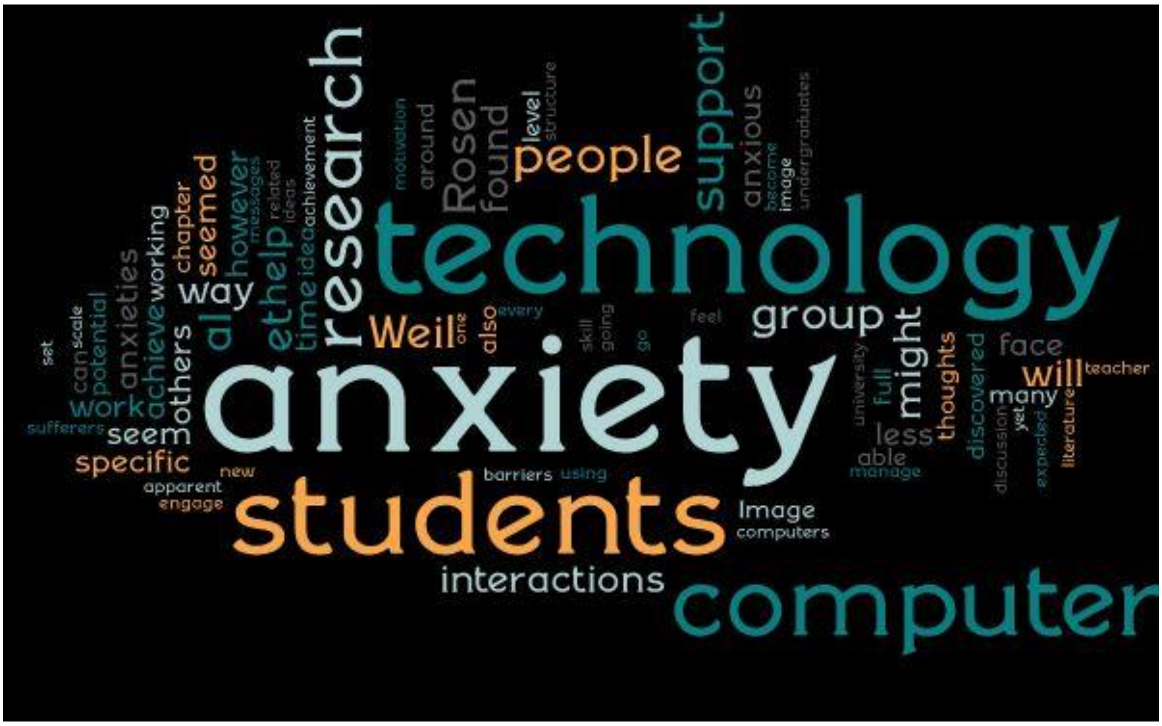


Computer Anxiety should not be allowed to impact negatively on anyone. This work is a step on the journey to addressing it for all.

Acknowledgements

This work is dedicated to my family for their steadfast support and encouragement when the going got tough. Thank you, Jim, Alex, Jenny, Phoebe, Charlie and Mum.

Thanks also go to my supervisors for the journey Peter Andras and Lindsay Marshall for their unwavering patience and support, and to my fellow travellers Frances and Janetta for their good humour and friendship, also colleagues at York St John University who have cheered me on.

I send my gratitude to colleagues at PPIG conferences who supported my ideas and gave me the space and confidence to present and develop them and those at HEASTEM who asked interesting questions. Your enthusiasm gave me the impetus to carry on.

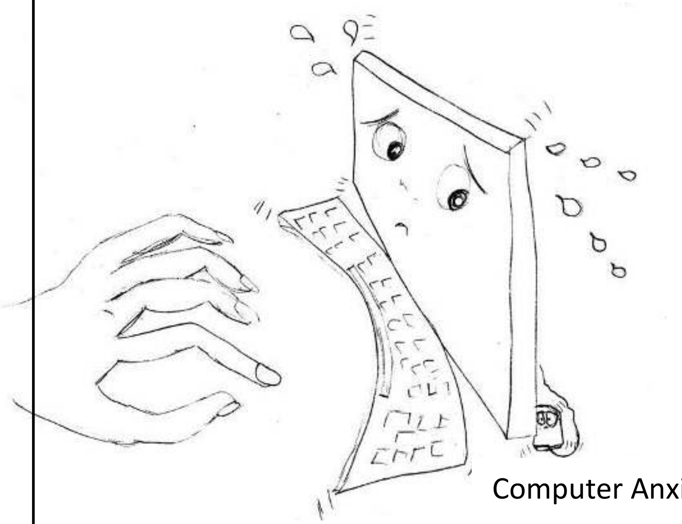
It is hoped that those who inspired me to do this work, and those who tested it along the way are less anxious.

Abstract

Computer anxiety is a particular anxiety that manifests when the sufferer has to interact with a specific technology. It impacts on the performance and health of those who suffer from it. In spite of, or perhaps because of, the prevalence of computers and technology in the world today, computer anxiety is still presenting in about 25% of the surveyed populations. This work culminates in the presentation of a new instrument, which identifies the type of computer anxiety: operational, sociological or psychological, measures its severity and suggests a range of strategies in order to mitigate the effects of that anxiety, and that this will be the start point in conversations around that support. There are also suggestions for proactive strategies to be adopted by teachers or employers in order to reduce the personal impact, and help sufferers to develop their own mitigation strategies.

<u>Quick definition of computer anxiety</u>

Not this



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Computer Anxiety by Sarah Crabbe

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1 An introduction to the research: Exploring why achievement evades some students when technology is involved

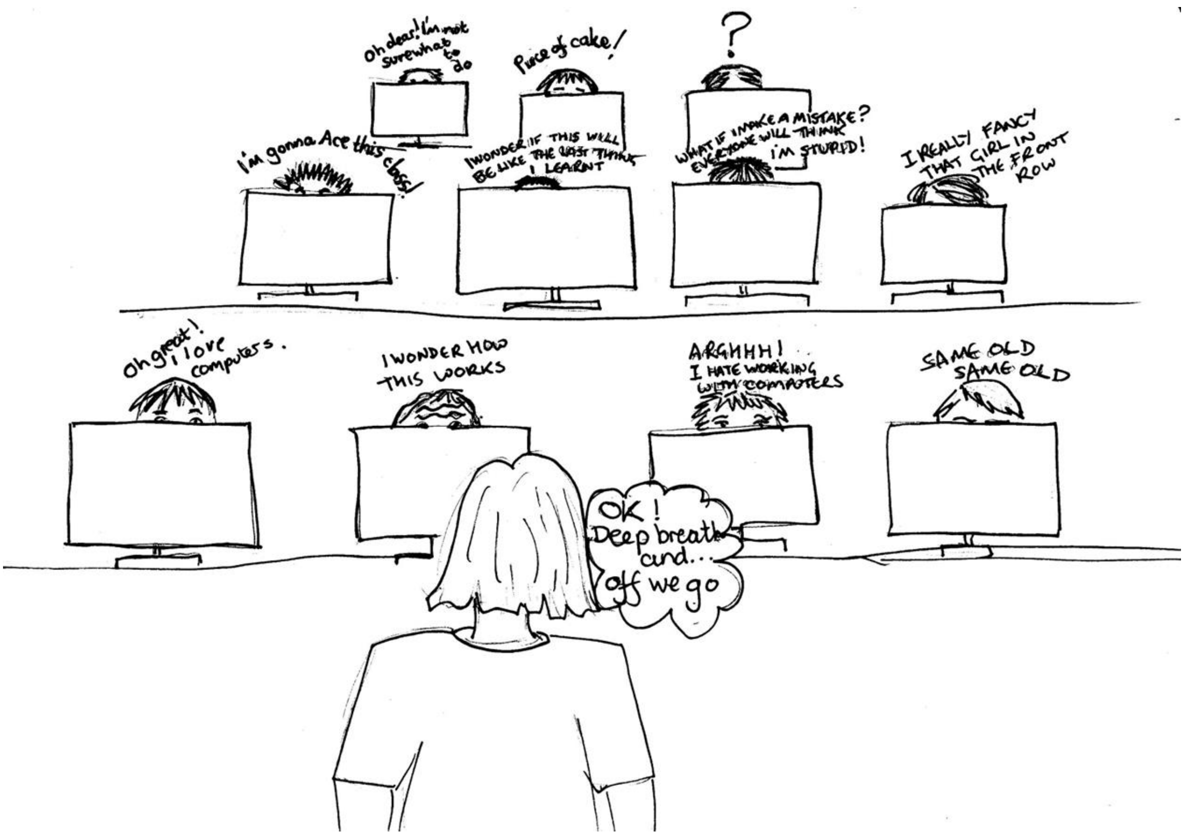


Image 1: thoughts of a class and their teacher (S. Crabbe)

As a Senior Lecturer in a Business School in a new university I noticed that in my classes there is a mix of approaches to technology (image 1). Some students have no aptitude for working with technology but carry on cheerfully and with no qualms, regarding error messages as challenges and glitches as amusing interludes. There are others who quietly and competently manage all the software with aplomb and constantly strive to extend their knowledge and skill set. Yet others creep into the room with apprehension clear on their faces, who treat the PC in front of them as the enemy and who find every stage of interaction fraught with difficulty and incomprehension. This last group are able to verbalise and communicate clearly in face to face situations but with a computer in the mix, become wracked with anxiety. Students in this group tend to either give up, to sit back and wait for a solution to be presented or press on with increasing speed and little attention to process, messages or information. Whichever route they took they exhibited a level of anxiety and discomfort. After discussion with colleagues it became apparent that these students achieved less well than expected in assignments, so I wondered, were there barriers to them achieving their full potential?

One of the issues did seem to be their confidence when dealing with technology. Their reluctance to engage with the computer meant that they spent less time researching, less time editing, less time proof reading and had a more limited skill set for presenting their work. After discussion with the students themselves I found the sorts of thoughts that filled their heads: summarised in image 2

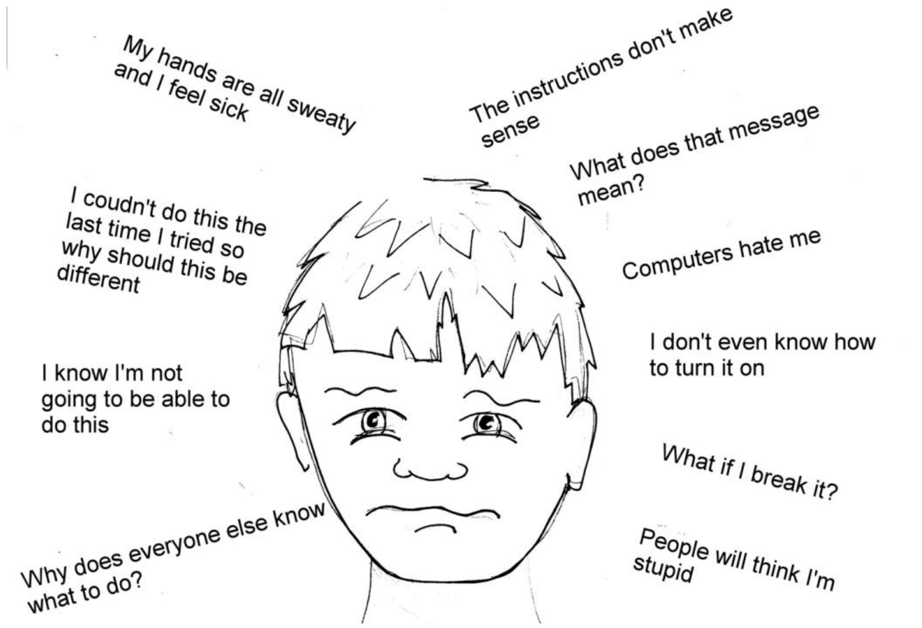


Image 2 Thoughts of the computer anxious

As their tutor, I wanted to know what was going on here. I discovered that computer anxiety is a recognised condition, where by sufferers feel uncomfortable when interacting with computers, and it is on a scale from mild right up to full blown phobia, covering the range of comments expressed in Image 2 (Maurer, 1984). I was surprised, as these undergraduates, born after 1982, would have been exposed to technology all their lives. I thought that they should not be worried about using IT, but I was wrong, some of them are.

If there was a way of identifying these students when they arrived at University I might be able to help them manage their anxiety and support them to go on to achieve their full potential so that gave me the focus for my research.

1.1 Structure of this chapter

This introductory chapter briefly presents some of the ideas found in key literature in the field of computer anxiety and related areas. It firstly explains the motivation of the research which is to support the learning of students. It then presents the final outcome which is an instrument to support students. The research question, aim and objectives are given. An explanation of the structure of the rest of the thesis is found at the end of this chapter.

1.2 Motivation

The omniscient presence of technology leads to the assumption that we will all be used to it and not be made anxious by interactions. However research suggests that this has not always been the case (Rosen and Weil, 1995a) in the past and is still an issue (Tarafdar, Pullins and Ragu-Nathan, 2015) with the term computer anxiety being used to describe this anxiety. Like maths anxiety, computer anxiety has an adverse impact for a significant minority of the population (Hill *et al.*, 2016)

I see and speak to students and other adults who talk about technology hating them, who admit that they could have done a better piece of work but could not face using their computer again and who become distressed and very anxious when asked to learn how to do something in a different way. I want to help them to feel more positive about these interactions and achieve more as a result using the technology that is presented to them without anxiety or distress.

Technology can be helpful in raising achievement levels for underachieving students (Jackson *et al.*, 2011) but it seems important that educators and employers do not assume that everyone will be excited and ready to embrace technological solutions as many advocates of increasing technology seem to (Hughes *et al.*, 2002; Chou and Liu, 2005; Camilleri and Camilleri, 2016; Balar, 2017) including the Higher Education Authority (HEA) (Trinder *et al.*, 2008). As educators and employers, there should also be recognition that, for some people, this could cause levels of anxiety and that these people will need additional support.

Initially three main causes of computer anxiety were identified by Howard (1986) as being Operational, Sociological and Psychological (Howard, 1986). These terms captured three different ideas. That people got anxious when they did not know how to do something was the first. The second was that people would be anxious that if something in their culture or background made them feel that they would not be successful when using technology. Finally if people had a deep-seated fear of technology, being made to use it would result in anxiety. Measures were developed for the phenomenon of computer anxiety but focussed on returning just one number to measure severity (Heinssen Jr, C. Glass and Knight, 1987; Rosen and Weil, 1992).

Treatments were developed to help those with severe Computer anxiety following the ideas of successful treatments of other phobias (Rosen, Sears and Weil, 1993; Brosnan and Thorpe, 2006) and were seen to be successful. Training and practice was prescribed for everyone else as there seemed to be correlation between lack of experience and higher levels of computer anxiety (Meier, 1985; Omar, 1992; Rosen, Sears and Weil, 1993; Hewson, Charlton and Brosnan, 2002; Tekinarslan, 2008; Koo and Wati, 2011).

However, training did not solve the problems for everyone, and discussions with students suggested that something had been lost by combining the three types of anxiety into one measure. Some students just did not know what to do while others wanted a discussion about why I was asking them to do something in a particular way. I looked again at Howard's (1986) work and saw that the different categories he identified seemed to fit with what I was seeing in the classroom. I decided to explore that further and as a result of this further research went on to create a measure that looked at these different types.

Measuring is not enough: while it may be helpful to know that a student is very anxious about using a new piece of technology it does not help the student to deal with that. The next step then was to find specific and relevant strategies which related to each type of anxiety and direct the suffer to them. This thinking led to the development of the final output of this work: The mitigation tool or instrument which combines measuring the three types of anxiety and, depending on the outcome, direction towards some strategies that might help or support the student.

But is this just a fuss over nothing? Is technology really that prevalent and are people that much disadvantaged if they get a little bit stressful when using computers? The next section will present some general background to provide a context for the work.

1.3 General Background to provide a context for the work

In 2014, an estimated 36 million adults (73%) in the UK used the internet every day (Office for National Statistics, 2014) to work, visit social networking sites, shop, watch films and play games as well as many other activities. By 2016 this number was estimated to have risen to 82% of adults using the internet almost daily and with the growing Internet of Things it is likely that this number will continue to rise (Office for National Statistics, 2017). Across the globe internet access and activity is also on the rise with young Asians using multiple devices simultaneously giving them average of 38 hours of activity in any 24 hr time period (Davis, 2008), and since this research was completed there are even more opportunities for interactions and it may not just be young people who take advantage of these.

People of all ages and nationalities learn new skills and find information using a range of technologies. Libraries have adapted their offerings to include technology alongside paper books (Brindley, 2009). Learning often takes place in an educational setting but is increasingly also in the work setting (Gravill and Compeau, 2008) where for instance Health and Safety understanding is often delivered and then assessed using online courses such as those delivered by “High Speed Training,” (2011).

In spite of these developments and the advent of items such as SMART Phones and SMART TVs there are still around 11% of households that do not have access to the internet in their home and of these, 21% cite lack of skill as the main reason (Office for National Statistics, 2017). The fact that 99% of homes with children or teenagers are connected to the internet (Office for National Statistics, 2017) might point to age being a barrier.

The arrival of the Smart phone and other mobile devices extended learning to include much which takes place out of the classroom and created a situation where students could access materials and be engaged anytime, anywhere (Derakhshan and Khodabakhshzadeh, 2011) Educational establishments have had to respond to this rise in technology use and the journey from managing the annoyance of students bringing mobile phones into the classroom (Campbell, 2006) to full integration of technology has been a swift one (Unknown, 2015). On the way educators have moved through ambivalence (Tess, 2013) to the idea that smart phones are the most important technology in education at least in the view of researcher (Al-Jundi *et al.*, 2016).

Indeed, all universities in the UK have a web presence and the admissions system (UCAS) is on-line requiring any applicant to interact with the internet and a computer at several points in the process. Learning opportunities are accessed via Virtual Learning Environments (VLEs) to deliver course materials and information to their students. There is an expectation that students will use personal computers or laptops to engage with research and the development of any assignments. However some research suggests that some potential students choose to avoid online engagement (Alenezi, Abdul Karim and Veloo, 2010).

In the workplace too, personal computers are commonplace but stress can be caused by interactions with this form of technology (Ayyagari, 2007) and there have found to be costs related to these stresses (Ragu-Nathan *et al.*, 2008). Companies spend money on training courses to support their staff (Patel, 2010) but as Woszczynski, Lazar and Walker (1999) noted, these are not always helpful and in some cases can have the effect of worsening stress levels if the experience is not a positive one, or the user feels a lack of control over the application (Beckers and Schmidt, 2003).

These feelings of stress related to technology use are often covered with the term “Computer Anxiety” which came into circulation in the mid-eighties (Howard, 1986). While this term was coined over thirty years ago, it still seems to be an issue and is cited in much of the current research around e-learning and using technology (Maricutoiu, 2014; Achim and Kassim, 2015; Camilleri and Camilleri, 2016; Drossel, Eickelmann and Gerick, 2016; Alothman, Robertson and Michaelson, 2017; Nikou and Economides, 2017)

Another term in general use, in the 1980s, was “technophobia”, made popular by the extensive work of Rosen with colleagues Sears and Weil, who created a measure which was used by them in a large number of settings and contexts (Rosen & Sears, 1987; Rosen & Weil, 1992). Other researchers also became interested in this phenomenon and several more instruments had been developed by 2000, which are explored and reviewed in an extensive paper by Anne Powell (Powell, 2013). She notes that all the instruments use self-reporting questionnaires as the method of data collection. The most popular ones are Rosen and Weil (1987) and Heinssman(1984) with Heinssman growing in popularity more recently

In related research around internet anxiety it is noted that levels have not changed over ten years and one study even found an increasing and persistent difference between the genders (Joiner *et al.*, 2013). Conversely, technology anxiety levels have dropped in South African universities (Smith and Oosthuizen, 2006) and this was also the case found by the ECAR study (2009) (Smith and Salaway, 2009).

Although, as we have seen, there is much research about measuring and discussing computer anxiety there is less work around reducing or addressing the anxiety. In some cases, solutions were proposed and tested but none seem to have been particularly successful. In early research a link between computer experience and computer anxiety was discovered and many solutions suggest increasing computer experience although later work seems to suggest that it is the quality rather than the quantity of experience that is the vital key (Cowan and Jack, 2011).

Computer anxiety appears to be a complex condition that can have its roots in a whole range of different things, from a poor first experience, cultural and peer influences as well as the individuals personality to name a few, and one reason that the solutions attempted before have had limited success may be because of this, after all if the anxiety is founded in a lack of understanding of the task, training people in the use of the application may not support their needs. To address this gap, I began to look in more detail at the problems, causes and potential solutions.

1.4 The Research Journey

I began by exploring what barriers might inhibit interactions with technology and discovered a wide variety of factors that might influence how people felt about technology. These ranged from lack of opportunity, to impacts of society and individual personality, with computer anxiety being a key factor.

This idea of a very specific technology related anxiety was reinforced by my observation of some students who presented with specific anxieties or were on the autistic spectrum and were very comfortable with technology but extremely anxious in other contexts. This view is further reinforced but the finding that students who present with math anxiety do not necessarily present with computer anxiety either (Anderson, 1996). This and other research suggests that having one form of anxiety does not suggest a predilection for other anxieties (Chien, 2008).

In my research on my own students, I found that around 25% of any cohort of first year business students (n >100) experienced computer anxiety, i.e. they experienced feelings of anxiety when working with computers. This might seem surprising given the prevalence of technology in the world, and the fact that this generation of students might be considered by some to have a different way of thinking caused by their exposure to technology from birth (Prensky, 2001a).

However this idea that young people are changed by technology has been challenged extensively (Bennett, Maton and Kervin, 2008; Bennett and Maton, 2010; Brown and Czerniewicz, 2010; Jones *et al.*, 2010; Margaryan, Littlejohn and Vojt, 2011; Joiner *et al.*, 2013) and many agree that this is not the case. The myth of the digital native is however persistent in educational circles and common parlance (Weinberger, 2008) alongside others such as learning styles.

Given the strength of opinion around learning and its potential relationship to computer anxiety this area was added to the literature review.

Having discovered the phenomenon of computer anxiety I was interested to see if any of the factors explored contributed to the level or severity of the anxiety. Firstly, personality was explored to see if there was a relationship with computer anxiety. When this proved interesting but inconclusive, the combination of personality and learning preference were considered using online and then paper-based data collection methods. Again, an inconclusive finding which gave me pause for thought. A complexity in the causes of computer anxiety belied the possibility of prediction. So instead the work focused on the identification and mitigation of computer anxiety and the development of an instrument to do this became the new aim.

This work led to the development of the research question.

1.5 Research Question, Aims and Objectives

This section details the research question, the aim of the research and details how the aim is going to be achieved through a set of objectives. The structure of the thesis is explained in relation to the objectives and a brief summary of the contents of each chapter is presented

1.5.1 *Research Question*

The question that this is research addresses is "Can a tool be created that will measure the type and level of a person's computer anxiety, and suggest a reasonable range of strategies that will support them?"

1.5.2 *Aim*

This research aims to bring to the attention of educators and employers the idea that, for some of the people in their care or employment, engagement with technology causes anxiety and if this is not addressed, what the longer-term implications of this are for those individuals and the companies themselves. It also presents a range of strategies and support mechanisms to help the individuals come to terms with and mitigate any computer anxiety they feel.

1.5.3 *The objectives*

These are the main objectives of the research. They map out the research journey and key milestones along the way.

The objectives:

1 to review and evaluate existing literature relevant to the research aims
2 to explore the extent of the problem within current cohorts
3 to evaluate and understand the causes and potential solutions
4 to produce a model for users and those around them to help them to understand the severity of any problem and provide suggestions for support

Objective 1

This objective is primarily addressed in the literature review which forms Chapter 2.

As there are many barriers that impact on the ability or desire to interact with technology these are explored here. There follows a discussion about the symptoms and impact of anxiety in general and potential supporting strategies for this. The focus then turns to computer anxiety specifically, its measurement, the factors that may contribute towards it and the strategies that may be useful for helping to address it. Much of the research in this chapter has been published since the first research phase and informed and supported the work as it moved forward.

Objectives 2 and 3

These objectives are addressed in Chapter 3, The Research Phase.

Within this chapter there are several sections. The first four present the four data gathering phases in the form of four mini research projects with methods, findings, discussion, conclusions and ideas for further work. The research was conducted over several years, assessing and checking the levels of computer anxiety in a number of cohorts of students. Other potential indicators were also measured to explore potential relationships between them and the findings are presented and discussed in the four distinct sections within this chapter. A fifth section presents a summary of qualitative data gathered over the course of the four data gathering phases. There is a summary section which draws overreaching conclusions and presents the recommendation to develop a supportive model

Objective 4

This final objective is addressed in Chapter 4 where the findings supplemented with many discussions contribute to the development of the first instrument.

Its piloting is presented with improvements noted and implemented. The launch of an improved version of the model at a conference is discussed and the feedback is analysed. A second version is presented with supporting documentation. The model is evaluated with a group of teaching students both from the perspective of student and that of teacher. The findings from this are presented and discussed in chapter 5.

1.6 Document structure

The thesis consists of 8 chapters with a reference list and appendices. The structure of each chapter is given in more detail in their own introductions

1. Introduction: to introduce the motivation for the work and describe the journey to come
2. Literature Review: to review existing literature in the area
3. Research Phases: to discover the current situation and look for potential links between a range of factors
4. Instrument development: to present the concept and development of the Computer Anxiety Instrument

5. Evaluation of the Computer Anxiety Instrument: to discuss the findings and responses of a user group
6. Conclusion: to draw the threads of the research and evaluation together
7. Limitations and further work: to discuss limitations and propose further work
8. Contribution to learning: to highlight the uniqueness of the instrument

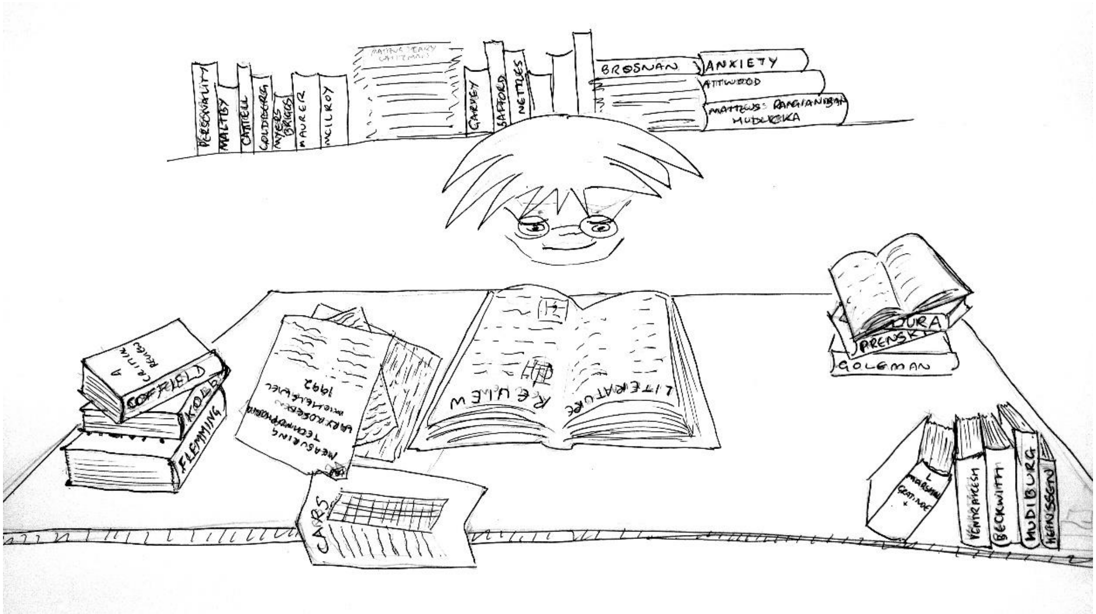
   References

   Appendices

This chapter has introduced the research ideas and some key literature. It sets out the research question, the aims and objectives of the research and the structure of the work to come.

The next chapter contains a review of the literature that supports the research.

2 Chapter Two: A review of the literature



The first chapter introduced the research and some key literature. In this chapter further literature is reviewed. The first section introduces the chapter and explains the structure of the work to come.

2.1 Introduction

In this chapter I explore the literature that led me to a deeper understanding of the problems facing people in today's world of ubiquitous technology. Over the course of the research, new ideas came to light, technology changed, and connectivity boomed. New literature was added all the time as I discovered more about the concept and the people involved, through data gathering and research. I came to realise that I needed to understand a range of concepts about people before I could begin to delve into technology related issues. This review looks at the obstacles that may make interactions with technology difficult for some people as well as reviewing thinking around personality, anxiety, and learning as these ideas underpin and support understanding of the concept of computer anxiety, which is evaluated at the end of the chapter. The research leads to the development of the first data gathering phase.

2.1.1 *Structure of the chapter*

The review is organised so that the thinking about key ideas is introduced and discussed first with the final section focussing on computer anxiety.

Section 2.2 looks at obstacles that make it hard for people to have positive experiences with technology. These are split into three areas: Environmental; Technological; Psychological.

The next section reviews current work about anxiety: what it is, the symptoms and impacts and finally treatments.

Personality theory is discussed in section 2.3 with particular emphasis on the development of The Big Five characteristics (McCrae and Costa, 1999).

The penultimate section reviews the literature around learning theory, including current discourse about the merit of learning styles and the emerging ideas of learning preferences.

Finally, computer anxiety is defined, symptoms and impacts are discussed, measures are considered and potential strategies for mitigation explored.

2.2 Reasons for lack of engagement with technology

In the increasing world of connectivity and pervasive technology some people find it difficult to engage while others choose to opt out altogether (Selwyn, 2006). This section explores the current thinking around what makes it hard for people to engage with technology.

It is recognised that some people will only adopt new technologies when the effort of learning how to use it is outweighed by the effort of doing the task without using the technology (Toledo, 2007), or in other words, if they can see the benefit, and not making this clear can lead to lack of engagement. Overall, reasons suggested as barriers seem to fall into one of three areas: environmental, technological or psychological.

2.2.1 *Environmental Obstacles*

Some of the things that prevent or deter users from accessing computers arise as a result of their environment. This may be a practical difficulty such as not being able to afford a computer or personal such as being differently abled or having difficulty in communicating in English.

Physical challenge

If a person is disabled this might interfere with their ability to access technology. In the past this group was excluded but some physical challenges have been addressed, in part, by the technology industry with accessibility guidelines (WC3, 2014). Although research shows that this has not been universally successful in the past with varying levels of compliance measured (Sullivan and Matson, 2000) it is still an area of interest with whole communities of researchers focussed on this area such as those who publish in the Journal of Usability Studies. A more modern approach suggesting that accessibility is not just an issue for the disabled, but for all and is more an activity than a framework has been postulated (Lewthwaite, 2011). This view underlines the aim of the accessibility guidelines to ensure that anyone is able to use a computer to achieve the expected outcomes. For the internet there are W3 standards (WC3, 2014) which describe in technical detail how to produce web pages that would be compatible with a range of supporting software packages such as text readers making them accessible. Although, as technology moves at a fast pace, often these adaptations lag behind (Lewthwaite, 2011) Unfortunately, sometimes accessibility compliant websites have poor usability (Putnam *et al.*, 2012) and it is a challenge to get the balance right, although the very best score highly on both counts (Sullivan and Matson, 2000). This does not apply of course just to websites but to all interactions and there are also many hardware adaptations such as magnifiers, brighter screens, different mouse styles and so on, to help users. There is research into the area of accessibility and the impacts this has on the ability of the user to perform (Abou-Zahra *et al.*, no date; Fichten *et al.*, 2009; de Lara *et al.*, 2010; Ludi and Reichlmayr, 2011; Putnam *et al.*, 2012). Other research is in the area of improving accessibility for users with anxiety (Bernard *et al.*, 2015). However, there does not seem to be any work that measures or evaluates anxiety caused by inaccessibility, while within the industry there are differing levels of engagement with this issue (Putnam *et al.*, 2012).

For this group the interface needs to be personalised to meet individual requirements. Any technology related anxiety is likely to be clouded by other issues, but generally there is already a lot of support for these users with many of the accessibility barriers being addressed or at least acknowledged which may go some way towards alleviating any of the anxiety that they might feel. Being able to understand and communicate with the technology is a key element in being able to use it effectively

Communication skills

It is not just the physical ability to communicate with the technology that can be problematic. A lack of spoken English has also been found to be instrumental in making it more difficult for people to interact with computers. Research conducted in both Turkey

(Aydin, 2011) and Iran (Rahimi and Yadollahi, 2011b) found those with poor English language skills were more anxious when interacting with computers than those with good levels of English, and this finding was repeated in Greece (Korobili, Togia and Malliari, 2010). In one small study, young children, who had a serious language impairment (Conti-ramsden, Durkin and Walker, 2010), also presented with levels of anxiety when working with technology suggesting it is not just operating in an additional language that this is a problem, but more about the ability to communicate.

Many of the major operating systems use English as the command language which might deter people from extending their time with technology if their grasp of it is poor. Significantly, one piece of research found that this does not seem to deter people from extending their contact time for entertainment interactions (Alothman, Robertson and Michaelson, 2017) so there may well be other factors to consider such as motivation or desire.

These separate areas of research suggest that perhaps a difficulty in understanding or expression gives rise to levels of a specific and additional anxiety which only relates to interactions with technology in formal or learning settings. It may be that learning something completely new in a non-fluent method of expression is the cause of the additional anxiety or it could be the technology itself that is causing the anxiety. While these studies are too small to generalise from it does seem likely that people avoid doing something if it is difficult and hard to understand, and therefore practice less, have less confidence and lower levels of experience than their colleagues.

Experience

Lack of access or time with a computer, whether caused by context or by actively choosing avoidance, has been seen to correlate with higher levels of technology related anxiety in several studies including (Bradley and Russell, 1997; Bozionelos, 2004a; Abd-El-Fattah, 2005)

There is debate as to whether this is causal or effectual (Schroeders and Wilhelm, 2011). On the one hand, there are those who feel that an increase in amount of experience causes people to be less anxious when faced with technology (Sigurdsson, 1991; Fagan and Neill, 2003; Doyle, Stamouli and Huggard, 2005; Ursavaş and Karal, 2009). As a result of this and other related research, the UK government has been attempting to increase access with the provision of computers in libraries and other public places (DCMS, 2010) and businesses have spent a deal of time and effort on end-user training (Gupta, Bostrom and Huber, 2010) Supporting the view that anxiety decreases with experience, research within one group of employees found that the older executives showed a lower level of computer anxiety than their non-executive colleagues perhaps indicating that age, education and more experience does reduce computer anxiety (Shah *et al.*, 2011).

On the other hand it can be seen that people who are anxious about using technology are less likely to go out of their way to create opportunities to increase their exposure (Maurer and Simonson, 1991; Rosen, Sears and Weil, 1993; Mahar, Henderson and Deane, 1997) and may employ an avoidance strategy instead (Mazloumiyan *et al.*, 2011) minimising their experience. For this group, it could be that increasing the time that they have to spend with a computer actually makes them less willing to engage and more anxious about those interactions.

Increasing experience therefore, may be useful in reducing anxiety for some people but not others. It is not a clear-cut solution and there may be other factors to consider such as the quality of that experience as well as its quantity.

The quality of the experience was found to have an impact on how often people choose to interact with technology (Bradley and Russell, 1997; Cowan, Vigentini and Jack, 2009). If a first or early experience was unhappy, or the teacher was not a good role model this was initially considered to have a long-lasting impact (Mcilroy *et al.*, 2001) although the same researcher later considered this to be not as significant as the impact of long term practice and engagement (Mcilroy, Sadler and Boojawon, 2007). A finding from this study also indicates that if the task itself is complex e.g. statistics, then this too can increase anxiety (Mcilroy, Sadler and Boojawon, 2007) while if the motivation and need to work with technology is high, then anxiety will be correspondingly low (Shah *et al.*, 2011).

From the research discussed here, it seems that managing the complexity of the task, increasing the motivation to succeed and presenting opportunities for practice may help to increase interaction and this in turn may help the user feel more comfortable during their interactions.

Gender

There is a persistent myth that one gender is better than another when it comes to interacting with technology. This section discusses the history behind this and exposes current thinking.

In the late nineties, women were found to have lower self-efficacy than men: they believed that they would be less skilful in their interactions. Men also bought into the stereotypical view that computers were for men (Whitley, 1997). One study (n=281) in the US found that women were less likely to practice and therefore learned less i.e. had less experience, and were less confident than their male colleagues (He and Freeman, 2010) and this finding was similar to several other studies (Durndell and Haag, 2002; Baloğlu and Çevik, 2008; He and Freeman, 2010; Ursavaş and Teo, 2011; Huang, Hood and Yoo, 2013; Lee and Huang, 2013) Conversely other work has found that females were more confident and therefore more likely to engage with technology than males (Ursavaş and Karal, 2009; Saleem, Beaudry and Croteau, 2011).

Gender was found to be significant when relating personality type to computer anxiety (Saleem, Beaudry and Croteau, 2011) suggesting that different environments or learning opportunities can support one group while simultaneously undermining another. It also seems that men and women use different factors to select technology: Women being more influenced by whether they think it would be easy to use while men were more influenced by whether they thought it would be useful (Venkatesh and Morris, 2000).

There also seems to be a difference between how the genders interact with technology in two different studies (Cotten, Anderson and Tufekci, 2009; Burnett *et al.*, 2010) supporting older findings which suggests different genders may react differently to different elements of the interaction (Whitley, 1996a) and this may cause different behaviours and learning.

In one study the gender balance of those experiencing computer anxiety changed depending on the level of achievement, with females being more anxious in the lower levels of achievement and males being more anxious in the higher levels (King, Bond and Blandford, 2002). While other later work found little or no gender imbalance (Sam, Othman and Nordin, 2005; Hashim, Ahmad and Abdullah, 2010; Mazloumiyan *et al.*, 2011; Shah, Hassan and Embi, 2012).

This range of outcomes for the different genders suggests that while gender may play a part in the cause and effect of computer anxiety, the relationship is complex and not easily explained. Gender therefore is an unreliable indicator of the likelihood of engagement, level of computer anxiety or competence. It does seem that the difference in anxiety relating to gender has changed over time and it may be that in general as technology advances are made anxiety levels change too so the age of the participants may have an impact on how they regard technology.

Age

The ease with which people relate to technology may be generational or age related. Younger people have had far more access to technology than previous generations and could be assumed to be therefore, far less likely to worry about such interactions (Prensky, 2001b; Kolikant, 2010; Vodanovich, Sundaram and Myers, 2010). Educationalists tend to buy into this story (Austin, Nolan and Donnell, 2009; Herther, 2009) although this is not supported by more recent findings of lower achievement among younger participants (Morris and Trushell, 2014) Given that intelligence is not affected by age (Ratcliff, Thapar and McKoon, 2010) it is unreasonable to assume that just because one is older one is less likely to engage with new ideas. It might be the opposite, as the easy availability of information has been seen to negatively impact the younger generation's ability to learn (Kolikant, 2010) although this is a limited study. However a wide-reaching study in Iran found that older teachers resisted the use of technology and had higher levels of computer anxiety than their younger colleagues (Rahimi and Yadollahi, 2011b) which was also found to be the case in Turkey (Simsek, 2011).

This assumption is not supported by a wider range of research, from a number of other countries, that has found age is not related to anxiety in relation to technology (Martin, Stewart and Hillison, 2001; Bennett, Maton and Kervin, 2008; Bennett and Maton, 2010; Waycott *et al.*, 2010; Brown and Czerniewicz, 2010; Jones and Czerniewicz, 2010; Jones *et al.*, 2010; Kennedy *et al.*, 2010; Salajan, Schönwetter and Cleghorn, 2010; Agyei and Voogt, 2011; Margaryan, Littlejohn and Vojt, 2011).

It may be, as one study has found, that older people prefer to learn with the support of others rather than by exploration and not meeting this need has exacerbated their anxiety

(Vaportzis, Clausen and Gow, 2017) Other research in this area concluded that while it might take older people longer to complete tasks, they were no less able than their younger colleagues or more anxious (Sonderegger, Schmutz and Sauer, 2016).

On balance it would seem that the classifying the digital divide by age is not an appropriate or realistic model, a view reinforced by Waycott and colleagues (Waycott *et al.*, 2010).

Summary of environmental obstacles

Overall the environmental causes do not appear to be useful in identifying or classifying people who might wish to avoid computer interactions, although they do highlight why some groups may have less computer experience. For some, their gender, age and socio-economic background have conspired to diminish their opportunities, but they do not seem to have a universal impact on the level of reluctance to use technology. They may all be useful factors to consider when working with an individual to help to understand how they relate to technology and why this relationship may be problematic for them.

2.2.2 *Technological Obstacles*

This section is going to look at the issues surrounding the computer or technology itself. In the workplace and educational establishments, the main interaction with technology is usually via a personal computer, workstation or laptop although observation suggests that the tablet is now a key tool in an increasingly mobile workforce.

Computers have two aspects: the hardware i.e. the actual bits of machinery such as the keyboard, screen and mouse, and the software i.e. the code that enables the machinery to do things.

Hardware

Learning to use the hardware was found to be a challenge for those who come to technology later in life (Chou and Hsiao, 2007) in one study, and concern about damaging equipment had been found to be an issue for some people (Bradley and Russell, 1997) in the past while more recently the constant upgrades and changes have been found to be a stressor for some people (Fuglseth and Sørebø, 2014). As the machines become more reliable, robust and less expensive it may be that the hardware itself is not an issue since literature in this area is hard to find.

Even for those with physical problems hardware use does not seem to be a problem unless it malfunctions when it was seen to increase stress levels (Why and Johnston, 2008). Having appropriate, working equipment that is capable of doing the tasks required does seem to be more important in reducing frustration and therefore increasing the chances that a user would choose to extend their interaction (Hudiburg, 1992).

In much of the research reviewed, hardware is assumed to be reliable and not cited as a cause for concern. The same does not seem to be true of software.

Software

Some barriers are inadvertently created by software developers as they write applications that they understand but that a novice user finds complicated and difficult to use such as a poorly understood interface (Bessière *et al.*, 2006) which can be frustrating. Earlier work found that an interface that responds to user stress by noticing and being sympathetic to the stress supported longer interactions (Klein, Moon and Picard, 2002). Within the increasing number of applications (apps) there is a degree of complexity which, according to a small study, increases the gap between those who can and those who cannot (van Dijk, 2006). There is also thought to be a gender issue, the premise being that men and women think differently and the field of coding is predominantly a male preserve (Capretz, 2003; Morris and Trushell, 2014). The conclusion drawn by one group of researchers is that as most software is written for the male brain this causes stress and anxiety to female users (Beckwith and Burnett, 2004).

Historically this was not the case when many of the scientists involved in computer science were female e.g. Ada King-Noel and Grace Hopper. It may be that this has changed as the reasons for coding have changed from science to entertainment and access by the wider population. There were still reported imbalances in coding teams with 80% male coders as recently as 2014 (Williams, 2014) and many of the games on the market are aimed at the male psyche, so this may be an issue. Even in school children it was noted that boys are better at coding than girls but girls have a higher average level of performance when a range of tasks is reviewed (Morris and Trushell, 2014) which fits in with the earlier findings of King et al (2002) which suggested at higher levels of achievement females are less anxious.

It has also been found that males and females seem to have different criteria for analysing and judging interfaces and in general (within this study) females were less satisfied with a webpage than males (Al-ma and Al-habashneh, 2008) which might be why they choose to engage less often and have lower levels of experience as discussed above.

Another issue is that code, historically, was written for people who understood it, while now the users may have little or no understanding of what happens behind the scenes, so the interface has become more important. The interface is the method with which a human and a computer interact: it is the 'face' of the computer, and as in humans, if it is unfriendly or scary looking it can cause initial apprehension for the user (Meier, 1985; Bessière *et al.*, 2006; Chou and Hsiao, 2007). Usability is a term often used to describe the quality of this interface between computer and human (Chou and Hsiao, 2007) in terms of how easy it is to use (Neilsen, 2014) It could also be described as the user friendliness or ease of use of a system or the level of communication between user and computer (Chou and Hsiao, 2007). According to the US government usability has five areas that should be addressed. These are based on Nielsen's (2014) ideas and are summarised as:

- Ease of learning - How quickly and easily a new user can learn enough to be able to achieve basic tasks
- Efficiency – Once the basic skills have been mastered how quickly the user can accomplish tasks
- Memorability – How easy it is for the user to remember how to complete tasks when they revisit the application
- Error frequency – How often users make errors, what the implications are and how the user can recover
- Subjective satisfaction – How much the user likes using the application

(Adapted from (Uasability.Gov, 2014))

Addressing usability seems to have an impact on the perception of the user in terms of how easy they think the system will be to use. Perception of ease of use can affect the frame of mind in which the user approaches the task, with some research showing that a higher perception of ease of use leads to a more positive attitude (Burton-Jones and Hubona, 2005; Ragu-Nathan *et al.*, 2008; Parayitam *et al.*, 2010). However as people are different, they may have different ideas about what makes a system easy to use (Hughes *et al.*, 2011), or they may like different interfaces to the same applications (Adamo-Villani, Wilbur and Wasburn, 2008). An interface that is seen as hard to use may reduce the positive attitude of the user (Hackbarth, Grover and Yi, 2003; Matthews, Panganiban and Hudlicka, 2011) and potentially be the source of anxiety or stress. However good the usability is, it is what the user expects or perceives that seems to have a significant impact.

Studies have been conducted about the impact of usability on undergraduates (Cowan, Vigentini and Jack, 2009; Cowan and Jack, 2011), an office workforce (Ayyagari, 2007), middle-aged and unemployed adults (Chou and Hsiao, 2007) and older populations (de Lara *et al.*, 2010; Lindblom *et al.*, 2011) and poor usability was found to be a cause of anxiety across all the age ranges studied and in different countries. Poor usability is also blamed for causing frustration (Bessière *et al.*, 2006) which can lead to anxiety.

Although a study in China found that mature MBA students were prepared to manage an interface with poor usability in order to achieve their goals (van Raaij and Schepers, 2008), there is not an indication of the impact this had on their levels of anxiety or achievement. This behaviour may be cultural as another study in China found that employees were prepared to deal with inadequate software and work harder to achieve the same productivity as those who were better equipped (Tu, Wang and Shu, 2005).

Interface, ease of use, needs of the user and an element of expectation are all issues around the software which impact on how the user views, treats and deals with an interaction. The idea that code is written for a specific audience with a certain gender, mind-set and approach is under debate. Giving users some evaluation tools may help them to see that it is the application rather than their own lack of skills or aptitude that is making the task difficult. This in turn might help to address any anxiety occasioned by having to use substandard equipment or badly designed software although if a user cannot afford the latest equipment, this lack of resource could have an impact on their choices to engage with technology.

Socio-economic factors

For some, the lack of opportunity to access a computer regularly because of socio-economic factors has been seen to have a negative impact on how they interact with technology

(Bozionelos, 2001b; Hassani, 2006; Fritts and Marszalek, 2010; Hargittai, 2010). The opposite effect was seen in a study of students in South Africa. Although this study used ethnicity to compare the two groups of students it is implicit that socio-economic factors are at play. These findings are supported by work that found that those students who had had less access to technology were more positive and confident prior to starting a course (Burger and Blignaut, 2007).

Adding weight to the argument that lack of money is a disadvantage is a study from Holland where researchers found that socio-economic factors contribute to digital differentiation as the wealthy have better internet access and therefore more ability to use it (Peter and Valkenburg, 2006). This finding that is similar to research in Asia (Teo, 2008) where lack of opportunity to build experience also contributed to raised levels of anxiety about interactions with technology.

Summary of technology factors

In short, this research shows that for some people who have not had much interaction with technology any future interaction was seen as exciting for some, while for others it was intimidating. This did not seem to be related to gender or context. People are unpredictable and react to the same situation in different ways: perhaps this difference is cultural as the studies described above were conducted across different continents. It may also be about how the potential experience is framed and presented than about the lack of interaction in the past. This leads us to the next set of obstacles.

2.2.3 *Psychological Obstacles*

These are ones that the users bring themselves when they come to interact with a computer, i.e. their emotional baggage.

Preconceptions and Self efficacy

The perception that an application is going to be easy or hard to use has been found to have an impact on achievement or engagement in a number of studies over a wide time period (Monnickendam, 1993; Saade and Kira, 2007; Nov and Ye, 2008; Galy, Downey and Johnson, 2011; Šumak *et al.*, 2011) Coming to any situation with a pre-conceived expectation usually means that the expectation is fulfilled, the so called self-fulfilling prophesy (Merton, 1948). This is also recognised as the negative feedback that can occur in some people (Dickhäuser, Buch and Dickhäuser, 2011; Rascle *et al.*, 2015). A useful term to describe this is Self-efficacy which is defined as the belief that one has about one's own abilities (Bandura, 1994) There is a further specific area of computer self-efficacy (CSE). For people approaching an interaction with high CSE, a positive outcome is more probable, a finding also recorded in attribution research i.e. the way people explain their own success (Chodkiewicz and Boyle, 2014).

Although some argue that self-efficacy has to cover both use of the working environment and understanding of the task (Marakas, Yi and Johnson, 1998) the majority of opinion leans towards it being related to what people believe about their own ability to solve the problem. This then supports the idea that people with different levels of self-efficacy approach problems in different ways (M. J. Brosnan, 1998) and it also affects their preconceptions about any interactions (Lindblom *et al.*, 2011).

There is the confounding problem that often people with low skill levels or a lack of experience also have a lack of perception of the skills that they do not have i.e. they do not know what they do not know and therefore judge themselves to be expert (Kruger and Dunning, 1999; Aesaert *et al.*, 2017). They have high self-efficacy, but founded on false grounds. These people may experience an extreme reaction when they subsequently fail because they were not expecting to, which could have a negative impact on their self-efficacy. This might explain why high self-efficacy is not always indicative of low levels of anxiety around technology, and also identifies a problem with self-reporting.

For those who approach with a combination of low level of self-efficacy (Wilfong, 2006), low self-confidence and low technical ability the likelihood is that they will be carrying a low expectation of success and therefore are more likely to fail. They may experience a strong reaction when they succeed because it is unexpected. Often this success will be attributed to external factors such as the software, or the teacher (Thatcher *et al.*, 2008).

Another group believe they will be able to succeed unless proven otherwise by something such as repeated failure (Coffee and Rees, 2011). While repeated success coupled with effective attributional feedback gave positive results that were transferable and durable (Rascle *et al.*, 2015) suggesting that efficacy can be increased or decreased depending on the circumstances, supporting a finding from 1990 (Perry and Penner, 1990).

This increase in the level of self-efficacy is important as a number of studies have found that people with high self-efficacy have lower levels of anxiety around technological interactions (Durndell and Haag, 2002; Sam, Othman and Nordin, 2005; Wilfong, 2006; Mcilroy, Sadler and Boojawon, 2007; Saadé and Kira, 2009; Ekizoglu and Ozcinar, 2010; Celik and Yesilyurt, 2013; Lee and Huang, 2013). This level of high self-efficacy has a greater impact than computer experience (Wilfong, 2006) in some cases, perhaps, as discussed above, when the high level of self-efficacy is justified.

Overall it appears that the state of mind of the person when approaching a task can have an impact on how successful they are at achieving that task. This success or failure then either increases or decreases confidence depending on the position in the first place.

E.G. Student A is confident but meets an error. They believe that they will be able to succeed so persevere until they complete the task. They have succeeded, and this supports their self-belief.

Student B is not confident but still succeeds. They believe that this was only because the task was easy. If they meet a problem, then this is the cue to give up as they were never going to be able to do it anyway.

(Brophy, 1998; Dickhäuser, Buch and Dickhäuser, 2011)

The field of attribution-based feedback seeks to manage a way out of the negative feedback loop (Försterling, 1985; El-Hindi and Childers, 1996; Coffee and Rees, 2011; Rascle *et al.*, 2015) as do many of the therapies used to relieve anxiety in other areas and these approaches can also have the effect of increasing self-efficacy (Phelps and Ellis, 2002). None of these interventions will be successful if the participant cannot understand and explain how they are feeling about working with technology. This ability to have discourse about emotions is termed emotional intelligence.

Emotional Intelligence (EI)

Emotional intelligence (EI) initially defined as the capacity to be aware of emotions in the self and others, and be able to both control and express them (Goleman, 1995) has been expanded to include the idea that this awareness enhances thinking (Mayer, Salovey and Caruso, 2004) EI theory suggests that alongside cognitive intelligence there is a way of dealing with the emotions that can impact on the effectiveness of the person (Lizeretti and Extremera, 2011). Having a high EI was found to increase coping ability and stress reduction (Kluemper, 2008) and learning about it increased people's feelings of control (Tatar, 2012). A finding reinforced with work among those with anxiety disorders (Lizeretti and Extremera, 2011; Summerfeldt *et al.*, 2011).

Although EI is of great importance in the management and leadership fields (Goleman D, Boyatzis R, 2004; Boyatzis, Smith and Blaize, 2006; Hicks and McCracken, 2011) it is also thought to be beneficial in understanding and treating anxiety (Lizeretti and Extremera, 2011; Summerfeldt *et al.*, 2011) and therefore of interest in this research. There is some debate as to whether emotional intelligence would be useful in indicating life skills or self-confidence with some finding that personality is a better indicator (Bastian, Burns and Nettelbeck, 2005) although a more recent study found EI to be a better predictor of anxiety than personality (Russo *et al.*, 2012).

Having a low level of emotional intelligence, as indicated above, could lead to feelings of frustration and anger.

Frustration or anger

Frustration manifests when there is something in the way of people completing a task or achieving what they set out to do (Klein, Moon and Picard, 2002; Bessière *et al.*, 2006). This could be a lack of knowledge or understanding as identified in a small study, (Shah, Hassan and Embi, 2012) and can also be occasioned by being interrupted (Kirschner and Karpinski, 2010). The impact of frustration, it is suggested, can move the user between paired states e.g. excitement and anxiety, although this is not totally convincing to some (Coffield *et al.*, 2004).

There is a view that people react to frustration in a variety of ways from rage to doing nothing, suggesting that biological responses to frustration can feed into the emotions causing the user to become angry too (Baars *et al.*, 2011). Unsurprisingly when a person is already in a low mood or frustrated by other causes they are more likely to become angry with a computer (Charlton, 2009) when it fails to meet their expectations or exhibits unhelpful behaviour such as crashing or freezing. Alternative findings suggest that someone who is anxious may become frustrated more quickly than someone who is calm (Anderson, 1996).

Bessière et al (2006) also found a link between self-efficacy and frustration in that someone with high self-efficacy did not give up however frustrated they became because they believed they would find the answer and so this was a positive driving force (Bessière *et al.*, 2006).

Learning does seem to be improved if frustration can be removed from the experience (Sun *et al.*, 2008).

2.2.4 *Summary of obstacles section*

Whatever the obstacle, it seems that having to work to overcome it introduces a level of stress or concern which for some is more significant than for others. In some cases, this manifests as anxiety. The following section explains what anxiety is and explores current thinking around its impacts and mitigation strategies.

2.3 Understanding Anxiety: Its symptoms and impact

Anxiety has been mentioned as a result of having to overcome obstacles to interaction and engagement with technology, so this section explores the literature around the definition, impact and treatments for anxiety.

Anxiety is a recognised condition which causes a range of symptoms including palpitations, sweating, shaking, shortness of breath, stomach upsets and a feeling of dread (American Psychiatric Organisation, 2010). Disorders associated with anxiety are the most common psychiatric disorders with 28% lifetime prevalence (Tye *et al.*, 2011) suggesting that over a quarter of the people who suffer from a form of anxiety will have it for their whole life although its severity might change.

Neurologists claim that anxiety has its roots in the amygdala section of the brain and the response to anxiety is governed by chemical reactions in the brain although the hippocampus is also involved to some extent (Meyer-Lindenberg, 2010). Treating anxiety by suppressing the chemicals that trigger the anxious responses with the use of drugs would have the effect of making the person feel fewer of the symptoms but would not address the root cause of the anxiety (Attwood *et al.*, 2011) so is a solution rather than a cure. However, once the symptoms are lessened there may be more of a chance of being able to establish the cause of the anxiety and work with the sufferer to reduce it. It seems unlikely that total elimination would be possible as fears and anxieties take little to reinforce them (Sah and Westbrook, 2008)

It has been suggested that people who are generally anxious have a higher degree of left brain activity than right brain activity (Matthews, Deary, & Whiteman, 2003:345 Wilt, Oehlberg, & Revelle, 2011). Left brain activity is typified as analytical with right brain activity more likely to encompass abstract thinking (Rosen and Weil, 1992; Parsons and Osherson, 2001). Once they are in a situation that causes particular anxiety, there is, in addition, extra activity in the right brain. Therefore, when a person, who has an anxious trait, is put into an anxiety inducing situation, such as working with a computer, both their analytical thinking and their abstract thinking are involved in being anxious and are less able to problem solve or make decisions (G Matthews et al., 2003:345). It has also been seen that under threat the brain tends to direct effort towards processing rather than recall (MacLeod and Mathews, 1991) and that this effect is present even when the threat is removed (Basten, Stelzel and Fiebach, 2012). The idea of sidedness of the brain is contested as research becomes more advanced and although some specific functions, such as sight or motion, predominantly reside in certain areas of the brain, concepts such as personality are becoming less easy to locate (Shmerling, 2017).

From the research cited above it could be inferred that someone who is anxious when interacting with technology would have diminished problem-solving ability and also find it hard to remember what to do thus reducing their effectivity substantially. A reduced level of effectiveness was confirmed in a study (n.233) in the USA for students with computer anxiety (Tarafdar, Tu and Ragu-Nathan, 2010) and is a key component in the motivation for other research (King, Bond and Blandford, 2002; Sun *et al.*, 2008) suggesting that whatever model is used to describe what is happening inside the brain, the impacts of anxiety are visible in levels of achievement.

Anxiety also seems to impact upon behaviour like other personality traits (Wilt, Oehlberg and Revelle, 2011). One type of behaviour, exhibited by anxious people, is to continually scan for threats which are related to their particular area of concern (Matthews, Deary and Whiteman 2003:350) but then, when they find a threat, they focus all their attention on it.

This results in a narrow field of focus (Matthews, Panganiban and Hudlicka, 2011) with attention seemingly being focussed on the most threatening aspect (G Matthews et al, 2003:348; Wilt, Oehlberg, & Revelle, 2011).

This sequence of behaviours may be unhelpful when working with computers. For instance, helpful hints are often delivered in side bars which would be missed by people exhibiting a narrowed field of focus or simply ignored as found in research around learning a new game (Alkan and Cagiltay, 2007). This idea is supported by a small study looking at help-seeking behaviours which found that anxious people had a much smaller repertoire of strategies to call upon (Lei Wu, 2010) while having a wide range of help seeking strategies has been found to be important in achievement in a number of studies (El-Hindi and Childers, 1996; Dickhäuser, Buch and Dickhäuser, 2011; Appel, 2012). Conversely, for those who are in the scanning phase, the overload of information can be intimidating (Tarafdar, Tu and Ragu-Nathan, 2010; Riedl *et al.*, 2012).

From the studies it can be seen that, anxiety inhibits problem solving behaviour, limits decision making, makes recall difficult and can narrow a field of focus. It also has physical symptoms such as increased heart rate, sweaty palms and fast breathing. If these symptoms are occasioned by working with technology then avoiding the interaction seems like a sensible choice and avoidance is a common strategy employed by anxious people (Meier, 1985; Weil, Rosen and Wugalter, 1990; Cuijpers and Schuurmans, 2007; Thorpe and Brosnan, 2007). There are other reasons that people might not interact with technology and these are explored in the next section.

2.3.1 *Techniques used to reduce a range of anxieties*

There is a plethora of research about how to relieve anxiety which is summarised at various dates by a range of reviewers (e.g. Hirai & Clum 2006; Cuijpers & Schuurmans 2007; Delmonte 1985; Coull & Morris 2011) as well as a range of therapies to counteract panic, a severe form of anxiety (Meuret *et al.*, 2010). There are a variety of anxiety management techniques ranging from the tried and tested drug therapies to newer techniques with over 135,000,000 hits for the phrase “anxiety therapy” on Google (13/01/2015).

If the view is taken that anxiety is a trait then there is nothing that can be done to mitigate this anxiety as traits are stable and an intrinsic part of an individual’s personality (Matthews, Deary and Whiteman, 2003), however trait anxiety may give rise to a state of anxiety which can be mitigated. At the very least an individual could be given strategies that might help them to manage the anxiety even if the root cause cannot be addressed. There are a range of anxiety management strategies and these have been grouped into three types: Physical where something is changed, Psychological where thought patterns are challenged, and Education which covers both how and what people are taught and learn.

Physical

These are interventions that involve some physical activity or some physical change in the environment or state of the sufferer and may help to manage the symptoms of anxiety.

Exercise

"To engage in physical activity to sustain or improve health and fitness" (OUP, 2015).

There is a prevalent and popular belief that physical exercise can relieve the symptoms of anxiety although "*So far there's little evidence for the popular theory that exercise causes a rush of endorphins*." (Dishman and Sothmann, no date) It can be seen that regular exercise does seem to have a positive impact in the management of stress levels (Dishman and Sothmann, no date; Salmon, 2001; De Moor *et al.*, 2006; Shirifard and Honari, 2012), although its value in the context of instantly alleviating an anxious moment has not been explored. Exercise has been found to impact positively on brain volume in older participants but has no impact for younger people in one study (Colcombe *et al.*, 2006) although the relationship between brain volume and anxiety is not clear.

Breathing

It is understood that anxiety can cause shallow breathing and in extreme cases this can also manifest as chest pain. There is often a vicious cycle as people become anxious their breathing is affected, and then anxiety about breathing kicks in and people become more anxious often leading to a panic attack. Controlling breathing is thought to help to reduce the feelings of anxiety (Meuret *et al.*, 2010; NHS, 2015).

There are many smartphone apps that can support calmer breathing. One typical example is available at www.flowygame.com which has been developed as a result of research and with the support of King's College London and the NHS, to help someone having a panic attack or moment of anxiety to manage their breathing and symptoms of anxiety. There are many other apps also available which support similar self-management. This growth area of self-management and personal control apps, presents a range of choices for finding a useful strategy for managing an individual's anxiety.

Drugs

Although this is a strategy that is without the reach of this research it is briefly discussed here for the sake of completeness. For the severe cases of anxiety there are a range of medical treatments that treat the symptoms of anxiety without addressing the cause of the anxiety (NHS, 2016). They are usually used alongside other therapeutic treatments such as those discussed above which do address the causes.

- Selective serotonin reuptake inhibitor increases the amount of serotonin in the brain and acts as an anti-depressant
- Serotonin and noradrenaline reuptake inhibitors (SNRIs) increases the amount of serotonin and noradrenaline in the brain
- Pregabalin is normally used to treat epilepsy but has also been found to be beneficial in treating anxiety
- Benzodiazepines are sedatives that are fast acting and may help to relieve a particular episode of anxiety

Adapted from NHS UK information page (NHS, 2014).

Play

Use of play can release tension and introduce an element of fun. It has been found to be beneficial in treating anxiety with children (Jun-Tai, 2008; Koller and Goldman, 2012) and may have a place in the management of computer anxiety. Using games to teach computer skills has been found to be successful (Graesser *et al.*, 2009) so gamifying the environment may help to reduce computer anxiety. Some correlation between the amount of internet use and the playing of games has been found (Joiner *et al.*, 2012b). In Powell's review several studies were identified which found that playfulness was negatively associated with computer anxiety (Powell, 2013) so trying to increase the playfulness of software or the computer related tasks may be useful. Players who performed well in games were found to predominantly use a trial and error approach (McPherson and Burns, 2008) and this strategy is often avoided by those who are computer anxious, so developing their playing skills might be a helpful approach in developing strategies.

Summary

These strategies that engage the sufferer in different sorts of activities serve to remove the cause of the anxiety as the focus of the sufferer. This allows them to continue to engage, but at a different level of intensity which seems to reduce the levels of anxiety. Physical activity can also mitigate the impact of the symptoms of anxiety serving to dissipate adrenalin for instance. It may not alter the thoughts though and these will be looked at next.

Psychological

Psychological interventions are those that impact on the thoughts of the sufferer in an effort to help them overcome their anxiety through positive thought cycles. They might also have the effect of increasing self-confidence which is seen as a useful element in avoiding anxiety (Qashoa, 2014). Some examples of these are discussed in more detail.

Cognitive Behavioural Therapy (CBT)

"A type of psychotherapy in which negative patterns of thought about the self and the world are challenged into alter unwanted behaviour patterns or treat mood disorders such as depression" (OUP, 2015).

CBT is endorsed by the NHS and an online NICE approved CBT coach can be prescribed or sessions with a therapist can be bought (Ultrasis, 2015) Research endorses the use of a form of on-line anxiety reduction although this is not confined to CBT (Beard and Amir, 2008; Rose *et al.*, 2013).

CBT is one of a range of techniques defined as a talking therapy (Gov.uk, 2014). These help people to alter their thoughts and reactions in order to deal with their problems and CBT has been increasing in popularity since its introduction in 1997 with Coull and Morris (2002) conducting a review of the clinical effectiveness of the range of self-help interventions (Enright, 1997; Bloom, 2002; Coull and Morris, 2011). The conclusion of the review brings into question the validity of research in this area but does not doubt the validity of the process certainly in a clinical setting while Cuijpers and Schuurmans (2007) suggest that self-help is a really valuable approach although they have some caveats around diagnosis and motivation to complete the therapy (Cuijpers and Schuurmans, 2007)

There is a tentative suggestion from one study, that CBT is more effective if it takes learning style into account as it recognises that CBT does not often give more than a 50% improvement account (van Doorn, McManus and Yiend, 2012) although the researchers themselves note that this was a small scale project with severe limitations.

CBT can be delivered in a range of ways including: One to one; group; via a self-help text or by using a specifically created computer based application. This last delivery method was found to be increasing in popularity and effectiveness (Lampe, 2009) while the value of CBT alongside drugs is also being explored for anxieties such as panic attacks (Bloom, 2002) and generalised anxiety disorder (GAD) (Borkovec and Costello, 1993; Da Fonseca *et al.*, 2008). The underlying theory is that negative thoughts are connected to physical actions and sensations so reprogramming the thoughts should alleviate the physical symptoms (Kendall, 1994; Gov.uk, 2014). The philosophy is that the trigger does not cause the anxiety but the way that an individual chooses to respond does. If the response is changed the anxiety can be reduced (Clerkin and Teachman, 2010).

This is a similar approach to that used in coaching where the inner voice is attributed with negative reinforcement (Albers, 2011; Anon, 2014) and changing the sound of this can impact on behaviour. CBT has some commonalities with Neuro-Linguistic Programming (NLP) which is also about reprogramming the brain through the use of language, to change the response to stimuli, although the value of this approach has been disputed due to lack of clear scientific evidence (Witkowski, 2010).

CBT is suggested as a potential strategy in dealing with math anxiety so could be relevant here (Blazer, 2011) and it is a technique that, once learnt, can be used in a variety of situations. If the level of computer anxiety was high and causing the individual to be ill or extremely stressed the long-term investment might be worthwhile. The method of delivery would have to be considered carefully as an on-line delivery method for someone with computer anxiety might be counter-productive.

Meditation

Meditation is defined as "Focus one's mind for a period of time, in silence or with the aid of chanting, for religious or spiritual purposes or as a method of relaxation": (OUP, 2015).

Meditation is a practice whereby an individual concentrates or focuses on something specific either within or outside and has been found to be as effective as some clinical interventions (Delmonte, 1985). There is some discussion about whether the act of sitting still and relaxing is the reason for the decrease in anxiety although relaxing on its own is not thought to be always helpful (Cuijpers and Schuurmans, 2007). It can be seen that those who practice meditation seem to be less anxious on the whole than those who do not, although it is not clear if this this causal or effective (Delmonte, 1985). There are a wealth of resources to allow individuals to learn how to meditate easily available in self-help books or as e-learning courses.

It may be a useful technique to teach the computer anxious in order to help them manage the anxiety in the moment. It might help them to isolate the exact cause of their anxiety and this could enable them to take steps to eliminate this.

Mindfulness

Mindfulness has been defined as "A mental state achieved by focusing one's awareness on the present moment, while calmly acknowledging and accepting one's feelings, thoughts, and bodily sensations, used as a therapeutic technique." (OUP, 2015) while Edenfield and Saeed (2012) have a more detailed definition.

> "Mindfulness refers to the process of intentionally bringing one's attention, in a non-judgmental manner, to the internal and external experiences that exist in the present moment. This may include awareness of sensations, thoughts, bodily states, consciousness, and the environment, while simultaneously encouraging openness, curiosity, and acceptance."(Edenfield and Saeed, 2012).

This technique is becoming more popular and is used by psychologists and coaches to help their clients manage stressful situations and it seems that one of the main focusses is on the removal of judgement from the situation (Brantley, 2003; Howell *et al.*, 2011). The National

Institute for Clinical Excellence (NICE) recommend mindfulness techniques to people who have suffered with depression more than three times as they see it as a useful strategy to help people change the way that they respond to their thoughts (Anon, 2016) although they position it within CBT as part of that process.

Some suggest that it is different from meditation in that it is active and does not relax the participant as meditation does by distracting them from the here and now, but equips them with the ability to examine the current emotions, accept them and then move on (Edenfield and Saeed, 2012). Although in the past mindfulness has been seen as a key component of meditation rather than as a different technique (Roemer and Orsillo, 2002). Midfulness has been found to be a useful technique, even in a short period, to support sufferers of math anxiety prior to a test (Brunyé *et al.*, 2013). It was not found to be as impactful as CBT for those with social anxiety disorder (Lampe, 2009). Work in Africa found mindfulness correlated with reduced anxiety in situations around racial prejudice (Graham, West and Roemer, 2012). It seems that mindfulness requires a period of training either on-line or with a trained professional and personal practice before it can be employed effectively (Roemer and Orsillo, 2002). Once learned some think it gives immediate beneficial results (Delmonte, 1985) while others think it takes a long time to learn how to apply it effectively (Ben-Hur, Kinley and Jonsen, 2012).

There was still a paucity of sound and compelling evidence to support the claims that this is a useful technique to address anxiety (Edenfield and Saeed, 2012) but since 2012 the field has grown and there are several studies on the NICE website that strongly support the use of mindfulness to address anxiety such as that conducted by Wetherell et al (Wetherell *et al.*, 2017).

For the computer anxious it might be a useful technique in that it allows them to stop, accept that they feel anxious and importantly, not judge themselves because of this. This could support the sufferer in building their self-efficacy. When they are calm, they can then look to what might be causing the anxious feelings. Identifying the specific cause may allow them to take steps to deal with it. On the other hand, given that there is a period of learning before the technique can be applied effectively it may be useful as a long term solution but would not be useful as an immediate response to an episode of computer anxiety. It would need to be supported with coaching as while on-line courses are freely available, for those with computer anxiety this might not be altogether appropriate.

Coaching

An expert in coaching works with an individual to help them solve a pressing issue or develop a skill (Thomas and Saslow, 2007). Coaches believe that an individual has the answer and the coach is just there to help them to find it (Nunnally, 2008; Hicks and McCracken, 2009).

Coaching can be used in different contexts:

- Executive - to develop skills (Atkinson, 2011; Ben-Hur, Kinley and Jonsen, 2012; de Haan *et al.*, 2013)
- general -to ‘fix’ a problem (Thomas and Saslow, 2007; Stradling, 2009; Flaherty, 2011; Taie, 2011)
- life coaching - to support the client through a challenging life situation (Edwards, 2012) and can be work-related or personal.

It is not always easy to measure the impact of it (de Haan *et al.*, 2013; van Oorsouw, Embregts and Bosman, 2013) and in many work situations coaching is used predominantly as a leadership development tool (Edwards, 2012), although it is often thought of as a technique that can be used to ‘fix’ problem employees (Thomas and Saslow, 2007; Wenson, 2010; Edwards, 2012). Often places of employment bring in coaches from outside the business (Smither and Reilly, 2001; Mulec and Roth, 2005) but the idea of internal coaches is increasing (Mansor *et al.*, 2012; Thompson, 2012).

The idea that coaching is the first in a three step programme where mentoring and then counselling are prescribed in order to address a range of issues was suggested (Minter and Thomas, 2000) but others see coaching as a way of moving forward or discovering rather than recovering (Wright, 2005).

The time with a coach is usually prescribed and spread over several one hour sessions (Thomas and Saslow, 2007), although there is a new idea of corridor coaching. This technique suggests less formal conversations which might take place in a corridor. The coaching is very short, less formal and aims to energise participants so that they solve their own issues (Grant, 2010). This is also termed as popcorn coaching (Hicks and McCracken, 2013) or the more common term of watercooler coaching.

Many external or independent coaches have a wealth of relevant experience and some have a level of qualification but coaching is an area that is unregulated in the UK, and at the moment anyone can call themselves a coach (Mulec and Roth, 2005). Many managers and leaders currently act as coaches (Minter and Thomas, 2000) and this type of coaching is on the rise with many companies aspiring to have a coaching culture (Garr, 2012; Thompson, 2012) where everyone behaves as a coach to each other.

One of the tools in the coaches repertoire is that of active listening (Wright, 2005; Nunnally, 2008; Parker, Hall and Kram, 2008; Gill, 2011; Segers, Vloeberghs and Henderikx, 2011) and this has been seen to be helpful for people working through anxious situations. Sometimes by vocalising an anxiety and working through a range of possible outcomes a sufferer finds that the anxiety is diminished or even removed altogether (Hicks and McCracken, 2009).

Self-talk is one of the ways that people become trapped in a spiral of low achievement and increasing anxiety (Connolly, Murphy and Moore, 2009) i.e. they tell themselves that they are going to be unable to achieve and when this is true, it confirms their belief. This is characterised in literature as attribution: the reasons one gives oneself for an outcome (Abramson, Seligman and Teasdale, 1978; Brophy, 1998; Hawi, 2010; Coffee and Rees, 2011; Rascle *et al.*, 2015). The theory suggests that by retraining the subject, they can change the attribution of failure away from one's own inadequacy or fault and towards specific and objective reasons that can be fixed (Perry and Penner, 1990; Brophy, 1998; Chodkiewicz and Boyle, 2014). The findings suggest that changing attributional feedback in one area actually changes it for the whole person and can therefore impact positively across a number of areas (Rascle *et al.*, 2015). There has been some specific work in this field related to computer anxiety (Phelps and Ellis, 2002). In this study students were taught about attribution theory and encouraged to reflect on their own approach. Students realised that the way they were thinking did have an impact on how they responded to problems or setbacks while using technology. This may be an approach that a coach or teacher could use in order to support a person suffering from computer anxiety to understand ways in which they could help themselves.

The range of approaches under the coaching umbrella might lend themselves to supporting the person with computer anxiety. Popcorn or corridor coaching might be delivered by peers or the tutor in the classroom while a longer-term response could be delivered by a nominated coach to help the sufferer respond in a more positive way to the situation using any of the many techniques discussed already in this chapter.

Distraction

In pain management, distraction through play has been seen to be a useful tool, certainly in the paediatric field (Jun-Tai, 2008; Koller and Goldman, 2012). It might be true that distraction through play can also be used to alleviate the symptoms of anxiety. It is also referred to as refocusing or redirection. Play is discussed more fully in an earlier section. Other forms of distraction may be toys that are designed to interact with the user as some form of emotional support can sometimes help a user get out of the frustration anxiety loop (Klein, Moon and Picard, 2002).

While distraction could be seen as a useful tool for immediate anxiety management (Koller and Goldman, 2012) it does not address the cause of the anxiety which may well reappear as soon as the distraction is removed. It is generally used as a way of managing general anxiety – where a person is anxious nearly all the time, and distraction can help them to move away from self-monitoring and into a more positive space. Given this it is unlikely to be a useful tool in the management of computer anxiety unless it gives people a window in which they can calm down and be able to refocus on the task with a clearer mind.

Music therapy

The use of music to manage anxiety has been explored in the field of paediatric pain management and pre-procedure anxiety reduction. The results are interesting and positive with music seeming to reduce the distress felt by the participants (Maratos *et al.*, 2008; Bradt, Dileo and Shim, 2013). There are two different aspects to the use of music:

- Music medicine: predominantly the area of listening to music as a relaxant and distractor where the patient is a passive recipient of the music
- Music therapy: predominantly active making of music and it is this area that has had the most significant results among children

(Maratos *et al.*, 2008; Bradt, Dileo and Shim, 2013).

Music therapy has also been used in the treatment and management of mental health with positive results (Gold, Voracek and Wigram, 2004; Nizamie and Tikka, 2014). The combination of music making and lack of judgement during the process also seems to have a fundamental influence on the working of the brain, restoring a degree of balance which in the long term may also have a positive impact on mood. Using wind instruments seems to have a double impact as the requirement to breathe deeply to create music relaxes the body and helps to counteract the fight or flight chemicals, and the impact of the music making itself also helps to relieve the symptoms of anxiety (Clements-Cortes, 2012).

It might be the case that making music before interacting with technology or even during the process could reduce the level of computer anxiety especially if a wind instrument isused (Field et al. 1998; Clements-Cortes 2012) while having music playing in the background could have an effect on the physical symptoms of anxiety (Field *et al.*, 1998).

Relaxation and breathing

For maths anxiety, relaxation prior to, or during a maths encounter is one of the suggested strategies and includes ideas such as breathing and taking breaks (Blazer, 2011). Brief breathing exercises before a maths test was found to be effective in improving performance for those with high levels of maths anxiety (Brunyé *et al.*, 2013). Relaxation has also been found to be an effective therapy for General Anxiety Disorder (Borkovec and Costello, 1993) and writing anxiety (Qashoa, 2014). A major meta-study concluded that relaxation was significant in the treatment of a range of anxieties (Kim and Kim, 2017).

Education

There are three strands to the education theme.

- Firstly, educating people with anxiety about anxiety, its physical manifestations, causes, impacts and biology as knowing about something can help to reduce its impact although sometimes paying attention to it has been found to increase the levels of anxiety (Bloom, 1985).

- Secondly, educating people about the mechanics of learning so that they can develop strategies that support their own learning journey (as discussed in the section about learning theory).
- Thirdly, educating people in the task that they are facing so that they have the appropriate skill set to deal with the problem thus avoiding any operational level anxiety.

These strands are explored in more detail below.

Anxiety awareness

There is a school of thought that suggests that the more understanding an individual has about the physical processes that happen when they feel anxious, and the causes of their own anxiety, the more they feel in control and the less anxious they are. This can be seen in the literature that Mental Health organisations give to their patients (Mental Health Foundation, NHS information, no date). Conversely paying attention to the anxiety can make it more intense (Bloom, 1985). Alternatively telling people that the symptoms of anxiety are actually useful in helping them to think seemed to both reduce the symptoms and boost performance in those with maths anxiety (Maloney and Beilock, 2012).

Checking with the student about their awareness of anxiety, and addressing any misconceptions or gaps in knowledge, looks to be a good start point in dealing with their anxiety.

Learning strategies

When people are presented with a range of different ways to learn they can choose methods which help them to learn the best (Puteh and Ibrahim, 2010). As discussed earlier, learning strategies are wide and varied but sharing a number of approaches may help people to discover new ways of learning that they had not previously considered. It is to be treated with caution though as some research found that learning approaches were not changed in undergraduates although those on postgraduate courses did show a change towards deeper learning (Samarakoon, Fernando and Rodrigo, 2013). As also discussed earlier, there is agreement that knowing about learning can help people to learn more successfully. Ensuring that a student's preferred way of learning is available may help to reduce their anxiety or help them to see that their anxiety is showing them where they need to focus attention.

Specific training

Often, when new processes or ways of working are introduced into the workplace, specific training sessions are organised. These are often workshops with an expert leading the day and the staff in a classroom type session. It has been noted that previous learning experiences can impact on new ones (Bloom, 1985) and that increasing skill level can have a positive impact for some people (Bodie, 2010). While for others it is more about educating them to think more positively about the experience (La Paglia, Caci and La Barbera, 2008). Once people know how to do something they are often less anxious about tackling it. It has been found to be important that the way the training is delivered is appropriate for the trainee or it can make them more anxious (Ruble and Stout, 1993; Chou, 2001; Coffield *et al.*, 2004; Gravill and Compeau, 2008; Galy, Downey and Johnson, 2011).

Software developers are attempting to use Artificial Intelligence (AI) to incorporate training within their systems. Artificial intelligence is when the coding of an application makes it appear to the user as if the application has intelligence as it is adapting to the responses of the user to make the experience more personal. Alternatively developers incorporate assistants within their software that can support the user, although these can sometimes be more of a hindrance than a help e.g. Microsoft's paperclip (Swartz, 2003). In other situations, the humanising aspect of a seemingly intelligent interface can help (Klein, Moon and Picard, 2002; Chou and Hsiao, 2007). The degree and design of the AI support coupled with the personality of the user can impact on its effectiveness (Beckwith, Burnett and Grigoreanu, 2006). This can make it difficult to deliver effectively across a group of individuals without careful preparation and design. In spite of this difficulty, AI is becoming more prevalent within education with adaptive tests for example (Hao, 2010; Nikou and Economides, 2017) for checking learning and providing next steps and advice based on scores.

2.3.2 *Summary of anxiety, its symptoms and treatment*

Anxiety can cause people to feel ill and want to avoid the cause of the anxiety. The symptoms can be severe and debilitating but can be addressed with a wide range of approaches. These approaches can be grouped into physical, psychological and education related areas. While they do not all resolve the root cause of anxiety they support the user in managing the symptoms and mitigating their impact. Finding the right one for each individual may be time consuming but could result in a major life change for them. People are different and may react differently to different situations so there is no single response that will work. This difference between people has been of interest to researchers since there have been people and is explored next.

2.4 Personality Type

Psychologists have observed many people over time and constantly attempt to explore and explain the relationships between the way they behave and why (G Matthews et al., 2003:4). Personality type is the classification of those differences between people's behaviour. There are some, like Plato, who would argue that it is impossible to classify all people into groups or types as each person is an individual and there would have to be an infinite number of types. The common view though, suggests that a general theory can be arrived at which describes the similarities of peoples' behaviour (G Matthews et al., 2003:6) as people often demonstrate some common behaviour patterns that are consistent across a range of situations. It is thought that specific personalities are more likely to succeed in certain subject areas either in education or the workplace, and that a mismatch between personality and subject area can cause undue anxiety (Woszczynski *et al.*, 2003). Although other research suggests that a whole range of personality types can be found among software engineers which undermines that conclusion (Cruz, Da Silva and Capretz, 2015) This controversy has not stopped the creation of a number of tests businesses use to asses the suitability of applicants.

There is some debate too about whether personality is a trait, fixed for the lifetime of a person, or malleable over time in response to experience i.e. a state (Spinath *et al.*, 2003). Some of the models, while distinct, identify similar characteristics and have been used for verification of new models (Zuckerman *et al.*, 1993). While most personality models present a mixture of traits or behaviours, e.g The Big Five, MBTI and others, to describe an individual, there is also the suggestion that there is a single unique identifier that can be used to classify personality although this does not have strong support (Hopwood, Wright and Brent Donnellan, 2011).

This long history of personality research from the ancient Greeks to the end of the twentieth century (Winter and Barenbaum, 1999) identifies a number of different areas and has resulted in the creation of a number of different models which attempt to identify and classify personality. Some of the key literature is explored in more detail in the following sections.

2.4.1 *Myers-Briggs Type Indicator (MBTI)*

One model uses the Myers Briggs Type Indicator (MBTI) to find out which category an individual fits into. This is a well-known tool throughout industry as it is often used as part of the recruitment process (Capretz, 2003) although it is not universally liked (Unknown, 2013), and there is a body of opinion that seeks to declare this approach as “bunkum” (Adams, 2010; Eveleth, 2013). Some feel that restricting the description of all the personalities to only 16 types is unrealistic and that the constructs are not valid (Zemke, 1992; Boyle, 1995; Unknown, 2013; Gerras and Wong, 2016) with many relating them to nothing better than horoscopes (Adams, 2010) and noting that psychologists do not use this measure in their work (Eveleth, 2013).

In spite of, what many see, as its lack of credibility, MBTI has been used in a number of research projects relating to computer use and anxiety (Capretz & Ahmed 2010; Towell & Lauer 2001; Bishop-Clark 1995) and there may be some merit in comparing how people choose to describe themselves with their levels of computer anxiety, and my research will be looked at through that lens. Written in 1962 by Myers and Briggs, the MBTI measures responses to a questionnaire. The responses can be grouped to give a range of personality types. These reflect the four ranges put forward by Jung:

- Extraversion (E) or Introversion (I)
- Sensing (S) or Intuition (N)
- Thinking (T) or Feeling (F)
- Judging (J) or Perceiving (P)

A personality is described by a combination of four letters, thus giving rise to potentially 16 types (Briggs Myers, 2000). The test has to be delivered by trained individuals who give specific and focussed personal feedback and has a fairly high cost implication both in terms of money and time for subject and administrator.

The results from one small research study suggests that there is some merit in more research around relating the levels of computer anxiety to MBTI personality profiles (Whitley, 1996b) and it has been found that in the area of programming there is a predominance of introverts as described by MBTI. This could be due to the often isolated working conditions of programmers, a situation which some research found to appeal to those identifying as introverts (Whitley, 1996b; Capretz, 2003) although in another area of computing science, that of exploratory testing, extroverts predominate (Shoaib, Nadeem and Akbar, 2009). Together these findings could lead to the conclusion that the introvert/extrovert dimension is not relevant for computer anxiety although it is possible that different learning or working environments do seem to have an impact on the level of computer anxiety for specific personality profiles. e.g. extroverts prefer to learn in teams (Elizabeth R. Towell and Lauer, 2001). Further research confirms that introverts prefer to take on-line classes while extroverts prefer to learn in a social setting (Harrington and Loffredo, 2010). It does seem to be the case that the extrovert/ introvert dimension is significant in providing valuable learning in adaptive systems (Kim, Lee and Ryu, 2013) in that the different personality types were found to respond to the messages in an adaptive system in different ways and have different learning styles.Contrary to this, a study in the field of engineering found that personality type did not have an effect on learning via technology (Elkins *et al.*, 2002) although this was also a small group.

Overall, given the body of opinion from scientific sources, it would seem that MBTI is useful as the beginning of a conversation about how a person feels about themselves but may not be founded on thorough research and should not be taken as a definitive description of an individual's personality.

2.4.2 *16PF*

The 16PF model looks at a selection of traits and the degree to which they are manifest in an individual.

Cattell identified factors that he believed contributed to a personality in 1946 (Cattell and Schuerger, 2003). This model lists 16 traits that he found made up a personality and can be seen in fig 1.

In later work these 16 were grouped together into 5 'global' traits as illustrated in fig 2.

Rapid Reference 1.2

16PF Scale Names and Descriptors

Descriptors of Low Range	Primary Scales	Descriptors of High Range
Reserved, impersonal, distant	**Warmth (A)**	Warm, participating, attentive to others
Concrete, lower mental capacity	**Reasoning (B)**	Abstract, bright, fast-learner
Reactive, affected by feelings	**Emotional Stability (C)**	Emotionally stable, adaptive, mature
Deferential, cooperative, avoids conflict	**Dominance (E)**	Dominant, forceful, assertive
Serious, restrained, careful	**Liveliness (F)**	Enthusiastic, animated, spontaneous
Expedient, nonconforming	**Rule-Consciousness (G)**	Rule conscious, dutiful
Shy, timid, threat sensitive	**Social Boldness (H)**	Socially bold, venturesome, thick-skinned
Tough, objective, unsentimental	**Sensitivity (I)**	Sensitive, aesthetic, tender-minded
Trusting, unsuspecting, accepting	**Vigilance (L)**	Vigilant, suspicious, skeptical, wary
Practical, grounded, down-to-earth	**Abstractedness (M)**	Abstracted, imaginative, idea oriented
Forthright, genuine, artless	**Privateness (N)**	Private, discreet, nondisclosing
Self-assured, unworried, complacent	**Apprehension (O)**	Apprehensive, self-doubting, worried
Traditional, attached to familiar	**Openness to Change (Q1)**	Open to change, experimenting
Group-oriented, affiliative	**Self-Reliance (Q2)**	Self-reliant, solitary, individualistic
Tolerates disorder, unexacting, flexible	**Perfectionism (Q3)**	Perfectionistic, organized, self-disciplined
Relaxed, placid, patient	**Tension (Q4)**	Tense, high energy, driven

(

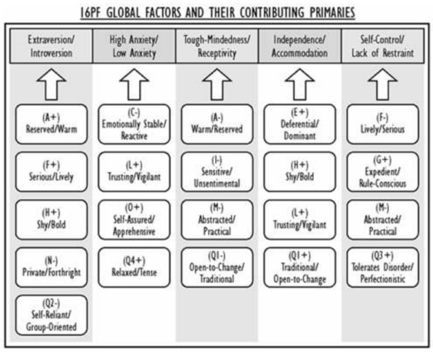


Fig 2. How the 16 personality factors combine to make up 5 personality traits.(Cattell and Schuerger, 2003)

Fig 1. listing of the 16 personality factors and their descriptors from Cattell & Schuerger 2003)

The test for 16PF does not have to be administered by a trained psychologist and is aimed at people aged 16 or over. It is in the form of a multiple-choice questionnaire which takes less than an hour to complete. The test has been widely used and there is a large body of normalised data to refer to, however the test is not freely available and has a cost attached.

2.4.3 *Big Five or Five Factor Model*

Building on the work of Cattell, is the Big Five model of personality. This looks at the five robust factors of personality (Digman, 1990) which came to be known as the Big Five or the Five-Factor model of Personality (Maltby, Day, & Macaskill, 2007:177; Nettle, 2007:9). This examines behaviours which are indicative of particular types of personality and groups them together into five trait clusters. These trait clusters each contain six traits (John and Srivastave, 1999; McCrae and Costa, 1999) and it is the extent to which each trait, within a cluster, is manifested that defines a person’s whole personality. The clusters of traits are:

- Extroversion: Someone who scores highly for extroversion is more likely to take risks and be more extrinsically motivated than someone who has a low score. The traits that make up this cluster are warmth, gregariousness, assertiveness, activity, excitement-seeking and positive emotions. The low end is referred to as introversion

- Agreeableness: The very agreeable person will demonstrate a high level of trust, compliance, modesty, straightforwardness, tender-mindedness and altruism. They may be too quick to concur with others. A low score is tending towards antagonism. Sometimes the scale is referred to as ‘Adapter’ (High in agreeableness) to ‘Challenger’ (low in agreeableness).
- Conscientiousness: A high score here indicates a person who is competent and well-organised and although they take time to make decisions they are self-disciplined and motivated by achievement, often referred to as ‘Focussed’. A low score may indicate a lack of direction or, in a more positive view, an ability to be ‘Flexible’.
- Neuroticism: Someone who is a highly neurotic person is likely to react more strongly to negative stimuli than a less neurotic person and is often referred to as ‘Reactive’. They will tend to worry more and be more adversely affected by bad news stories. A person with low levels of Neuroticism may not be careful about avoiding danger but will tend to be emotionally stable or ‘Resilient’.
- Openness: An open person has lots of ideas often straying into fantasy but always with an awareness of aesthetics and their own values. They are often excitable and active and can be referred to as ‘Explorer’. A low score here suggests a person who is closed to experience, sometimes referred to as resistant to change or as a ‘Preserver’.

(Huczynski and Buchanan, 2007; Srivastava, 2011)

Tests for the Big 5 have been used widely in research for a reasonably long period of time (Socan and Bucik, 1998; Hudiburg, Pashaj and Wolfe, 1999; Korukonda, 2005, 2007; Baker and Bichsel, 2006; Furnham, Monsen and Ahmetoglu, 2009; Doerfler and Hornke, 2010). Those who are sceptical about MBTI find the Big 5 to be a valid model backed with scientific research (Gerras and Wong, 2016)

One very short test, which has a large body of data behind it, is found in Nettle’s (2007) book, Personality. This test can be administered and analysed by anyone as it is simple to complete and understand and has a low cost both in term of money and time as it is free of charge and takes a short period of time to administer and do the analysis. However it produces results that give a general overall picture of a population and does not give a detailed picture of an individual.

There appears to be some correlation between some of the traits within the Big 5 and the level of computer anxiety. Anthony, Clarke and Anderson (2000) found correlation between the level of computer anxiety and the trait Neuroticism. They also found that it was inversely correlated with Openness as had Hudiburg the previous year (Hudiburg, Pashaj and Wolfe, 1999) .

People who generally worry or are anxious and have a negative self-view are said to have negative affectivity (NA), while trait anxiety (TA) is a response to a specific threat but its intensity and duration varies between individuals. When Anthony et al (2000) split Neuroticism into (TA) and (NA) it was found that TA was positively correlated with computer anxiety. This seems to be sensible in that people with high TA experience anxiety when they have to face specific challenges, while those with high NA are more generally anxious whatever situation they are in i.e. their anxiety is not exacerbated by a specific issue (Thatcher and Perrewe, 2002). The participants in another study were undergraduates on computer or psychology courses in South Africa and showed around 33% of participants were computer anxious (Anthony, Clarke and Anderson, 2000).

Korukonda (2005) also found a relationship between computer anxiety and the traits of Neuroticism and Openness and later in another study found that Agreeableness also seemed to be a contributory factor (Korukonda, 2007). These studies were carried on undergraduate students in a private university in the USA. This finding was replicated with a meta-analysis of precursors to computer anxiety (Maricutoiu, 2014).

However it has also been found that the personality trait of neuroticism combined with other behaviours such as lying, can lead to problematic use of technology such as overdependence or overuse (Ozturk and Kaymak Ozmen, 2010) which would seem to be the opposite of computer anxiety which manifests as avoidance. This overdependence on computer mediated communication is noted in the media too (Greengard, 2011; Grey, 2015).

The concurrent nature of the different research which has found some connection between particular personality traits and computer anxiety, suggests that this might be a useful avenue for further exploration.

2.4.4 *Summary of personality*

People who use computers will be a mixture of types, which ever method is used to define them, as most people encounter technology in their work. Some types of people are drawn to specific types of jobs and it can be seen that a prevalence of one personality type is common in some specific roles (Pocius, 1991; Prediger, 2000). It has also been seen that particular personality types tend to gravitate towards specific career areas (Prediger, 2000; Antoñanzas *et al.*, 2014). It might be true that in some professions there are higher levels of computer anxiety as the type of personality attracted to those roles is not one that enjoys interaction with technology (Beaulaurier and Taylor, 2005). Some cultures nurture particular personality types, such as emphasising Feeling and these types seem to be more likely to have anxiety during interaction with computers (Carter, Jernejcic and Lim, 2007). In a study around personality variables, it was found that those who self-reported as having pessimistic thoughts, as defined by the researchers, were more likely to suffer from computer anxiety than optimists (Ceyhan, 2006), and this is reflected in findings (Anderson, 1996; Gravill and Compeau, 2008) that indicate positive attitudes reduce computer anxiety. It may also be that culture has a part to play as differences have been seen between European and East Asian students (Liu, 2010).

2.5 Learning theory

Learning theory discusses the strategies and approaches an individual uses to receive and assimilate new information and then apply this new knowledge to novel situations as described by one study for example (Popescu, 2010). There is a strong suggestion that a mismatch between how people want to learn and how they are taught can lead to anxiety about the topic being taught, while on the other hand a match may promote better results (Tulbure, 2011). The learning process and how to facilitate this has been a hot topic among educationalists since education began as explored in this paper summarising the journey (Edgar, 2012). The desire to find a way to describe different learners and the environments that they need has given rise to a plethora of research in the field of learning styles discussed in several meta-critiques of the field (Coffield *et al.*, 2004; Edgar, 2012; Scotland, 2014). One suggestion is that if information is presented in a way that is appropriate for the personality type of an individual, they will be better at problem solving (Fumero and Santamaría, 2010), another that it is only by experiencing something that learning will occur

– the experiential learning model (Kolb, 2014) while others suggest that it is something to do with the focus of control (Anderson, 1996).

As there are so many different approaches only a few are discussed here.

2.5.1 *Learning style*

Educationalists have long held the view that the way people learn varies between individuals, and for a long time it was thought that this was tied to the personality of the individual, was immutable and if not aligned with learning opportunity would be detrimental to the learner (Gargallo López *et al.*, 2013). Much of the work in this area talks about Learning Styles although there is a strong voice that decries this as neuromyth and suggests even though there is a lot of literature about it, it is all flawed research (Newton, 2015). This view is not new as earlier work is also critical (Cassidy, 2004; Coffield *et al.*, 2004; Scotland, 2014) and the idea that one has a learning style which is concrete is not accepted by these reviews (Coffield *et al.*, 2004; Sharp, Bowker and Byrne, 2008; Hatami, 2013).

As much of the research relies upon the individual self-reporting, there is some doubt as to the its reliability (Scotland, 2014) although the process of filling in questionnaires does raise awareness of the learning process and increases understanding of metacognition with individual learners. The importance of not just learning, but understanding how and why learning has occurred is seen as important for learners (Penger, Tekavcic and Dimovski, 2008). Even critics agree that this can help participants to identify and use their strengths and develop their weaknesses. (El-Hindi and Childers, 1996; Coffield *et al.*, 2004). This is a view that is growing in popularity (Urval *et al.*, 2014) although there are have been arguments around how to describe a way of learning (Herbster, Price and Johnson, 1996), a discourse that wonders if a combination of models gives a better picture (Ocepek *et al.*, 2013) and whether it is useful to pander to a preference (Dunn and Honigsfeld, 2013; Ganesh and Ratnakar, 2014) or to disrupt it (Popescu, 2010).

In spite of the voices against the idea, there are still many different learning styles models that appear to be used in many projects, some of which are referenced here, (Bermingham and Mahdi, 2006; Ding and Lin, 2013; Doyle and Jacobs, 2013; Gargallo López *et al.*, 2013; Marek, 2013; Ocepek *et al.*, 2013; Samarakoon, Fernando and Rodrigo, 2013; Khanal, Shah and Koirala, 2014; Urval *et al.*, 2014) and advocated by educators in the classroom (Rolfe and Cheek, 2012). One of these is the VARK (Fleming and Mills, 1992) approach.

VARK describes four learning styles that are used for the processing of new information: Visual, Auditory, Read and Write and Kinaesthetic. There is a simple self-reporting questionnaire that has been used in education for many years with a range of ages as the subjects (James, D'Amore and Thomas, 2011; Flemming, 2014; Ganesh and Ratnakar, 2014; Peyman *et al.*, 2014; Prithishkumar and Michael, 2014). The learning style concept and classification is simple to understand and explain to children, and, as one study confirmed, seems to have some validity (Leite, Svinicki and Shi, 2010).

Educationalists, who assume learning style is a valid approach, are keen to link learning styles to other issues in the classroom such as computer anxiety. Kolb's learning inventory (Kolb, 2014) has been used with a computer anxiety questionnaire by Altinkurt and Yilmaz to identify the traits that they see as being related to computer anxiety (Altinkurt and Yilmaz, 2012). In their work, they found that being indecisive or having a divergent learning style was related to a higher level of computer anxiety. However some people feel that Kolb's work is being given too much credence and disagree that learning styles should be used to inform training or learning approaches (Ruble and Stout, 1993).

In spite of all the arguing it has been seen that different ways of learning do predominate in some sectors (Ozbiçakçi *et al.*, 2011). Participative learning had a positive impact on levels of computer anxiety in this study, so there might be something around matching learning to the learner that is useful and has been seen to positively impact on achievement (Tulbure, 2011). Alternatively, it may be the case that rather than a concrete learning style, people have a learning preference which they adapt to match the situation. This was found to be the case when dealing with math anxiety (Ozgen, 2012).

Learning style may be linked to personality type as found in some research (Dewar and Whittington, 2000; Conti and Mcneil, 2011) but is seen more as a tentative indicator of how a particular person chooses to approach a learning opportunity rather than a factor in that choice. Others feel that it can be influenced by culture (Holtbrugge and Mohr, 2010) and suggest that for educators of multi-cultural cohorts these need to be considered. Further influences of learning style are suggested to include the political environment, the needs of the education sector, the background of the researcher or the thinking of others (Edgar, 2012) which might explain the wide number of theories and models.

Newer work tends to shy away from the idea of an individual having one learning style and instead talks about a learning preference which can change depending on context, motivation, need and style of delivery (Doyle and Jacobs, 2013). So presenting information in a range of ways, allowing students some freedom in how they approach learning and being respectful of other approaches is suggested as a useful way forward (Rolfe and Cheek, 2012). Technology has been seen to be useful in supporting the delivery of a wide range of opportunities (Ayersman and Minden, 1995; Lai, Wang and Lei, 2012), although other older research viewed the use of technology as a waste of time (Ruble and Stout, 1993). As technology has developed hugely since 1993 this dissent can be discounted.

Learning styles has moved towards being learning preferences. The suggestion being that given a range of learning opportunities people will chose the method that they prefer. How people make decisions about how to learn is termed learning approach or strategy.

2.5.2 *Learning approaches and strategies*

The idea of learning preference suggests that people choose a way to approach their learning and the idea that a mismatch between preference and opportunity may promote anxiety.

In 1974 Kolb suggested that there are four stages of learning that are cyclical, and a learner may prefer a particular start point, but that true learning will only occur if the full cycle is completed. He further added that the choices were impacted by how the task is approached and the feelings held about the task (Kolb, 2014). There are many studies that refer to Kolb's work (McClure and Werther, 1993; Burger and Blignaut, 2007; Heaton-Shrestha *et al.*, 2007; Tulbure, 2011; Rolfe and Cheek, 2012; Ding and Lin, 2013; Gargallo López *et al.*, 2013; Ocepek *et al.*, 2013) and those that aim to improve upon it (Manolis *et al.*, 2013). Some of this work specifically looks for a relationship between learning approach and a number of different areas. For example one looked at the type of technology and how this supported people with specific personality and learning styles (Elkins *et al.*, 2002) finding that students who had a match made better progress than those without, so there might be something here that indicates a mismatch could lead to anxiety. This finding is supported by a study which found that a person's learning approach impacted on the benefits of training (Saengratwatchara and Pearson, 2004).

Honey and Mumford (1986) describe how people learn and their model is based on Kolb's work. Although their work is criticised (Caple and Martin, 1994) it is still widely used particularly in the world of work (Sharp, Bowker and Byrne, 2008; Holtbrugge and Mohr, 2010; Tatar, 2012; Gargallo López *et al.*, 2013; Scotland, 2014).

Learning strategy i.e. the way people go about learning can make a difference to how well they learn. It was found in a small study, that teaching people about learning strategy alongside their other learning did see a reduction in their computer anxiety compared to a control group (Namlu, 2003) and this approach is also recommended in other studies (Penger, Tekavcic and Dimovski, 2008; Peyman *et al.*, 2014) as it was seen that greater learning could be achieved as students varied their learning strategies. This may be useful to keep in mind when looking at how to support learners with computer anxiety and seems to centre on giving students a range of options from which they can choose. This type of teaching is often referred to as student centred learning.

2.5.3 *Student-centred learning*

There is a trend away from the didactic, teacher-as-expert style of teaching to one where the student is a partner in the learning journey and indeed in some cases the driver as described in this study (O'Neill and Mcmahon, 2005). This approach may be something that needs to sit alongside the development of a learning strategy to allow informed choices.

Research suggests that providing learning opportunities in a range of ways can be a positive experience for the diverse student body (Prithishkumar and Michael, 2014), giving some control over learning to the student and reducing the anxiety in relation to that subject. Although some suggestions are unrealistic in an academic setting such as personalised learning environments that relate to the culture, learning style and other factors of each individual (Saengratwatchara and Pearson, 2004) trying to present a range of opportunities and support strategies may be beneficial in reducing the incidences of anxiety while a mismatch, or limited options may contribute to the development or increase of computer anxiety.

2.5.4 *Summary of Learning Theory*

People have been fascinated by how learning works since learning began. There have been a number of different ideas over time some of which seem more persistent than others. What seems to be clear is that humans have a range of different learning strategies. These strategies are flexible and adaptable to respond to a range of contexts, opportunities and teaching styles. When a model to describe a strategic approach is presented it can be divisive with defenders and detractors being equally vociferous. What they all agree on is that talking and thinking about how we learn as individuals can help us to be more effective learners. One supportive approach is providing resources in a range of different ways which can allow individuals to choose what they feel is the most useful to them, but even this has its critics who feel that making learners learn in a variety of ways helps them to develop a more flexible approach. One key piece of learning is that if people associate a particular topic with poor teaching, or a stressful time, they are not going to enjoy revisiting that topic. This might be important when we come to explore the potential causes of computer anxiety.

2.6 Computer Anxiety

As has been discussed previously, there seem to be several problems in the way of easy engagement with technology of which any one, or a combination of several, are often the cause of stress or anxiety. This sort of stress or anxiety occasioned by interaction with technology is often covered by the term "computer anxiety" and is commonly defined as: when a user displays the symptoms of anxiety when they are interacting with, or anticipating interaction with computers (Howard, 1986; Bozionelos, 2001b) and is seen as a distinct and individual anxiety like math anxiety (Hill *et al.*, 2016). In this section the history of computer anxiety is explained, the symptoms and impact explored, the range of causes, and measures are presented. Finally potential support strategies and treatments that have been used are discussed.

2.6.1 *A history of computer anxiety*

In the beginning, computers were built and used by scientists and interacting with them was complex and only accessible to experts in the field. With the advent of personal computers non-expert people were expected to be able to use them. Initially this caused problems as the interfaces were not very user friendly, but the problems did not seem to diminish even though the interfaces improved. As one researcher puts it “we are adapting to computers rather than having computers adapt to us” (Pribbenow, 1999, p. 180). Technology was also seen by some as a threat to a way of life, the creation of an elite and marginalisation of specific groups which may have planted seeds of anxiety in people’s minds (Rassool, 1993)

As early as 1981 a Master’s level student was using the term “Computer Anxiety” to describe this difficulty, and attempting to define and measure it and by 2012 computer anxiety was being referred to as a common anxiety (Blume, Baldwin and Ryan, 2012)

Maurer (1984) defined computer anxiety as:“the fear and apprehension felt by an individual when considering the implications of utilizing computer technology, or when actually using computer technology” (Maurer, 1984) and found that the prevalence of computer anxiety did not change much between the age groups that were studied. This may have been because computers were new for everyone and age in this setting was not a relevant or appropriate factor to take into account although it may have an impact going forward (Agaoglu *et al.*, 2008). There was research around this time into the attitudes people had towards computers as this was felt to be a key factor in their adoption and this, not surprisingly, found there to be a range of attitudes from positive to negative with college students tending to be positive (Nickell and Pinto, 1986).

Bloom (1985) felt that there were several common fears among potential users among which were:

- Breaking the computer
- Looking stupid
- A misalignment between expectation and reality

He found that avoidance was a common coping strategy. He also noted that people who are comfortable playing games become anxious when using computers for work. The suggestion is that this relates to the perception that managers will judge performance when users are engaged with work tasks (Bloom, 1985) and being judged often gives rise to anxiety. It is possible that it may also be something to do with being able to choose the context for the engagement at home but *having* to use a particular package in a specific way at work.

In his book "Computer Anxiety and the Use of Microcomputers in Management" (1984) Howard explored the potential types of computer anxiety and found there to be three main groups:

- Psychological: this maps to trait anxiety and may be difficult to change
- Knowledge: this is a general understanding of computers, their place in society and the workplace. This is slightly correlated with personality type but can be changed with education
- Operational: this is anxiety about specific applications and can be addressed by appropriate training.

(Howard, 1986:102)

These three areas were confirmed to some extent by the work of Bradley and Russell (1997) who found concern about potentially damaging equipment or data (operational), concern about being unable to perform efficiently (knowledge) and concern around being embarrassed (Psychological) (Bradley and Russell, 1997).

Rosen and Sears used the term technophobia (Rosen and Sears, 1987) and in more recent times it has been revisited and found to be a real and current phobia (M J Brosnan, 1998; Brosnan and Thorpe, 2006; Thorpe and Brosnan, 2007)

Both research teams looked at developing a cure for the phobia with some success. The treatment devised by Rosen and the team (1993) was grounded in psychology and looked at three different degrees of technophobia.

- The most serious - The Anxious Computerphobic – treated with desensitization strategies
- The Cognitive Computerphobic – treated with thought stopping (recognisable as Cognitive behavioural therapy)
- The least serious - The Uncomfortable User – treated with information and skills training

(Rosen, Sears and Weil, 1993)

M Brosnan and S Thorpe (2006) have treated technophobia, as did Rosen and Sears, with a desensitization programme (Brosnan and Thorpe, 2006). They note that the levels of technophobia in the global population have remained stable over time. In this same article, there is some discussion about the relatedness of computer anxiety and technophobia with many of the criteria common to both conditions and therefore they conclude that the treatment that is successful in reducing a phobia should be successful in reducing levels of computer anxiety.

It has been suggested elsewhere however, that stress related to computer use is unrelated to technophobia, and is in fact a different thing entirely, in that a person could become stressed when using a computer but was not phobic about them (Hudiburg, 1990) and this stress seemed to be higher in people who were more experienced, contrary to other research which suggests that more experience leads to lower levels of anxiety (Meier, 1985; Omar, 1992; Rosen, Sears and Weil, 1993; Hewson, Charlton and Brosnan, 2002; Tekinarslan, 2008; Koo and Wati, 2011).

Whatever the terminology used, or the links that may or may not exist between phobia and anxiety, there is a common acceptance of the existence of a problem faced by a significant minority that is caused by their interactions with technology. For the purposes of this work the term Computer Anxiety will be used with the understanding that it encompasses both terms.

Computer anxiety, described in this way, is to be found across all disciplines including among computer science students (Palaigeorgiou *et al.*, 2005) and was found to be debilitating in some cases (Pocius, 1991). Coupled with the unmet expectation that levels of computer anxiety would decrease as students who come into universities would have had exposure to technology for nearly all of their lives (Korukonda, 2005; Mcilroy, Sadler and Boojawon, 2007; Hargittai, 2010). This suggests that there may be more to computer anxiety than merely the amount of interaction.

In the early 1990’s it was postulated there were also tentative links between personality type and locus of control, and anxiety around computers (Pocius, 1991). The work around computer anxiety extended to include a range of factors such as those discussed earlier in my thesis.

Measures of Computer Anxiety

Over time a number of researchers have been interested in discovering more about computer anxiety and its severity. To this end, several measures have been developed which are self-reporting questionnaires with Lickert scale responses. Often the responses are added together to give an overall score. Anne Powell examined a number of measures in detail in her review in 2013 (Powell, 2013) and some of the key ones are discussed next.

Rosen and Weil's measure is called the Computer Anxiety Rating Scale (CARS) which they used in projects across the world (Rosen and Weil, 1995a; Weil and Rosen, 1995). They found that Computer Anxiety was not an individual culture's problem but rather a global one and it is interesting to note that it has also been used by other researchers in non-UK settings including the Lebanon (Yaghi and Abu-Saba, 1998) and South Africa (Anthony, Clarke and Anderson, 2000). Even though this measure was developed prior to the internet explosion it has been found to be helpful in identifying 20% of undergraduate students who were still found to be suffering from computer anxiety (Mcilroy, Sadler and Boojawon, 2007) and has been used to discuss potential issues in the burgeoning distance learning field (Sultan and Kanwal, 2017) as well as several studies in the intervening years encompassing children, medical students and others (Powell, 2013). There have been some criticisms of the measure but this is related to the internal factors and the value of the instrument overall is supported (Gordon *et al.*, 2003).

At the same time another measure also called CARS was developed (Heinssen Jr, C. R. Glass and Knight, 1987). It has been validated (Chu and Spires, 1991) and is also used in many projects (Chu and Spires, 1991; Lambert, 1991; Beckers and Schmidt, 2001; Palaigeorgiou *et al.*, 2005; Torkzadeh, Chang and Demirhan, 2006; Shah, Hassan and Embi, 2012). According to the literature review conducted in 2013 this measure is increasing in popularity (Powell, 2013) through a range of adaptations to make it more contextually relevant.

Looking at the problem from a different angle, "The Computer Hassles Scale" (Hudiburg, 1992) looks at the various types of 'hassle' that can cause stress in the user. Several factors were identified including runtime problems and information problems. Hudiburg (1990) felt that stress was distinct from anxiety although stress over a period of time can lead to a level of anxiety, so it may be that the hassles identified are contributory factors in the level of computer anxiety felt by a person.

Noting the value of self-efficacy, The Computer Attitudes Scale (CAS) was developed by Gressard and Loyd (1986) to explore the impact of attitudes, while the Computer Anxiety Scale (CAS) developed by Marcoulides and Mayes (1995) has been used in a range of studies using both students (Marcoulides, 1991; Havelka, Beasley and Broome, 2004b; Wicherts and Zand Scholten, 2010) and workers (Chou, 2003) as subjects, confirming the view that computer anxiety is not limited to just one generation.

These are just a few examples of the many measures identified by a meta study in 2003 (Powell, 2013), which is complemented by the meta-study into computer attitudes at work (Shaft, Sharfman and Wu, 2004). These papers cover the range of measures which are too numerous to include in this work.

While all the measures are slightly different, they are mainly focussed on discovering how anxious a user is and if this anxiety is related to their interaction with the computer in front of them. They all employ the same methodology of a self-reporting questionnaire and this method of data gathering is common for much of the work around computer anxiety. This limited methodology has been questioned in a review of the work from 1990's – 2000's (Powell, 2013) and although there is work that measures cortisol levels to prove computer anxiety does have an impact, it has not been developed further (Riedl *et al.*, 2012), and self-reporting remains the main method used.

More recently computer anxiety has been defined as:

> "(a) Anxiety about present or future interactions with computers or computer-related technology
> (b) Negative attitudes towards technology
> (c) Specific negative cognitions or self-critical internal dialogues during present computer interactions or when contemplating future computer interaction"
>
> (Anthony, Clarke and Anderson, 2000).

This wider definition relates to the three different facets of Rosen and Weil's work: Computer anxiety, Computer attitudes and General thoughts about technology (Rosen and Weil, 1992).

Beckers and Schmidt (2001) identified a further three factors although of the six identified, computer literacy and self-efficacy were the strongest indicators (Beckers and Schmidt, 2001).

By unpicking the meaning of “computer literacy” (Beckers and Schmidt, 2001) it can be seen that previous experience, training and motivation contribute to the overall picture. Combining this and the work from Howard (1986) it was suggested that computer anxiety really has three causes or elements

- Psychological – e.g. self-efficacy
- Operational – e.g. previous experience
- Sociological - e.g. socio-economic status

(Rahimi and Yadollahi, 2011a)

Psychological, in this context, is the user’s own beliefs in their own abilities sometimes termed self-efficacy (Bandura, 1994) or attributional style (Phelps and Ellis, 2002). People with high self-efficacy and an optimistic attitude coupled with an objective view of technology tend to have low levels of computer anxiety (Phelps and Ellis, 2002).

Operational is the actualities of making the computer work in terms of managing the hardware and understanding how to make the software achieve the desired outcomes.

The sociological aspect takes into account the culture of the user and their background. This might have an impact if for example the user has not been able to use a PC at home because they could not afford one, or peer pressure suggests that they cannot expect to be successful.

A brief questionnaire has been developed which has six elements relating to the factors identified above (Lester, Lester and James, 2005). It has been tested extensively and found to be a valid measure of computer anxiety, and useful to use alongside other research such as that looking at on-line retail, but not as useful for detailed research into the factors and their impacts on the general anxiety levels of an individual.

Measuring internet anxiety

Associated with computer anxiety is a similar concept known as internet anxiety. This is specifically looking at those computer interactions that involve engaging with the internet, such as amount of use. Internet anxiety has been found to be related to, although not indicative of, computer anxiety (Sam, Othman and Nordin, 2005; Ekizoglu and Ozcinar, 2010). A number of measures have been developed to look at this particular aspect of computer anxiety (Joiner *et al.*, 2007; Kalwar, Heikkinen and Porras, 2012).

(Durndell and Haag, 2002) found that computer anxiety had an impact on the self-efficacy of internet users. This work was later undermined by work that found the opposite (Torkzadeh, Chang and Demirhan, 2006) although it would seem logical to take the stance that if someone is anxious about using technology they will also be anxious about using the internet. However, using an application to create information is a different task from browsing existing material and this might be where the difference lies.

This difference might be at the root of some concern about overuse (technophillia) rather than under use of technology (technophobia) and problematic use of the internet is something that is an increasing consideration (Liu, 2010; Ozturk and Kaymak Ozmen, 2010; Osiceanu, 2015).

Internet use was also explored in relation to personality, using the Big 5 dimensions finding that extraversion, neuroticism and conscientiousness were related to increased internet use (Mark and Ganzach, 2014). The findings from this large-scale study imply that these personality traits might diminish the likelihood of having any anxieties about interaction with the internet.

It was also found that there are gender differences between type of internet use and length of that interaction which was grounded in anxiety about use of the internet (Joiner *et al.*, 2012a) while research among language learners indicates that it is the task that causes anxiety when using the internet rather than the internet itself (Aydin, 2011).

Internet access has changed hugely between the 1980's and today, so one long-term study compared access behaviours of those born in 1980 and those born in 1993 (Joiner *et al.*, 2013) finding more interaction with the 1993 group. It is not a surprising finding as the content of the internet grew and developed extremely quickly in that timeframe, with user created content forming a large part of that growth. This, along with a cultural shift might have had an impact as well as an attitude change which diminished anxiety alongside increased opportunity.

Looking at these different elements it is clear that there are different factors at play within internet anxiety: how to use it, the content of the information found and the task which necessitates internet use, as well as the personality of the user. These factors seem to be similar to those relating to computer anxiety, so any measures developed for this will be considered too.

Measuring IT anxiety

This moves the focus away from PCs and towards other devices and another measure is presented (López-Bonilla and López-Bonilla, 2012) and although its use has not been extensive, the idea that computer anxiety is not limited to interactions with the traditional desk based pc, but also relates to other technologies with the term "IT's" (sic) (meaning information technologies) replacing the word "computer" in their survey. This adaptation, although crude, does bring into mind the evolving technology and using the vocabulary of the users in any self-reporting instrument is important.

Impact of computer anxiety

This section explores the impact of computer anxiety on the individual, their education and employment.

Impact on the Individual

People who are anxious generally have increased heart rate and may sweat. They complain about feeling uneasy, uncomfortable or even frightened (Howard, 1986:19; Mahar et al., 1997). Any anxiety can be a severe and debilitating condition. Usually sufferers try to avoid situations where their triggers exist, but for people with computer anxiety, avoidance is often impossible and this has been found, by a number of studies, to be responsible for causing a direct and detrimental effect on their wellbeing (Davy *et al.*, 2000; Bozionelos, 2001b; Bessière *et al.*, 2006; Ayyagari, 2007; Ragu-Nathan *et al.*, 2008; Parayitam *et al.*, 2010; Tarafdar, Tu and Ragu-Nathan, 2010) .

They will feel the symptoms, to some extent, each time they have to interact with a computer and many studies have found that this can have an impact on their health in the long term causing them to take time off work or away from their studies. (Havelka, Beasley and Broome, 2004a; Tarafdar, Tu and Ragu-Nathan, 2010) and has been named as one of the factors impacting on student wellbeing (Davy *et al.*, 2000). Since wellbeing in related to ability to learn, the impact on education needs to be considered.

Education

There are two aspects to education: the students and the teachers. Each group has their own difficulties and areas of concern and will be explored separately.

Students

Even though the current generation of students can be seen to engage with a range of different technologies through choice, one study found that informal engagement with technology does not seem to predict academic excellence (Jones and Bennett, 2016). A finding confirmed by other studies showing that the level of ICT skills does not have as much of an impact on academic achievement as more traditional measures such as entry level qualification (Taylor, Goede and Steyn, 2011; Wit, Heerwegh and Verhoeven, 2012).

Studies have found that some people may choose not to study at all because of their low self-efficacy (Kolikant, 2010) or computer anxiety (Tuncan and Uzunboylu, 2010) and these worries may also have an impact on their choice of course as they select those with a minor computer element (Buche, Davis and Vician, 2012). Further it was found that students studying the humanities had a higher level of computer anxiety that those studying more science related subjects (Mazloumiyan *et al.*, 2011) suggesting that perhaps those with computer anxiety are choosing courses which they perceive as being less technology focussed. This finding is reinforced by studies that found similar patterns in the workforce (Monnickendam and Eaglstein, 1993).

Attempting avoidance is not a successful tactic as most university courses use a virtual learning environment (VLE) to deliver learning opportunities (Heaton-Shrestha *et al.*, 2007; van Raaij and Schepers, 2008; Jones *et al.*, 2010). Research suggests that the use of VLEs supports students who present with a wide range of learning approaches (Heaton-Shrestha *et al.*, 2007). Many students have been seen to benefit from this, making good use of the available technology to have a positive impact on grades (Huffman and Huffman, 2012) provided it is grounded in good pedagogical design and has adequate technical infrastructure (Lambert, 1991; Kurt and Gürcan, 2010).

However, a large study in Norway found that students considered the use of technology to be a barrier to learning if they did not percieve it to be useful, but this attitude changed in situations where they could see that using technology was useful (Scherer and Hatlevik, 2017). Another study conducted in Norway and China found that culture also had a part to play in how much students chose to engage with e-learning approaches, with the Chinese students in this study preferring books over on-line resources (Liu, 2010). It may be therefore that students manage their anxiety and are prepared to put up with it when there is high motivation, but will find other ways to learn when they are on offer.

Supporting this stance is the finding, in a number of studies, that the degree of computer anxiety was found to impact on how much students are prepared to accept or engage with e-learning elements of their course (Brosnan, 1999; Chien, 2008; Hashim, Ahmad and Zainab, 2010; Chen and Tseng, 2012). Further studies also confirm that the anxious students minimise the time spent using technology in an effort to reduce their symptoms of anxiety (Heinssen Jr, C. R. Glass and Knight, 1987; Mahar, Henderson and Deane, 1997; Anthony, Clarke and Anderson, 2000; Lester, Lester and James, 2005; Korukonda, 2007; Mcilroy, Sadler and Boojawon, 2007; Agaoglu *et al.*, 2008). As academic achievement and deeper learning seems to happen when a student engages consistently with any material asking questions of it and debating its value, reduced engagement with e-learning materials was found to limit the potential to improve (Murray *et al.*, 2012) and poorer performance was found among students with computer anxiety in a number of contexts and over time (Abd-El-Fattah, 2005; Buche, Davis and Vician, 2007; Rahimi and Yadollahi, 2011b; Taylor, Goede and Steyn, 2011). This is confirmed as particularly evident if there is an element of e-learning within their study (Sun *et al.*, 2008).

Academic performance can also be affected because computer anxious students have been found to generally take longer to complete each computer mediated task and find the time management of assignments problematic (Mahar, Henderson and Deane, 1997) Any work that entails research is also likely to be negatively impacted as Computer Anxiety has been found to correlate to internet anxiety (Ekizoglu and Ozcinar, 2010; Aydin, 2011). A student with computer anxiety would be less likely to search the internet for information about their subject, reducing their overall knowledge and minimising their contact with recent research (Joiner *et al.*, 2007).

Students on distance learning courses are at risk too. Here, where all the learning is mediated by technology, and one might assume that the computer anxious would avoid taking this route, there are people who have been found to have high levels of computer anxiety (Hashim, Ahmad and Abdullah, 2010). While for some deliverers the assumption that "user attitude, efficacy or skills should no longer be considered an issue" (Sun *et al.*, 2008, p. 1194) it is still the case for some students (Sun *et al.*, 2008).

Both on-line and technology-supported learning often have some element of on-line testing. There is a suggestion that some students with computer anxiety are more likely to fail tests than their colleagues (Anderson, 1996) and another study found that those with computer anxiety had higher levels of anxiety during a test than their colleagues (Beckers, Wicherts and Schmidt, 2007).

This is contested by other studies which found no effect on scores (Hewson, Charlton and Brosnan, 2002; Fritts and Marszalek, 2010), and the suggestion is that it may be test anxiety that is manifesting (Mahar, Henderson and Deane, 1997; Hewson, Charlton and Brosnan, 2002; Beckers, Wicherts and Schmidt, 2007) although if this is combined with computer anxiety, it may be enough to impact on some individuals as it has been found that when people are anxious their processing speeds are reduced (Basten, Stelzel and Fiebach, 2012).

Continuing performance issues either in tests, or through avoidance of resources, coupled with untreated computer anxiety can have the effect of diminishing self-confidence, as studies show, people connect feelings of stupidity with computer anxiety (Heinssen Jr, C. R. Glass and Knight, 1987; Sigurdsson, 1991; Rosen and Weil, 1992; Bradley and Russell, 1997; Scull, 1999; Chou, 2003; Olatoye, 2009; He and Freeman, 2010; Waycott *et al.*, 2010). It is, therefore, important that this is addressed in the classroom. However, teachers themselves may also be victims.

Teaching

Within teaching there are two areas of concern: that of the anxiety of the teachers and how teachers respond to the rise of technology in the classroom.

Teachers who have computer anxiety have been seen to resist incorporating technology into their teaching materials (Rahimi and Yadollahi, 2011a; Celik and Yesilyurt, 2013; Drossel, Eickelmann and Gerick, 2016) which as discussed previously has the effect of reducing the student experience (Vuorela and Nummenmaa, 2004). There is a suggestion that certain subject areas have teachers with higher levels of computer anxiety (Chou, 2003) which would fit with the research that suggests people choose courses and careers to meet their own needs. It was also been seen, in an old study, that teachers with computer anxiety pass this on to their students (Elkins, 1985) which can have an impact on a student's level of achievement. Conversely, a teacher who is positive and confident in the use of technology has been seen to have a positive impact on their students (Sun *et al.*, 2008).

Even those teachers who do not have computer anxiety may become anxious when expected to include and implement new technologies in their teaching in response to the myth of digital natives. This is sometimes seen to be at the expense of a structured and well considered pedagogy (Jones and Bennett, 2016). More significantly one piece of research found that there is little benefit to 'technologising' an existing model, but the suggestion is that new pedagogies need to be created to add benefit (Toledo, 2007).

Of course all this adaption requires investment and resource (Kyle *et al.*, 2016) if it is to be done well and the pressures to use the newest ideas are high. Ideas such as using social networking for education receive mixed reviews with some staff being concerned about privacy (Gokçe Akçayır, 2017) while the idea of mobile technology in the classroom has been seen to be rising in popularity (Campbell, 2006; Derakhshan and Khodabakhshzadeh, 2011; Van Praag and Sanchez, 2015; Al-Jundi *et al.*, 2016; Camilleri and Camilleri, 2016; Nikou and Economides, 2017).

Another issue which may increase, is that postulated by a very limited piece of research which presents a condition termed digital dysfunction. The author suggests this is a bit like dyslexia but relating to computers. The children in this research with digital dysfunction did not display computer anxiety However, there were only three subjects so this work cannot be generalised but if this becomes a more common phenomenon it may have to be addressed.

A type of dyslexia but related to computers has been suggested by Thorvaldsen et al., (2011) and termed digital dysfunction (Thorvaldsen *et al.*, 2011). Computer anxiety did not seem to be a factor here, but digital dysfunction is an issue that may become more prevalent in the future.

Intellectual implications

For easy tasks, anxiety has been seen to have a positive effect on performance (Moldafsky and Kwon, 1994) and the suggestion is that anxiety may act as a driver pushing the anxious user towards practice to alleviate their fears and so increase their competence (Eysenck *et al.*, 2007; Parayitam *et al.*, 2010). This effect reverses when the task becomes more complex (Moldafsky and Kwon, 1994) with the anxiety once again impacting on performance levels (Eysenck *et al.*, 2007). The possibility that external stressors, such as a harder task or unrelated problems such as relationship issues, can exacerbate existing anxieties is postulated (Elizabeth R. Towell and Lauer, 2001), suggesting that a person who is managing their computer anxiety most of the time can find it much harder to manage when deadlines are looming or other pressures are brought to bear.

When people are anxious one study found that their processing speeds are reduced (Basten, Stelzel and Fiebach, 2012). This would slow down the work rate of people with computer anxiety (Socan and Bucik, 1998) and if they work in a time pressured environment this introduces another level of stress, reducing the efficiency of the work place (Ayyagari, 2007), or the effectiveness of study.

As people who have computer anxiety are less likely to use a range of help strategies they will probably find it more difficult to solve any problems that they are faced with as found in a limited study (Lei Wu, 2010). As previously discussed, anxious people have a narrow field of focus and concentrate on the threat (Eysenck *et al.*, 2007). For computer anxious people, this manifests as focussing specifically on one area of the screen. This means that they may not even realise that there is other helpful information in different areas of the display (as I have observed in my teaching), thus limiting their learning opportunities. A study on nurses found that when they became anxious their learning was adversely affected (Beischel, 2013) which suggests that having computer anxiety can impact negatively on learning.

Decision making is an important aspect of computer use and overreaching meta-review of the literaturein the mid-nineties found the factors affecting this were wide ranging and complex. Computer anxiety was seen as an important part of the decision making story (Moldafsky and Kwon, 1994). It has also been noted that anxiety can introduce a bias into decision making situations although the effect was slight. Anxious users have been found to often overcompensate for their fear by increasing the effort they put into research making it harder for them to reach a decision (Matthews, Panganiban and Hudlicka, 2011).

Employment

Computer anxiety or technostress has been seen to negatively impact on performance of employees and therefore the business (Wang, Shu and Tu, 2008; Fuglseth and Sørebø, 2014) although the same team of researchers had previously found that this is not always the case (Tu, Wang and Shu, 2005). Other research found that some people find a certain level of anxiety to be motivational in spurring them on to finding a solution (Parayitam *et al.*, 2010).

Often people with computer anxiety, in common with other anxieties, do not have the skills or capacity to manage the large amounts of information presented to them electronically (G Matthews et al., 2003:345). One suggested implication from this is that they may make bad decisions because they cannot manage this information overload or become too anxious to focus on a given task for a sufficient period of time (Tarafdar, Tu and Ragu-Nathan, 2010). Another overload issue can come about as technology increases work rate to an extreme level spilling over into personal life causing extreme stress, and this has been found to be a problem particularly in China (Tu, Wang and Shu, 2005). So, whether they are overworking, or avoiding work, employees with computer anxiety are not always as productive as they might be.

Employers are aware that they lose money from underproductive employees (Mahar, Henderson and Deane, 1997) and, since many jobs now involve the use of technology, businesses often try to solve the problem by sending their staff on training courses or provide on-line training, i.e. increasing exposure and time on the computer. In the USA, in 2009, 36.5% of formal training was delivered electronically (Patel, 2010). As the budget then was $125.88 Billion, and can be assumed to have increased since then, this is a sizeable investment and much of it will be wasted if delivered to people who suffer from computer anxiety as it is seen to not always be effective at ‘solving’ the problem of an underachieving computer user and sometimes increases the anxiety (Beckwith and Burnett, 2004; Shah, Hassan and Embi, 2012).

One issue with training may be that people with computer anxiety often perceive that any application is going to be difficult to use and will therefore avoid engaging with it or practicing the techniques, thus reducing the benefit of any investment a business may make in technological solutions (Hackbarth, Grover and Yi, 2003). The link between perceived ease of use and computer anxiety is well-recognised although there is some debate over whether computer anxiety causes a poor perception, or if when something is perceived as being difficult to use this causes the anxiety (Hackbarth, Grover and Yi, 2003; Saade and Kira, 2007; Nov and Ye, 2008; Thatcher *et al.*, 2008; Fakun, 2009; Chen and Tseng, 2012). Whatever side of the debate is true, training may address the problem for some participants but continued avoidance of technology for the others may influence their choice of job or career as they take the amount of computer contact into account (Conti-ramsden, Durkin and Walker, 2010) when making career decisions (Parayitam *et al.*, 2010). This may mean people who could have an impact exclude themselves from certain careers.

Summary of impact

From the review it can be seen that there is a large body of research that agrees that computer anxiety is a "potentially serious affliction"(Beckers, Wicherts and Schmidt, 2007). This has a detrimental effect on both the sufferer and their effectiveness and one which prevents or minimises the sufferer's contact with technology (Brosnan, 1998:17) or causes them stress while they are so engaged (Moldafsky & Kwon, 1994,Parayitam, Desai, Desai, & Eason, 2010:345). This can lower their level of achievement (M J Brosnan, 1998; Huffman and Huffman, 2012) as well as impacting on their health and wellbeing.

Overall research suggests that computer anxiety has a negative impact on the individual, their learning and their performance. In some cases, supplying additional training can help, although in others it can exacerbate the problem.

Computer Anxiety trait or state?

While most research agrees that computer anxiety exists, there is some debate about where computer anxiety sits in the personality of a person and whether it is something that cannot be changed or a transient emotion. A brief explanation of what a state or trait are follows and then there is a discussion about the specific status of computer anxiety.

Trait explanation

A trait is an aspect of a person's personality that is sTable over time and in a variety of environments (Nettle, 2007:31).

Traits are what make a person who they are most of the time. They are often influenced by genetics, and are responsible for the nature of a person. Traits observed in childhood are carried over into adulthood. For example a person who is easily angered as a child will still find it hard to keep their temper when they are an adult (Nettle, 2007).

State explanation

A state is a transient emotion that is not stable over time and is affected by the environment and other factors (G Matthews et al., 2003:76). For example, a person who is not normally anxious may show signs of anxiety when moving house but once the move is completed these signs of anxiety will disappear again. They will have been in an anxious state, but this will have been transient.

Computer anxiety – where does it fit?

Some research indicates that the likelihood of someone suffering from computer anxiety is set while they are still in the womb and in this it can be seen to being similar to other anxieties (Brosnan M J. Gallop V, Iftikhar N, 2010) indicating that it is a trait and cannot be changed. This finding is supported by other researchers who believe that anxiety is a personality trait, of which computer anxiety is a part, and therefore stable and cannot be altered (e.g. Beckers et al., 2007; Chu & Spires, 1991; Maltby et al., 2007; Safford & Worthington, 1999). This idea is reinforced by work where it was found that anxiety was related to prenatal testosterone exposure and therefore is pre-determined (Brosnan *et al.*, 2010). Neurologists have found evidence in the amygdala that anxiety is genetic and hereditary so could be definitely described as a trait. (Ciocchi *et al.*, 2010).

Conversely, other research found that many teachers in training who themselves suffered from computer anxiety passed this onto their students (Elkins, 1985; Epstein and Klinkenberg, 2001; Ceyhan, 2006) suggesting that it is a state as it can be influenced and changed by experience. Other research is more categorical stating that "Computer anxiety is state-based; a transitory response to a specific situation" (Phelps and Ellis, 2002, p. 515) similar to the classification of Math Anxiety (Maloney and Beilock, 2012). Further evidence comes from a study that found because there were only moderate relationships between personality traits and computer anxiety this indicates that computer anxiety can be changed through training (Maricutoiu, 2014).

There is the thought that general anxiety, rather than anxiety existing as state or trait, could be a state caused or magnified by an underlying trait (Anderson, 1996; Mahar, Henderson and Deane, 1997; Chua, Chen and Wong, 1999; Krohne and Hock, 2011; Wilt, Oehlberg and Revelle, 2011). A person is predisposed to become anxious in certain situations (G Matthews et al., 2003:77) because of their anxiety trait combined with other factors such as past experience (Matthews, Panganiban and Hudlicka, 2011) or the current context (Matthews et al., 2003:78) e.g. working with a computer (Thatcher and Perrewe, 2002). Conversely, this is called into question by Cowan and Jack (2011) who found no correlation between trait anxiety and computer anxiety.

However, Cowan and Jack (2011) suggest that any user can have anxiety about computer use if their first experiences with technology was unsuccessful or frustrating (Cowan and Jack, 2011) and this would appear to be a state rather than a trait as previous research found that early exposure to a high quality experience reduced the likelihood of computer anxiety (Mcilroy *et al.*, 2001; Teo, 2008; Korobili, Togia and Malliari, 2010).

The suggestion that computer anxiety diminishes with maturity (King, Bond and Blandford, 2002) would also seem to suggest that computer anxiety is a state rather than a trait, although people who have had to support elderly relatives come to terms with technology might find this hard to accept.

It seems from the evidence discussed, that computer anxiety can be exacerbated by a situation, but that to some degree it will be always present in some individuals while only being a transient state in others. It would seem to be a complex issue that cannot be explained or described by using only state or trait but is perhaps a combination of the two.

Profile of sufferers

In this section there is consideration around whether there is a particular type of person who is more susceptible to suffering from computer anxiety. Building on the previous discussion around age being an obstacle, the idea of digital native is considered. The way a person relates to the world, their gender and self-efficacy are further discussed related to computer anxiety as well as the impact of personality.

By date of birth

In 1990 Rosen & Weil found that up to 50% of college students suffered from computer anxiety (Weil and Rosen, 1995) and more recent research found that a large proportion of students do still find it problematic when interacting with computers (Korukonda, 2005, 2007; Brosnan and Thorpe, 2006; Connolly, Murphy and Moore, 2009; Hashim, Ahmad and Abdullah, 2010).

Many students born after 1980 have been surrounded by technology since their birth and have been termed 'Digital Natives' (Prensky, 2001a). The suggestion is that 'digital natives' have different ways of learning and relating to the world tempered by their exposure to technology and in fact that their brains have changed as a result (Davis, 2008; Vodanovich, Sundaram and Myers, 2010) although there are many other voices who disagree with this assertion (Bennett, Maton and Kervin, 2008; Bennett and Maton, 2010; Brown and Czerniewicz, 2010; Friedl and Verčič, 2011; Margaryan, Littlejohn and Vojt, 2011). In one study, comparing youth and older people, the younger group was found to have higher levels of computer anxiety than the older group (Bozionelos, 2001a). Research confounding the view of Prensky suggests people of any age can become proficient in their use of technology and just because one has a date of birth later than 1980 does not mean they will automatically be less anxious and better at interacting with technology (Bennett and Maton, 2010; Kennedy *et al.*, 2010; Margaryan, Littlejohn and Vojt, 2011). In spite of this evidence the idea of digital native has been embraced by industry and educationalists alike (He and Freeman, 2010) and many teachers are under pressure to change their approaches to meet the suggested new ways of thinking.

One study found that people with high levels of time spent playing with technology had increased theoretical computer knowledge and decreased levels of computer anxiety but when having to use computers at school some still had increased levels of anxiety (Appel, 2012). This suggests that in spite of increased interaction with technology, many students are becoming anxious when interacting with computers, a suggestion supported by a number of studies (Korukonda, 2005; Mcilroy, Sadler and Boojawon, 2007; Tekinarslan, 2008; Korobili, Togia and Malliari, 2010). Further to this is an assertion that in any one class there will be people who have different levels of experience and different attitudes to computing (Van den Beemt, Akkerman and Simons, 2010) and therefore different expectations and different levels of computer anxiety.

It seems that computer anxiety is not limited to students in the Western world. Marcoulides (1991) found that the levels were very similar in American and Chinese populations, while Rosen and Weil (1995) found that while across ten countries there was variation in levels of computer anxiety this was not extreme. In Greece, students on an IT course were found to have comparable levels of computer anxiety (Korobili, Togia and Malliari, 2010) although in Turkey the levels of computer anxiety were higher than those in Holland (Tekinarslan, 2008), while in Malaysia researchers were surprised at the high levels of computer anxiety (Hashim, Ahmad and Abdullah, 2010). The higher levels of computer anxiety were found in those countries where students had little opportunity for exposure to technology and could be related to normal levels of anxiety when confronted with a new experience. This ties in with the idea that more experience equates to lower levels of computer anxiety.

By locus of control

Many researchers believe that a certain sort of person will be more susceptible to computer anxiety than others. In one study it is suggested that a predilection for computer anxiety is formed in the womb (Brosnan *et al.*, 2011) and in another the suggestion is that people with instrumentality traits in their personality are less likely to become computer anxious (Bozionelos, 2004b). People with low intrinsic motivation were seen as more likely to have higher computer anxiety levels than their peers (Jahromi *et al.*, 2010; Dickhäuser, Buch and Dickhäuser, 2011). A finding supported by work that found those who believe that they have no control over what is happening, i.e. have an external locus of control, have higher levels of computer anxiety than those who believe they are in control of their lives (Anderson, 1996). Earlier work had found that people with a serious mental illness, often typified by feeling loss of control, were also found to have high levels of computer anxiety (Safford and Worthington, 1999) forming a foundation for that later research. A study also discovered that people who have a negative internal dialogue or attributional errors are more likely to suffer from computer anxiety (Phelps and Ellis, 2002). It might be that having a lower feeling of control leaves one open to the potential of becoming anxious.

By self-confidence and gender

Computer anxiety was found, by two separate studies, to be lower in students who had high levels of self-confidence, and these people were also more able to learn new technology skills (Anderson, 1996; Gravill and Compeau, 2008). Self-confidence is sometimes referred to as self-efficacy: the measurement of how a subject feels about their competence, and some studies have found this to be higher among males (Beckwith and Burnett, 2004; Beckwith, Burnett and Grigoreanu, 2006; Burnett *et al.*, 2010). There is speculation that this is due to the Matthew effect (Byington and Felps, 2010) where young children who show an interest and an aptitude for working with computers are given more opportunities to hone their skills than children who are naturally more cautious, and, because there may still be a perception that computers are 'boys toys', the boys are more encouraged to engage. Other studies dispute the gender difference and in some cases, have found males to show higher levels of computer anxiety Overall, gender does not seem to be a significant factor as there are some studies suggesting that males are more anxious than females while others found females to be more anxious then males (Rosen and Weil, 1995a; Anderson, 1996; Chua, Chen and Wong, 1999; King, Bond and Blandford, 2002; Rautopuro *et al.*, 2005).

By personality

As previously discussed there are a number of different models of personality and research relating to them and computer anxiety is reviewed briefly here.

In those countries where computer use is common people may feel that understanding of technology ought to be intuitive (M. J. Brosnan, 1998) but this can put pressure on individuals who find this approach to be problematic. Others, such as innovative people, who the researchers define in this context as those who have a 'willingness' to try new information technology, enjoy being left to explore new technology (Gupta, Bostrom and Anson, 2010). But for people who have a preconception that computers are difficult to use this has been found to create a level of computer anxiety (Hackbarth, Grover and Yi, 2003; Nov and Ye, 2008; Saadé and Kira, 2009; Alenezi, Abdul Karim and Veloo, 2010; Lee, Hsieh and Ma, 2011).

'Feelers' as defined by Myers- Briggs were found to be more anxious than 'thinkers' when it came to doing on-line tests (Shermis and Lombard, 1998) but this could be attributed to test anxiety as well as computer anxiety. While those who were scored highly for openness were less likely to be anxious when using technology (Korukonda, 2005).

People with a high score for neuroticism (as defined by the big 5), or who are sensing or feeling (as defined by Myers-Briggs) people were found to be more likely to be anxious when using computers (Chu and Spires, 1991; Anthony, Clarke and Anderson, 2000; Korukonda, 2005) and they are more likely to have this anxiety compounded when they receive error messages or hit problems (Nettle, 2007, p. 108). It is also suggested that neurotic people are more sensitive to problems (Nettle, 2007, p. 117) and a relatively trivial problem can become a cause of computer anxiety for them while people who have a 'resistant to change' aspect of their personality (one of the Big 5 factors) seem to have higher levels of computer anxiety than expected (Nov and Ye, 2008).

Summary of profile

What all parties are agreed on is that the level of computer anxiety in the population has not reduced even though many societies have a much higher level of computer exposure than they ever had in the past (Cowan and Jack, 2011). What might have happened is that as levels of computer use increase so does the complexity of the systems that are used and that of the tasks that computer users are expected to deal with. So a person might present as having computer anxiety related to a task which can only be completed by interacting with a computer, as was found in several studies, but the anxiety is caused by the task rather than the actual interaction (Nov and Ye, 2008; Teo, 2008; Saadé and Kira, 2009; Lee, Hsieh and Ma, 2011). Another thought may be that people are happy to interact with technology that they choose, but have a problem with imposed interactions.

From the literature explored so far, it looks like there are some indicators that are more reliable than others in the identification of people with computer anxiety.

Gender and age seem to be irrelevant, but personality type (from a range of models), learning preferences and prior experience do seem to be useful.

Overall the profile of someone who has computer anxiety looks to be a person who has probably had some poor early experiences, is sometimes a little pessimistic, lacks self-confidence, or is over confident, are resistant to change, have limited reasons to try new things and thinks that they are likely to fail anyway, or is none of these things. In short, the person with computer anxiety is a complex mix of personality (however it is defined), education, experience, socio-economic situation and motivation, but not a specific gender, nationality or age.

2.6.2 *Potential causes of computer anxiety*

Having understood that computer anxiety may be a trait or a state or a combination of the two, the causes of computer anxiety are going to be complex and varied.

Much of the research into causes have found many different correlations with computer anxiety such as prior experience, owning a pc and time spent per week on a computer. It often appears to be a combination of these which are present in a person with computer anxiety, although some researchers are correct to point out that correlation does not in itself mean causation (Baloğlu and Çevik, 2008). In the early days of research a model was presented which implicated computer experience as a major consideration alongside demographic and personality characteristics and also the impact of life choices (Maurer, 1994)

Some of the items which have been considered to cause computer anxiety are listed here with an example of supporting source:

- If the person is working when they are tired or not in their optimal time zone (Beşoluk, 2011).
- If the user's first encounter with technology is not positive this can set up the user to feel negative to all future encounters with technology (Monnickendam, 1993; Cowan, Vigentini and Jack, 2009).
- A badly designed interface, which makes the task harder, can cause a user to feel frustrated and these negative feelings can be transferred to all interactions with technology (Hudiburg, 1990; Monnickendam, 1993; Epstein and Klinkenberg, 2001; Thatcher and Perrewe, 2002; Cowan and Jack, 2011).
- The user thinks it is not 'cool' to be comfortable with computers as this is 'geeky' (Reid, 2009; Joiner *et al.*, 2012a) so mimics computer anxiety as a reason for not interacting and this act then becomes a reality.
- The user has a poor command of English (Rahimi and Yadollahi, 2011b).

- The user does not understand the task and becomes frustrated (Bessière *et al.*, 2006).
- The user does not believe in their own ability(Ceyhan, 2006).
- The user is a pessimist (Ceyhan, 2006).
- The user has negative thoughts (Glass and Knight, 1988).
- The user is a certain age (Maurer, 1994).
- The user possesses a number of personality traits (Maurer, 1994).

These reasons cover the spectrum from sociological (not cool) through operational (does not know how to use a computer), to psychological (I found it hard last time so…) and may be manifest in various degrees from slight anxiety to extreme anxiety. Some of these may relate to usability problems such as poor instructions, or low memorability, or accessibility issues preventing or making it difficult for some users to have a satisfactory interaction. Scull (1999) identified three broad areas that caused concern:

1. the situation – deadlines and targets
2. the computer - reliability and usability
3. the support - appropriate peer support preferred over jargon filled expert support

(Scull, 1999)

It can be seen that most of the concerns detailed above could be classified into these areas.

Reviewing the list, it is clear that Computer Anxiety is a complex condition, with a wide range of potential causes. Attempting to address a number of causes may go a long way toward mitigating an individual's anxiety levels while recognising what the cause is may be helpful in suggesting the correct strategy for supporting the user to reduce their anxiety level. While acknowledging the range of causes discussed previously, several more ideas are explored next.

The effect of intelligence

There is some evidence linking personality type with ability or intelligence, and with computer anxiety. For instance openness (as described previously) is positively related to ability (Austin *et al.*, 2002; Baker and Bichsel, 2006; Silvia and Sanders, 2010). For some people, increasing their IQ through training and intelligence manipulation diminished their general anxiety levels (Da Fonseca *et al.*, 2008) although this was a limited piece of research and some would question the ability to impact on IQ through training.

It was also found that computer anxiety was inversely related to intelligence (Havelka, Beasley and Broome, 2004a; Chou and Tsai, 2009) although other research indicates that computer anxiety is not related to intelligence at all, but rather to the feelings of control and self-confidence (Connolly, Murphy and Moore, 2009).

There appears to be a relationship between the time taken by people to decide what to do, and IQ (Der and Deary, 2003). It seems that for those with higher levels of intelligence, making the decision about which answer to choose takes longer, but they have a greater chance of deciding correctly (Furnham, Monsen and Ahmetoglu, 2009; Doerfler and Hornke, 2010; Goldhammer and Klein Entink, 2011) so often end up with lower than expected scores in timed multiple choice tests as they run out of time. This would appear to be the case when the tasks are lexical or involve recognition, but seems not to be true for numerical tasks (Ratcliff, Thapar and McKoon, 2010).

However people who have computer anxiety may also take longer to complete computer based tasks as they spend more time ensuring they use the technology correctly, and worrying about the process (Brosnan, 1999). This group also tends to make more mistakes in multiple choice tests although they answer questions more quickly i.e. they are more likely to decide on the wrong answer (Mahar, Henderson and Deane, 1997).

In contrast with the ideas above, speed of reaction is thought to be indicative of intelligence (Reed, 1998; Sheppard and Vernon, 2008). Contrary to this view, research with dyslexic children, who had high IQ but poor short term memory, had slow speeds of reaction. However their dyslexia amongst other factors might have confounded the findings (Bonifacci and Snowling, 2008). The comparison between reasoning speed with reasoning ability shows a weak correlation but is not conclusive (Goldhammer and Klein Entink, 2011) and since both of these reasoning skills are needed for multiple choice tests it may be that these are clouding the findings with relation to levels of computer anxiety.

Better educated people (not necessarily more intelligent) were found to be better at reading error messages and solving their own problems than less well educated people who wanted someone to tell them the answer (Chou and Hsiao, 2007). It may be that both the more intelligent and better educated members of society are given more opportunities to interact with higher levels of technology and therefore increase both their confidence and competence (Byington and Felps, 2010). This increase in self-efficacy could be a factor in how they respond to error messages, and ultimately impact on their level of computer anxiety thus an indirect relationship, and not easily verified.

The conclusion can be drawn here that intelligence does not indicate levels of computer anxiety, but does suggest that the more educated people have more fully developed help seeking and confidence so might be better able to manage their anxieties.

Problem solving

The problem-solving strategies employed by different types of people may make some of them more vulnerable to computer anxiety.

Previous experience and culture has been found to have an impact on how people approach problem solving (Gonzalez, Dominik Güss and Dörner, 2011). For example people with a Confucian approach to intelligence were seen to be more likely to adapt their strategy to solve problems effectively (Cho, 2010) regardless of their IQ level. A Confucian approach is one that believes that intelligence is incremental and can be improved by reflecting on what has gone before (Cho, 2010) this contrasts with the view that Confucian students are predominantly passive learners (Tran, 2012). This adaptability may give these learners a larger scope of strategies to solve problems and therefore avoid being made anxious because they cannot find a solution.

Personality type seems to also have an impact on the problem solving strategies chosen by an individual as some types like to take a step by step approach, and others prefer to look at the big picture (Briggs Myers, 2000:39) regardless of their level of intelligence. People who are intuitive as identified by the MBTI, or score highly for reasoning in the 16PF test seem to be able to apply their openness and creativity to solving problems in novel ways (Cattell and Schuerger, 2003). This may help them to deal with the problems that they meet when working with technology, while those who are not intuitive may apply an inappropriate strategy, which can create more stress and may add to the level of computer anxiety.

It might be that the problem-solving strategy is impacted by a relationship of skill to task. In a map recall test (where subjects had to recall locations on maps using computers) it was not found to be the case that high IQ predicted high achievement (Cho, 2010). What Neisser found in 1998 (Maltby et al., 2007:364) and Cho in 2010 was that people with high spatial awareness did achieve well and people with high verbal reasoning skills performed less well. There is a suggestion that this may be related to the relationship of personal skill to the skill required for the task (Cho, 2010) and may be the key to which problem solving strategy is chosen by an individual.

For people with computer anxiety, part of this seems to be rooted in not being able to find the answer. If their strategy is fixed it may be harder to address the range of issues that are met when dealing with technology. This might be an area that can be supported to help a person with computer anxiety.

While intelligence seems to be a trait, problem-solving strategies can be extended and improved suggesting that those who argue that they are the same thing may not be correct (Visser, Ashton and Vernon, 2006), but this may well be a useful approach to take in the case of computer anxiety. Improving problem solving skills may well boost confidence which will be explored next.

Self-confidence and self-efficacy

As suggested in the psychological barriers, any self-awareness has an impact on how individuals approach a challenge, and this implies there might be impact on the level of computer anxiety. While it has been found, that on the whole people, approach a new experience in a positive way, this can be negated in response to repeated failure leading to feelings of low self-efficacy (Coffee and Rees, 2011) and this may be a common occurrence when first learning how to use technology.

In this section both self-confidence and self-efficacy are defined and discussed in the context of computer interactions.

Definitions

Self-confidence: confidence in oneself and in one's powers and abilities (Encyclopedia Britannica, 2014).

Self-efficacy: People's beliefs about their capabilities to produce effects (Bandura, 1994).

Discussion of the impact on computer anxiety

Low self-confidence often causes people to believe that they are less able to achieve than they actually are and people with low self-confidence are often more strongly affected by negative feedback than their more confident colleagues (Brockner, Derr and Laing, 1987). This focus on the negative can cause the right pre-fontal cortex to be active which increases feelings of anxiety (Goleman D, Boyatzis R, 2004:137). This effect could be why confidence and computer anxiety seem to be related in some cases.

Sometimes low self-confidence is reinforced by learned helplessness (Abramson, Seligman and Teasdale, 1978; Försterling, 1985; Brophy, 1998) and although these studies were completed before the advent of large-scale computer use, the behaviours discussed relate to Bandura's work around self-efficacy (Bandura, 1994). In this case, it is where the user has a self-belief that they are going to fail anyway because some external force is against them, a form of low self-efficacy which negatively impacts on performance (Havelka, Beasley and Broome, 2004a; Hauser, Paul and Bradley, 2012) . It has been observed that people who are seen to struggle in the IT classroom ascribe a personality to the computer with the phrase "Computers hate me" i.e. the external force that is against them, and also do not relate their own learning strategy to their lack of progress (Hawi, 2010). This adds further to the argument that low self-confidence has an impact on levels of computer anxiety, and goes some way to explaining why often training to increase competency is seen as a potential solution. One reason why training alone may not work is explained by the finding that students with high computer anxiety found it harder to increase their self-efficacy than those with low computer anxiety (Torkzadeh, Chang and Demirhan, 2006).

While a small study in Malaysia in 2004 found a weak positive correlation between computer anxiety and self-efficacy suggesting that being confident in one's ability may not be enough to totally negate the possibility of suffering from computer anxiety (Achim and Kassim, 2015), there is more research finding a strong and significant negative correlation between the two (Saadé and Kira, 2009; Karsten, Mitra and Schmidt, 2012). A finding that was corroborated with research from South Africa on over 2,500 students (Taylor, Goede and Steyn, 2011).

Bandura (1994) suggests that people with high self-efficacy are more resilient and more driven than those with low self-efficacy. While high self-efficacy may be related to proficiency, it is the belief in the skill that is the main force (Goleman, 1998:70). This could explain why those with high self-efficacy are less likely to have computer anxiety than their lower scoring colleagues: they believe that they will be able to achieve and therefore they persevere until they do. There are confounding factors though. Even if the self-efficacy is high, if other factors such as environment or software are not supportive levels of computer anxiety will be evident (Koo and Wati, 2011), or if the high self-efficacy is unfounded the discovery of failure, as discussed above, can have a more significant impact than would be expected, so high self-efficacy is not the magic pill to solving computer anxiety.

Self-efficacy can be influenced and changed by external influences such as training, observing a person succeeding who had similar problems and experience (Maltby et al., 2007:89, Bandura 1994). This would suggest that this is a state that can be affected by environment and context. Self-confidence can also be altered by using cognitive-behavioural techniques i.e. training the person to react in a different way than they have learnt. (Froggart, 2005) The theory suggests that this technique should be able to change the way a person feels about themselves and their abilities. The fact that self-confidence can be affected by training suggests that it is a state rather than a personality trait and if the level of self-confidence does have an impact on the level of computer anxiety as was seen in a number of studies, (Namlu, 2003; Agaoglu *et al.*, 2008; Tarafdar, Tu and Ragu-Nathan, 2010) then increasing this should help to reduce the impact of computer anxiety. This was found to be the case in a small study of programming students (Golding, Facey-Shaw and Tennant, 2006).

While increasing self-confidence or self-efficacy does seem to have some relationship with decreasing levels of computer anxiety this is not universal, so it is a factor to be considered but not the only one.

2.6.3 *Strategies for the mitigation of, or relief from, computer anxiety*

In this section, the strategies that have already been tried for the reduction of computer anxiety will be explored. Where the treatments of other anxieties appear to be useful in this context, they are discussed here too.

Curriculum changes

The UK Government has noted that the workforce needs to be more adept in their use of technology so has introduced IT and computer science into the National Curriculum in the hopes that this will address the problem. One unintended consequence may be the impact on level and occurrence of computer anxiety.

Teachers have been seen to become more familiar with using technology increasing their understanding and use of the range of technologies that are prevalent and used by their students (Toledo, 2007). So too, their skills at passing this knowledge on should have developed over time, having an impact on the level of anxiety in younger people. Certainly IT or computing or ICT have been seen as an important part of learning being noted as a foundation subject in the National Curriculum since its beginning in 1988 (DoE, 1988) fostered by the needs of industry to have a computer literate work force (Rassool, 1993) and (as discussed previously) being competent can help to reduce computer anxiety. In 1994 ICT became promoted from a Foundation subject to a core subject and by 2000 was expected to be found across the curriculum in a similar way to language (DofEE and QCA, 1999). The expectation was that children would be equipped with the necessary skills to “promote an enquiring mind and [the] capacity to think rationally” (DofEE and QCA, 1999, p. 11).

It is in the implementation of the ideas in the national curriculum that the real impact lies. (Rassool, 1993), and it is teachers who are in the front line of this. Good teaching should reduce the levels of computer anxiety as good early experiences seem to be instrumental in this (Cowan and Jack, 2011). Conversely, poor teaching may have increased the level of computer anxiety among this group of children. Looking at the time line, those at school in the 1990s, when digitisation was a new phenomenon, could well be the teachers of the current student cohort. If those teachers had a poor experience they could well be anxious about teaching technology and pass this anxiety on.

Overall, students who are entering tertiary education from 2013 onwards have experienced some sort of technology teaching for their whole school career with a richer experience from 2000 onwards, although this may have been delivered by anxious teachers. It is to be hoped that this will have the impact of reducing the levels of computer anxiety, although, knowing that math anxiety has not changed in spite of different teaching methods, it is by no means a certainty.

From September 2014 the curriculum has changed yet again to include computational thinking and programming from the foundation stage to year 10. It will be some time in the future that the impact of this approach will become visible in university students (Wright, 2017). Training delivered in Primary Schools to support this (via Barefoot CAS) suggests that there are still many Primary School teachers who are not confident about delivering this work (I deliver this training in Primary schools and a large number of staff declare their lack of confidence in delivering this aspect of the curriculum).

Technophobia treatment programme

There was some success with desensitising techniques (Rosen, Sears and Weil, 1993; Brosnan and Thorpe, 2006) but to replicate this it would have to be undertaken by trained psychologists. It is a similar technique to that used to treat other phobias and involves introducing the subject to the cause of the anxiety in carefully controlled contexts over a long period of time. It is unlikely that in the workplace or university someone would present with a severity of the level that this technique addresses, although the constant presence of technology may be achieving this end. Peer support and the modelling on non-anxious behaviour may be informally achieving similar outcomes.

Changing user perception

Attitude or belief can have an impact on the likelihood of computer anxiety (Rautopuro *et al.*, 2005). As found by one study, when some users were told that computer use was a skill that could be learnt, their computer anxiety levels were reduced (Mahar, Henderson and Deane, 1997), they assumed that they would be able to succeed and so they did. This fundamental idea that if someone perceives something to be possible, then they ensure that it is, could be harnessed to reduce levels of computer anxiety.

The users' perception of the usefulness of the tool and how easy it is to use have also been shown to have an influence on the users' willingness to engage with the technology (Tarafdar, Tu and Ragu-Nathan, 2010; Lee, Hsieh and Ma, 2011) so showing the value of the tool and training people to use the tool effectively may increase their perceptions of both usefulness and usability and which has been found to have an impact on any computer anxiety they might feel in one study (Tarafdar, Tu and Ragu-Nathan, 2011).

Computer anxiety was seen at a reduced level in those people who approached tasks with a positive attitude in studies conducted several years apart (Anderson, 1996; Parayitam *et al.*, 2010). Possibly making the task seem exciting or useful may change people's approach. Once the tasks have been successfully completed user confidence has been found to increase (Terzis and Economides, 2011) and a perception of playfulness has been seen to enhance the positive feel of an application encouraging people to engage with it (Terzis and Economides, 2011).

Conversely it has been found that even if a user has high self-efficacy in a task and achieves a good result they may still be anxious about using a computer to complete that task (Abd-El-Fattah, 2005; Rautopuro *et al.*, 2005; Yukselturk and Bulut, 2007). This suggests that, for some users, even if they understand the task very well it is not enough to overcome any computer anxiety that they feel. These users need to be supported to see how the computer will make their task easier or even produce results beyond their expectation, as even if it is perceived as being difficult to use, anxiety was found to be reduced (Fakun, 2009).

Showing the user that the technology makes their job easier, produces useful results and telling them that they will succeed have all been found to contribute to reducing computer anxiety for many. One way of showing the user that the technology will make their job easier is through training.

Focussed and appropriate training

With appropriate training there is the belief that computer anxiety can be reduced (Bloom, 1985; Meier, 1985; Omar, 1992; Rosen, Sears and Weil, 1993; Hewson, Charlton and Brosnan, 2002; Tekinarslan, 2008; Koo and Wati, 2011). One type of appropriate training is the introduction of new ideas with play and simplified versions of the final activities which (Doronina, 1995). This finding is a level of playfulness in the teaching material to be useful (Lee, Yoon and Lee, 2009; Terzis and Economides, 2011) likely to engage and be successful with training labelled as play rather than work (Webster, Heian and Michelman, 1990).

Conversely teaching students in a traditional manner i.e. lectures, worked examples and so on was found to be more effective for those students with high levels of computer anxiety while modelling appropriate behaviour helped to extend the learning of those with low levels of anxiety (Chou, 2001). Although this finding is from a study in Taiwan so there may be cultural effects as another study found a cultural dimension around how people expect to learn (Ding and Lin, 2013). This aspect underlines the complexity of dealing with computer anxiety, and strongly indicates that teachers should be aware of the levels of anxiety among their students, and their expectations before beginning a teaching session. An approach advocated some time ago by a study around teaching adults about technology (V. K. Hemby, 1999).

While teaching and training appropriately does seem to decrease computer anxiety for some people, there is other, older research that showed increasing anxiety was related to increased contact time (Monnickendam, 1993; Monnickendam and Eaglstein, 1993; Safford and Worthington, 1999; Mcilroy *et al.*, 2001; Havelka, Beasley and Broome, 2004a; Connolly, Murphy and Moore, 2009). More recent work points out that the increase in the amount of time people spend with technology increases the levels of depression and anxiety disorders – not computer anxiety particularly but other sorts of anxiety (Kim *et al.*, 2016) and there is an increasing popularist thought that sitting down might contribute to anxiety levels although this article suggests that when interacting with a computer that anxiety is reduced (Geggel, 2015).

Perhaps this reduction in anxiety is due to the quality of the experience, as it has been seen that this, rather than mere quantity of time, is most helpful in mitigating computer anxiety (Korobili, Togia and Malliari, 2010). The feeling is that a “lack of knowledge and experience contribute to computer anxiety” (Anderson, 1996, p. 71) so increased time which is not underpinned by feelings of competency could be the issue. A reduction in computer anxiety was found to be addressed by focussed training that included an anxiety management element (Bloom, 1985; Marakas, Yi and Johnson, 1998) but this is old work and is disputed by more recent work which found that learning anxiety management techniques had no impact on the level of computer anxiety (Buche, Davis and Vician, 2007). For some researchers this absence of impact clearly shows that computer anxiety is a separate and distinct anxiety (Lambert, 1991). Even without the added learning around managing anxiety it has also been found that in some cases increasing self-efficacy did not reduce computer anxiety (Ekizoglu and Ozcinar, 2010). Other, research did find that computer self-efficacy and computer anxiety were clearly related (Doyle, Stamouli and Huggard, 2005; Downey and Kher, 2015) so perhaps there is another factor that should be taken into account.

Gender differences might be one of those additional factors (Rosen, Sears and Weil, 1993) and although some research strongly suggests that the genders react differently to support (Beckwith and Burnett, 2004) this has not been a universally accepted thesis in the past (Whitley, 1996a). It has been noted that different genders use communication tools differently and this too should be taken into account (Tong and Klecun, 2004) and as discussed earlier in this work, different genders seem to use technology in different ways and for different purposes and this might have more impact than research has found to date. Those presenting as female were found to generally use technology in a more social way than males, a strategy that supports more collaborative learning, with learners tending to support each other maybe less likely to use jargon, and will be closer to the understanding level of each other (Scull, 1999; Shah, Hassan and Embi, 2012) which might help to support their learning. This collaborating style might help people to develop their own help-seeking strategies as it has been found that people who have computer anxiety are generally not very good at finding the right sort of help at the point of need (Lei Wu, 2010). Developing and using strategies both to manage the anxiety so that it does not get in the way, and to learn effectively would therefore seem to be key in helping a learner become better at using the technology. This approach was found to be successful in approving the attainment level for students who were given online coping messages and opportunities for expressive writing (Huang and Mayer, 2016).

The important point to take from this discussion is making the training both appropriate to the problem and to the user, a point which is made repeatedly (Heinssen Jr, C. R. Glass and Knight, 1987; Woszczynski, Lazar and Walker, 2003; Saengratwatchara and Pearson, 2004; Chou and Liu, 2005; Gupta, Bostrom and Anson, 2010; Gupta, Bostrom and Huber, 2010; Galy, Downey and Johnson, 2011) but often it is not clear what this appropriateness actually looks like. The best option, in conclusion seems to be to offer a range of learning opportunities so that students can use their own self-regulated learning strategies as this has been found to be a useful approach in this and other fields (Yukselturk and Bulut, 2007; Puteh and Ibrahim, 2010) while including some anxiety management techniques.

An idea proposed in 2000 by Gardner and Rozell has three steps for a lesson framework to reduce anxiety inducing situations

1. Enhance understanding of the task and environment
2. Provide training in the task and understanding of how to apply it to an IT situation
3. Make clear the amount of effort that will be required

(Gardner and Rozell, 2000).

These suggestions are around three areas that map to the three areas of anxiety as put forward by Howard: Operational, Sociological and Psychological (Howard, 1986).

A three-pronged attack is seen again in the suggestions provided in 2011, although the paper provided does not evaluate the approach, it would seem to be the common-sense approach taken at the beginning of any learning opportunity.

1. Purpose is made clear
2. There is a positive learning environment
3. Support is provided

(Sivakumaran and Lux, 2011).

Both of these suggestions are a subset of the suggestions put forward in much earlier work (V. K. Hemby, 1999) who provided a clear set of guidelines for teaching adults.

These suggestions and ideas are for a range of approaches for the development of any training sessions, but will be particularly supportive for those who have computer anxiety. In spite of the best training though, it is when the learner returns to their own environment to implement the learning that other issues need to be resolved.

Improving the environment

A potential problem may be that, in spite of increasing the self-efficacy of the user and mitigating the task related anxieties, the environment the user is in is not changed. For some people, it has been found, the environment that they have to work in can be the cause of computer anxiety, such as sitting in the sun or having an uncomfortable chair so creating a pleasant working environment could be a good step (Sivakumaran and Lux, 2011)

Part of a pleasant working environment is around the pressure being applied. If the user is being asked to work under pressure, to achieve more than they are capable of, or are in an unsupportive environment then their computer anxiety may not be relieved in spite of increased training and support as has been found (Koo and Wati, 2011). Also if the user is being asked to do too much this can contribute to computer anxiety as was found in several studies (Ragu-Nathan *et al.*, 2008; Wang, Shu and Tu, 2008; Tarafdar, Tu and Ragu-Nathan, 2010) so reducing the work load and making realistic deadlines are key strategies in reducing computer anxiety. This will not help if the technology itself is not appropriate for the task. If the hardware is not appropriate it has been found that computer anxiety is increased in spite of mitigating strategies (Kurt and Gürcan, 2010). Interaction with an unreliable machine or trying to learn across the internet with sporadic connection problems can cause computer anxiety too (Kurt and Gürcan, 2010). Ensuring the system is fit for purpose should help to avoid these problems.

It is not just the physical environment that should be considered but also the psychological one, for instance increasing the value of the task (Hewson, Charlton and Brosnan, 2002) so that the focus shifts from the tool to the task. Another factor here could be the culture of the organisation as an innovative culture has been seen to decrease levels of computer anxiety (Koo and Wati, 2011).

Another way of improving the environment may be to ensure that the interface has been designed with the user in mind to make it more enticing and intuitive (M. J. Brosnan, 1998; Hackbarth, Grover and Yi, 2003). An intuitive and friendly interface has been seen to help the user to see no risk or threat in the interaction, thus removing the need for them to feel anxious about it (Matthews, Panganiban and Hudlicka, 2011). This may also have the effect of increasing the ease of use perception by the user which has also been shown to mitigate computer anxiety in some cases (Saadé and Kira, 2009). Taking gender into account when developing an interface may also be something that improves the experience. A small study of school age children found that the different genders preferred different physical interfaces so this might also be a factor (Adamo-Villani, Wilbur and Wasburn, 2008). Although it would not be sensible to generalise from such a small study this effect was also found in adults in the past (Beckwith and Burnett, 2004).

Conversely an overly helpful interface can cause increased computer anxiety among some users as they feel overwhelmed with hints and information although for others this is a useful aid to mitigating anxiety (Beckwith, Burnett and Grigoreanu, 2006). Some users interpret these hints as 'failure feedback' and this can decrease performance quite dramatically (Matthews, Deary and Whiteman, 2003, p. 344) and by implication increase the level of anxiety experienced by the user. It was also found that hints delivered after success attract more attention than those delivered after a failure (Conati, Jaques and Muir, 2013). So some tailoring of interfaces to present error messages in an adaptive way, that takes gender into account, may need to be considered.

It is not just the environment or the interface that needs to be appropriate in creating a supportive environment, the software being used, and the way it is presented also needs to be taken into account (Tarafdar, Tu and Ragu-Nathan, 2010). Constant updating of versions with new things to learn can undermine confidence so it seems to be important that the quality of the experience is considered before the software updates are applied (Hashim, Ahmad and Abdullah, 2010).

In conclusion, to reduce the effects or incidences of computer anxiety, the user needs to be comfortable, have equipment that works well and is suitable for the task. They also need to understand how the software works and be well prepared for the task ahead understanding the deadlines as well as how to complete the tasks before them. One other way of creating a pleasant environment is making it clear that support is available if needed.

Offering support

Suitable support systems for technical and content issues have been seen to help to mitigate computer anxiety (Bradley and Russell, 1997; Thatcher *et al.*, 2008; Lee, Hsieh and Ma, 2011; Tarafdar, Tu and Ragu-Nathan, 2011) in some cases as some users feel more confident when they know there is someone to turn to for help who can act like a virtual safety net.

There are two threads of support:

- support with the task
- support with the technology

Support with the task

Support before the task is delivered through appropriate training as discussed above, but ongoing support during the deployment is different.

Sometimes, and surprisingly, an online support system can be seen to be more helpful than a person (Davy *et al.*, 2000; Klein, Moon and Picard, 2002) perhaps it is perceived as less likely to judge or somehow gives the user some thinking and calming down space. It has also been seen that people are more honest when they think they are dealing with a virtual assistant (Lucas *et al.*, 2014). Having manuals available in a range of media can also allow the user to choose which method of support they would prefer to use (see section 2.5 for a discussion of learning preferences) if the on-line support is not for them.

Support with the technology

Having a helpline or supporting technology team is seen as important by many, as evidenced by the helpdesks found in many institutions and businesses. Knowing that there is an expert to support has been found to be reassuring (Hewson, Charlton and Brosnan, 2002; Tarafdar, Tu and Ragu-Nathan, 2010; Terzis and Economides, 2011).

Relaxation

In one study specifically aimed at reducing computer anxiety muscle relaxation was taught just before a computing class. The results were not dramatic but suggestive of the advantages (Maurer and Simonson, 1991). Brosnan and Thorpe (2006) developed this idea further and found that teaching students how to relax was significant in reducing their levels of computer anxiety (Brosnan and Thorpe, 2006). This idea was also used in the desensitisation program which saw dramatic and long lasting effects (Rosen, Sears and Weil, 1993). Other studies recognise that a relaxed participant is more likely to achieve good outcomes as summarised in this early literature review (Pocius, 1991) while others found that relaxation reduced computer anxiety (Glass and Knight, 1988).

Exercise could also be considered as a form of relaxation and although a long-term exercise plan may be useful in the management of computer anxiety it seems unlikely to be a solution for anxiety at the point it occurs. On the other hand, a brisk walk away from the computer to reduce the level of frustration may be useful and as part of a longer-term strategy to improve the wellbeing of someone with high levels of computer anxiety it could be significant.

There does not appear to be any more recent literature specific to the use of relaxation as a treatment for computer anxiety, although there is, as discussed above, a large body of literature expounding the benefits of relaxation for other sorts of anxiety.

2.6.4 *Summary of computer anxiety*

The literature supports the concept of computer anxiety as a separate and distinct anxiety with similar symptoms as maths anxiety or public speaking anxiety but occasioned by interactions with technology. As with other anxieties, there is a scale of severity from mild anxiety to phobic reactions.

The reasons why someone might have computer anxiety seem to be complex but have been found to be variously related to personality, learning experiences, learning preferences, predisposition and self-efficacy.

The treatments for this anxiety could be similar to those for other anxieties but many of them have not been tried for computer anxiety. The majority of approaches have been focussed on getting the sufferer to spend time with that which causes them anxiety in the hopes that increasing experience will mitigate any anxiety. This has not been universally successful, so it seems that finding strategies that address the cause for concern and support the user to manage their anxiety symptoms would be something worth exploring.

2.7 Summary of the literature review

The literature reviewed covers a wide range of topics, from the definitions of anxiety, personality and learning preferences through to potential ways to address anxieties. It then dealt with the specific anxiety related to interactions with technology, Computer Anxiety. This section will bring those threads together, synthesise some of the ideas and identify the need for the research to follow.

Many people have to interact with computers in their everyday lives, at work, to shop, in their dealings with banks and to communicate with colleagues. They also may use computers in their social lives to share photos and ideas with friends, plan events, play games and so on. Most people are very comfortable in the technological world and they enjoy the challenge of learning how to manage new gadgets and software tools both for work and play. For a sizeable minority it appears that the interactions that are required for work are stressful and cause them to become anxious. As computers are everywhere is would be helpful if these people could be supported to either manage their anxiety or deal with the cause of the anxiety and so learn to enjoy and be enhanced by their computer interaction rather than feeling hampered and restricted by it.

One important consideration is the cause of their computer anxiety. If the cause is that the user does not know how to do something, then the response could well be to provide appropriate training in a context that supports the user. If the cause is more complex than that the solution may well be to provide strategies to manage the anxiety in the moment. Once successful interactions outweigh problematic ones the level of computer anxiety should reduce.

There have been several studies that present strategies for supporting people, but they have been seen to each have limited success. It appears that different personality types respond in different ways to specific interventions, and different needs require different approaches. Existing research into computer anxiety uses a range of models to classify the personality of anxious users. What might be useful would be to develop a profile of the person with computer anxiety to include personality, learning preferences and cause to be able to offer them an individual programme of support that suits their problem, their personality type and their situation.

It is also the case that advancing technology may be solving the problem with the swiftly changing mobile devices technology. From the introduction of widely available mobile phone technology in the mid 1980's to the widespread use of tablets connected to the World Wide Web via wireless technology, and the advent of the Smart Phone students are becoming more attuned to the benefits of technology (Wright, 2017) and more prepared to engage with it. Making technology a fashion statement rather than something in the zone of geeks may have had wider and more positive impacts than the marketing departments considered.

That computer anxiety needs to be addressed is not in question. What is in question is how this should be tackled. Should the approach be to prevent computer anxiety occurring in the first place by suggesting strategies to be used in primary education settings, or to ‘cure’ it once it manifests itself in universities and workplaces? Ideally both areas should be tackled and ultimately the need for a cure should reduce, however it seems clear that the most pressing need is create an instrument to enable teachers and employers to identify those who are suffering now and offer them some sort of support.

This research will address this by ultimately presenting an instrument that will identify the type of computer anxiety, the severity of the problem and suggest appropriate strategies for mitigation.

The next chapter explains how I went about confirming that computer anxiety was indeed an issue in the student population and how the findings from each phase guided me towards the final outcome, the creation of the computer anxiety instrument.

3 Chapter Three – gathering data and exploring what it means

Having reviewed the literature it is time to begin checking and confirming that the theories presented still hold true and exploring what else might be useful. This chapter presents the data gathering phases. Firstly, there is an overview of the whole research journey, followed by a more detailed explanation of the individual phases. The sample groups and the reasons for choosing them are detailed. At the end of each phase is a summary of the discoveries and a brief discussion about the implications for further research.

The research is summarised in the final section of this chapter where the conclusion that computer anxiety cannot be predicted is drawn, and the idea of formulating an instrument that not only identifies the type of computer anxiety and measures its severity, but also goes on to suggest mitigation strategies appropriate for the type and severity is presented.

3.1 The Research Journey

The research evolved over the time of the PhD. The first phase was a checking moment to see if computer anxiety did still exist in a cohort of university undergraduates and to see if their individual personality was connected in some way to the level of anxiety that they felt.

The results of this phase did show that computer anxiety was still an issue, but the number of participants was small and the connection between personality and computer anxiety only accounted for less than half of the variance so it seemed as if there may be other factors to consider. Something that had come up in the literature was quality of previous experiences so that seemed a useful avenue to explore further.

The second phase of research therefore needed to expand its reach and also explore learning experiences. It seemed appropriate to also ask about how the participants would prefer to learn in the future. In order to expand the reach, the cohort this time included a global cohort of mature MA level students who were studying via an on-line course. Of necessity the survey had to be delivered via on-line methods, and while this elicited a deal of response from on-line students the returns from the home students were very limited and in contrast to the first phase returned very low levels of computer anxiety. This finding suggested the need for a third phase to confirm the findings from the first phase.

By this stage the surveying instrument had become very bulky, so the elements were reviewed to reduce the number of questions, while other elements were added such as learning styles to see if how the students thought they learnt affected their levels of anxiety.

This third phase was delivered on paper to those students studying within the university. There was a good level of participation and the results from this phase suggested that there was a level of CA within the population. It also showed that personality, learning preference and gender were not factors that influenced the level of CA. Now that this was confirmed within this population there was a need to see if it was the case in a wider group that could have the research delivered via paper methods.

There were four distinct groups that were surveyed in this final phase. One group of undergraduates from a small university Business School (as has been the case throughout the work), one group of foundation students, one group of undergraduates and one group of MA level conversion students. These three final groups were situated in the Computer Science department of a large Russell Group University.

The final phase just focussed on computer anxiety. The instrument used to this point, although used in many other studies and validated in the past, may, due to the advances of technology, be measuring something that was no longer valid. Looking at the work of Powell (2013) it seemed that adaptations on the CARS developed by Heinssen et al (1987) were used more recently in a number of studies, and that these adaptations made the questions more relevant to current technology. As a result of this I decided to use this survey in my final round. The inclusion of the Business students maintained a level of consistency with the previous work in that any major changes would be reflected in both contexts, and some tentative comparisons of the categories (high, medium and low computer anxiety) could be made.

3.2 Phase One

This section looks at the first phase of data gathering which was developed to check the levels of computer anxiety in the current university population, and to explore the possibility that personality traits are related to it. The overall aim at this stage was to explore personality trait as a mechanism for being able to predict which people might be going to suffer from computer anxiety so that they could be supported before it got too debilitating.

The research initially follows a deductive approach in that it takes existing theories of personality and computer anxiety and explores the current reality to check that they are valid. It moves to deductive as it explores if there is a relationship between the two.

There are a few different findings from previous research to be considered

1. That computer anxiety is still an issue of concern in the student population.
2. That computer anxiety and neuroticism are positively related i.e. the stronger the preference for neuroticism the higher the level of computer anxiety (Hudiburg, Pashaj and Wolfe, 1999; Anthony, Clarke and Anderson, 2000; Korukonda, 2005, 2007).
3. That computer anxiety and openness are negatively related i.e. the less openness a person demonstrates the higher the level of computer anxiety (Anthony, Clarke and Anderson, 2000; Korukonda, 2005, 2007).
4. That computer anxiety and openness are positively related i.e. the more openness a person demonstrates the higher the levels of computer anxiety (Hudiburg, Pashaj and Wolfe, 1999).
5. That computer anxiety and agreeableness are negatively related. i.e. a low score on the agreeableness dimension correlates with a high score in computer anxiety (Korukonda, 2007).

There are five questions that will be answered by this research:

1. Can computer anxiety still be found in the student population?
2. Are computer anxiety and neuroticism positively related?

3. Are computer anxiety and openness positively related?
4. Are computer anxiety and openness negatively related?
5. Are computer anxiety and agreeableness negatively related?

3.2.1 *Methods*

This section explains why particular instruments were chosen to explore computer anxiety and personality. The sample group and reasons behind their selection is also discussed.

The instruments

Both Anthony et al (2000) and Korukonda (2003) used the same instruments in their work and although Hudiburg et al (1999) used a different computer anxiety measure, they all used the same personality measure. In order to discover the relationship between computer anxiety and personality the measure created by Rosen and Weil (1987) to measure computer anxiety, and items from the Big 5 inventory will be used as these were the instruments in Korukonda's (2003) and Anthony et al's (2000) work. These are explained in more detail below

Measuring computer anxiety

From the literature we find that a self-reporting questionnaire is the most popular method for measuring Computer Anxiety in a student body. There are a number of such instruments in common use.

An early and well-used one created by Rosen and Weil (Rosen and Weil, 1992) has been used both in the UK and internationally to measure the levels of computer anxiety including (Anthony, Clarke and Anderson, 2000; Korukonda, 2007). It is part of a set of three questionnaires that together give a full picture of the attitudes, thoughts and anxiety level of a respondent.

The element that looks at anxiety level is the Computer Anxiety Rating Scale (CARS) and it has only twenty questions, which are clearly written, and seems to be easy for the respondent to fill in. The results are not complex to analyse. There is a large body of data to verify its validity. As well as this the scale has been successfully used globally and therefore would be appropriate to use with a mixture of nationalities. The scale gives a total score of the participant's computer anxiety and the range is 20 to 100. The boundaries are: A score of less than 42 signifies none to low levels of computer anxiety; a score of more than 50 suggests moderate to high computer anxiety. This is the measure that was used in both the work of Anthony et al (2000) and Korukonda (2003).

There are two other questionnaires in this section that relate to thoughts about computer (CTS) and technology and General Attitudes towards computing and technology (GATC). Both these instruments use Likert scales and in these cases high scores indicate a positive attitude and positive thoughts towards computers and technology.

	CARS	CTS	GATCS
No Technophobia	20-41	69 -100	64-100
Low Technophobia	42-49	61-68	56-63
Moderate/High Technophobia	50-100	20-160	20-55

Table 1: The range of scores and severity levels (Rosen and Weil 1992)

The interpretation of the scores is that if any one score is in the high range this would indicate a moderate to high level of technophobia while a range of scores including low and no indicates low technophobia (see Table 1). It is expected that the distribution between the three sectors is about equal with a third of respondents in each range (Rosen and Weil, 1992).

There are factors within each of the questionnaires which might indicate different areas of anxiety. Within CARS the researchers postulate that there are several factors of which one is Interactive computer learning anxiety. Further research suggests that the factors are not always seen to be reliable (Gordon *et al.*, 2003) so will be treated with caution.

Measuring personality Type

Personality type is also often measured using self-reporting questionnaires. There are a number of different models but for this work the Big 5 was appropriate as it has been used both by Korukonda (2003), Anthony et al (2000) and in a number of other studies with computer anxiety (Korukonda, 2005; van Dijk, 2006; Brosnan *et al.*, 2010) showing a relationship between some of the traits and the levels of computer anxiety.

There are a number of questionnaires available (John and Srivastava, 1999; McCrae and Costa, 1999). This questionnaire was developed based upon the items available from the International Personality Item Pool (Goldberg, 1992) and like CARS uses a Likert Scale for capturing the respondent's responses. This similarity should make it easier for the participants to fill in. Some of the questions are reversed, but these are amended using the formula

$$\text{score} = (\text{maximum score} + \text{minimum score}) - \text{participant score.}$$

All of the scores for each trait are summed to give an overall value for that trait. A mean value for the trait could be used instead, but this would give rise to decimal values and might introduce rounding errors so the raw data was used in preference, in addition the instructions at the end of the test suggest that summing the responses is the correct approach (John and Srivastava, 1999).

3.2.2 *The Sample Group*

Using the opportunist philosophy and the fact that supporting the student body is the main motivation for this work, the First Year Cohort of a Business School was selected.. Within the Business School there are a wide variety of courses and this cohort included students from all of them. Some of the students would be studying accountancy and would therefore need to be comfortable with EXCEL as well as being able to use word processing software. Others were studying Business IT and would be programming and creating databases and websites. All the students have to engage with the VLE, access resources via the library and some may have to create e-portfolios. It is likely that many of these applications would be new to the students. As much of the assessment is done via some form of written work the students would also be expected to use word processors to format and present their work to a high standard. Later in their studies the use of SPSS to analyse data would also be part of their experience. The students are a mixture of nationalities although the majority are home students i.e. normally based in the UK. If the level of computer anxiety was found to be worrying in this group, there would be time to intervene to support them. The entire cohort was 160 students.

3.2.3 *The Process*

One objective is to check the levels of computer anxiety in this cohort. One of the strategies of someone suffering from computer anxiety is avoidance of non-essential interactions with computers (Rosen and Sears, 1987; Maurer and Simonson, 1991). Taking this into account it seems sensible that the questionnaires are delivered and completed on paper so as not to deter anyone who has computer anxiety from taking part in the research.

The students were briefed by lecturers who then handed out the paper questionnaires making it clear that participation was voluntary. This was recognised as some returns were blank or only partially completed. All papers were then collected back at the end of the session giving those students who chose to participate plenty of time to complete them.

The completed questionnaires were then manually entered into an EXCEL spreadsheet for later analysis.

At a later date, the personality questionnaires were distributed on paper to the same sample group. Participants in both surveys were asked to supply their email address so that the two different questionnaires could be connected. This was not an ideal request as it made the responses not anonymous and so could deter participation.

The two instruments can be seen in appendix 1 .

3.2.4 *Analysis*

The results were analysed using the data analysis tools in Microsoft EXCEL to show descriptive statistics and explore the data for correlations. SPSS was used to do multinomial stepwise regressions.

There are several aims of the analysis.

- To review the personality profiles of the year group
- To address the questions listed in section 3.2
- To see if the level of computer anxiety can be predicted by the personality type

3.2.5 *Phase One Findings*

The questionnaire was delivered in two parts. There were few identifiable participants who completed both sections.

Computer anxiety element: 57 returns

Personality analysis element: 131 returns

People who could be identified who did both: 26 returns

Computer anxiety element

This looked at three different measures of anxiety

CARS – Computer anxiety rating scale

CTS - Computer thoughts scale

GATC – General attitude towards technology and computers

CARS

The Table (Table 2) and Chart (Chart 1) below show a summary of the findings from the first questionnaire.

statistical measure	*Total Anxiety My research*	*Distributive characteristics from Rosen and Weil*
Mean	48.23	41.46
Standard Error	2.31	
Median	46.00	
Standard Deviation	17.42	14.25
Kurtosis	-0.99	
Skewness	0.33	1.15
Range	63.00	80
Minimum	22.00	20
Maximum	85.00	100
Count	57.00	2940

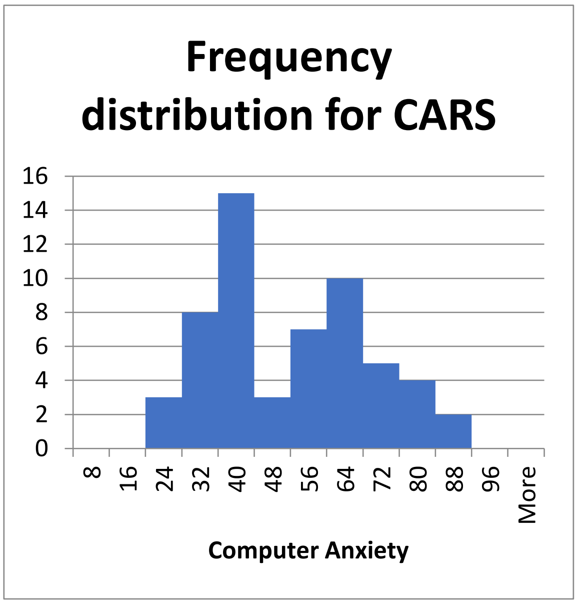


Chart 1:Frequency Distribution for the scores awarded to items in the CARS

Table 2 Descriptive Statistics for CARs questionnaire showing total score and for comparison the characteristics from Rosen and Weil (1992)

As the data in Table 2 and Chart 1 show, the data is not normally distributed as it has a skewness of 0.33. To be symmetrical the skewness should be 0. This contrasts with the findings from Rosen and Weil (1992) whose results show a skewness of above 1, although the values are both positive i.e. both are skewed in the same direction, it is not to the same extent. This could be because the sample size in this research is much smaller than the 2940 in Rosen and Weil's research.

The Median value is 46 which is in the range for low-medium levels of computer anxiety, however the relatively larger standard deviation indicates that the data is fairly-well spread out, with a range of responses of 63, this is less than the range of 80 found by Rosen and Weil, who had participants presenting with scores at both extremes of the possible range.

The mean value of 48 which sits in the low to medium computer anxiety range, contrasts with the findings from Rosen and Weil who found a lower mean of 41 which is in the no-low anxiety range.

Looking to see if there is a difference between the two groups using Cohens effect size (ES) test

ES = ($\mu_{\text{my research}} - \mu_{\text{distribution characteristics}}$)/Standard deviation of distribution characteristics (S)

Gives the result of 0.48 which suggests a low difference between the groups, in spite of what appear to be differences, these are not so great as to be statistically different.

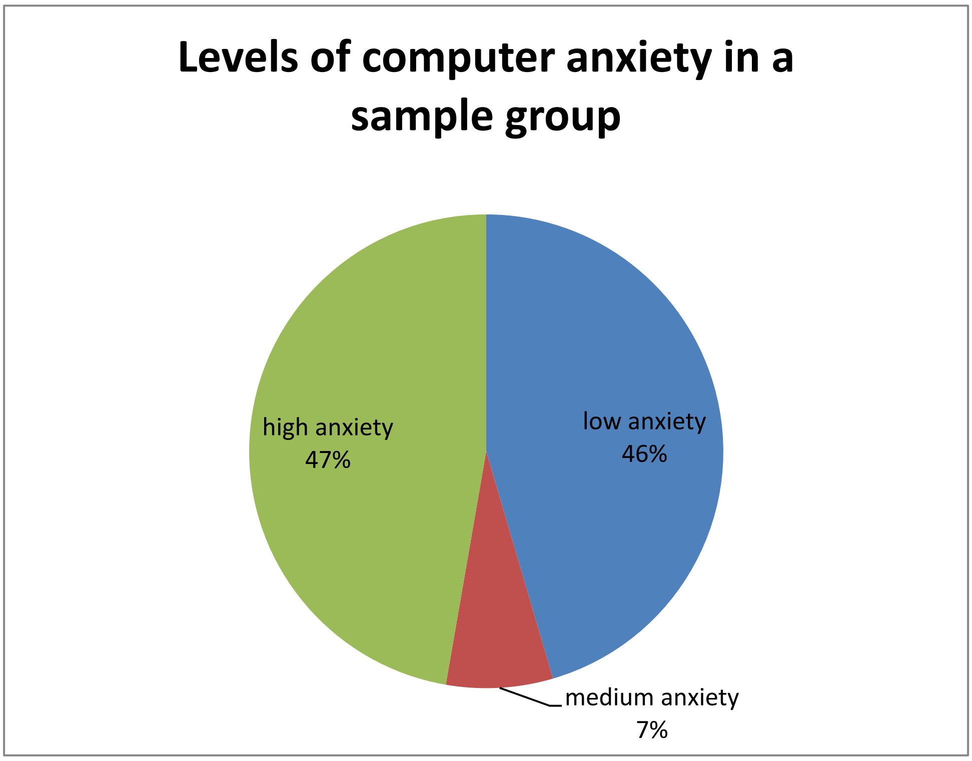


Chart 2: The distribution of computer anxiety (CAR)

The general levels of computer anxiety as split into nothing to low (Under 42), low to medium (between 42 and 50) and medium high (over 50) can be seen in Chart 2

It can be seen (Chart 2) that while nearly half of the group experience low to no computer anxiety, more than half the group (54%) experience medium to high computer anxiety levels. These findings are not consistent with the literature which suggests that the distribution should be around a third in each group, with the majority in the mid-range (Rosen and Weil, 1992).

CTS

Within the CTS there are three factors: Negative computer cognitions, Positive Computer Learning Cognitions and Computer Enjoyment. Combining these factors gives rise to an overall score suggesting the positivity of the person's thoughts around using computers.

Statistical measures	***CTS total***	***NEGATIVE COMPUTER COGNITIONS:***	***POSITIVE COMPUTER LEARNING COGNITIONS***	***COMPUTER ENJOYMENT:***	***Distributional characteristics from Rosen and Weil***
Mean	67.72	40.39	16.82	12.86	76.14
Standard Error	1.39	1.02	0.28	0.44	
Median	70.00	41.00	17.00	13.00	
Mode	70.00	41.00	18.00	13.00	
Standard Deviation	10.46	7.72	2.10	3.35	13.91
Sample Variance	109.48	59.65	4.40	11.19	
Kurtosis	-0.13	0.20	1.63	-0.28	
Skewness	-0.33	-0.45	0.22	-0.32	-0.67
Range	45.00	37.00	12.00	15.00	77
Minimum	41.00	18.00	12.00	5.00	23
Maximum	86.00	55.00	24.00	20.00	100
Sum	3860.00	2302.50	959.00	733.00	
Count	57.00	57.00	57.00	57.00	2343

Table 3: Descriptive statistics for the CTS showing the three contributing factors and overall score

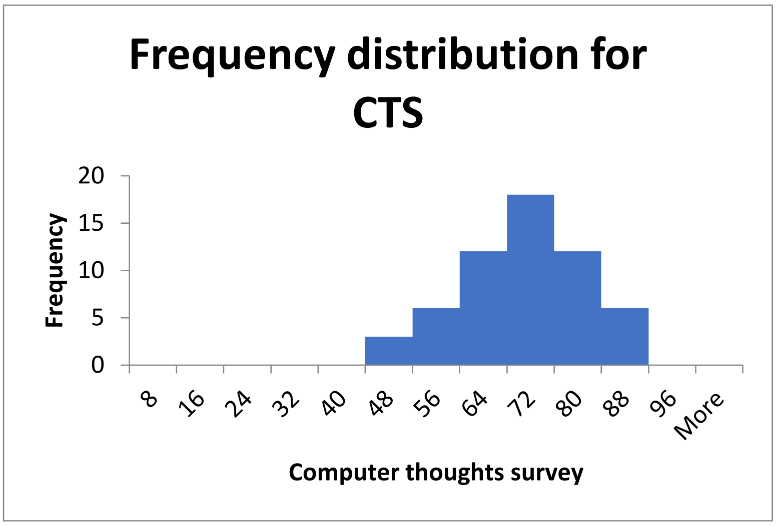


Chart 3: The frequency distribution for the results from the CTS questionnaire

Table 3 and Chart 3 show the data distribution with a relatively small standard distribution indicating a narrow distribution of data, an analysis confirmed by the low value of Kurtosis. The mode and median are close to the maximum value indicating that in general most people thought positively about computers.

Compared to the distribution characteristics in the same way as above we find an Effect Size (ES) of 0.6. This indicates that this group varies moderately from the distribution characteristics. Although most people had positive thoughts, they were not as strongly indicated as those found in previous research (Rosen and Weil, 1992).

	CTS total	NEGATIVE COMPUTER COGNITIONS:	POSITIVE COMPUTER LEARNING COGNITIONS:	COMPUTER ENJOYMENT:
CTS total	1			
NEGATIVE COMPUTER COGNITIONS:	0.85	1.00		
POSITIVE COMPUTER LEARNING COGNITIONS:	0.13	0.20	1.00	
COMPUTER ENJOYMENT:	0.67	0.26	-0.07	1.00

Table 4: Scores from the CTS

From Table 4 we can see that negative computer cognitions and computer enjoyment correlate strongly with the CTS total. Negative thoughts seem to have more of an impact than either of the other two factors. The factors do not correlate with each other suggesting that they are independent in this sample. It seems odd that computer enjoyment and positive computer learning cognitions are not at all related suggesting that people enjoy playing on their computers but do not like using them to learn. Although this would fit in with Blooms theory that anxiety is occasioned when performance is going to be judged by a third party (Bloom, 1985)

GATC

Statistical Measure	GATC total	ATTITUDES TOWARD COMPUTERS IN EDUCATION	ATTITUDES ABOUT COMPUTER CONTROL	ATTITUDES ABOUT INEQUITY IN COMPUTER ABILITY	COMPUTERS AND EMPLOYMENT	COMPUTERS SOLVING SOCIETAL PROBLEMS	COMPUTERS AND FUTURE JOBS	ATTITUDES ABOUT COMPUTERS AND HEALTH	Distribution characteristics
Mean	63.88	18.72	5.00	9.42	6.26	6.40	3.54	2.33	67.12
Standard Error	0.75	0.33	0.21	0.34	0.20	0.22	0.16	0.11	
Median	64.00	19.00	5.00	9.00	6.00	6.00	4.00	2.00	
Mode	63.00	20.00	4.00	8.00	7.00	6.00	5.00	2.00	
Standard Deviation	5.68	2.46	1.56	2.60	1.52	1.64	1.21	0.85	5.71
Sample Variance	32.25	6.06	2.43	6.75	2.30	2.67	1.47	0.73	
Kurtosis	1.00	0.59	-0.32	-0.86	-0.59	3.07	-1.08	-0.34	
Skewness	-0.10	-0.37	0.50	0.19	0.14	-0.94	-0.29	0.37	0.32
Range	30.00	13.00	7.00	10.00	6.00	9.00	4.00	3.00	41
Minimum	50.00	11.00	2.00	5.00	3.00	0.00	1.00	1.00	49
Maximum	80.00	24.00	9.00	15.00	9.00	9.00	5.00	4.00	90
Sum	3641.00	1067.00	285.00	537.00	357.00	365.00	202.00	133.00	
Count	57.00	57.00	57.00	57.00	57.00	57.00	57.00	57.00	1286

Table 5: Descriptive statistics for GATC questionnaire showing the seven different factors and the total score

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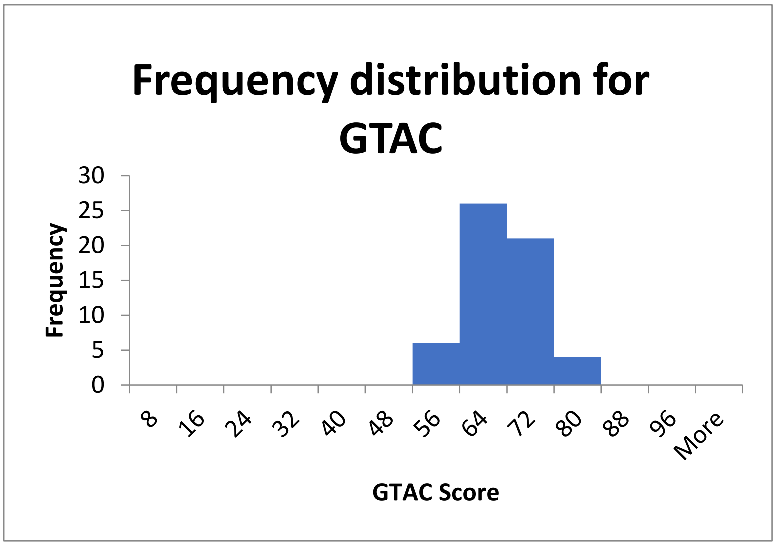


Chart 4: The Scores from the GTAC

As can be seen from Chart 4, there is a non-normal distribution for the compiled score. In this survey, the standard deviation is small suggesting that the data does not have a big spread (Table 5). Some of the factors have a very low score although the factor discussing attitudes to computers in education scores much more highly than the others. The overall score suggests that most students have positive attitudes to computers.

Compared to the distribution characteristics this sample is a moderately different with a ES value of 0.57. Compared to previous research this group has a more pessimistic attitude towards computers.

	GATC total	ATTITUDES TOWARD COMPUTERS IN EDUCATION:	ATTITUDES ABOUT COMPUTER CONTROL	ATTITUDES ABOUT INEQUITY IN COMPUTER ABILITY	ATTITUDES ABOUT COMPUTERS AND EMPLOYMENT	ATTITUDES ABOUT COMPUTERS SOLVING SOCIETAL PROBLEMS	ATTITUDES ABOUT COMPUTERS AND FUTURE JOBS	ATTITUDES ABOUT COMPUTERS AND HEALTH
GATC total	1							
ATTITUDES TOWARD COMPUTERS IN EDUCATION:	0.45	1.00						
ATTITUDES ABOUT COMPUTER CONTROL	0.47	-0.18	1.00					
ATTITUDES ABOUT INEQUITY IN COMPUTER ABILITY	0.47	-0.10	0.14	1.00				
ATTITUDES ABOUT COMPUTERS AND EMPLOYMENT	0.31	0.29	0.09	-0.02	1.00			
ATTITUDES ABOUT COMPUTERS SOLVING SOCIETAL PROBLEMS	-0.08	-0.05	-0.01	-0.01	-0.14	1.00		
ATTITUDES ABOUT COMPUTERS AND FUTURE JOBS	0.37	0.14	0.14	0.27	0.45	0.04	1.00	
ATTITUDES ABOUT COMPUTERS AND HEALTH	0.38	-0.12	0.44	0.00	0.12	-0.09	0.27	1.00

Table 6: Correlations within GATC

Looking at the correlation between factors in Table 6, it can be seen that none of the factors correlates strongly with the total score suggesting that all need to be taken into account. The factor around solving societal problems has very little influence over the final score. The only factors that show any correlation are those about jobs and employment. This shows that all the identified factors are independent replicating the findings from Rosen and Weil (1992).

Comparisons across the three parts of the technophobia questionnaires

Although from looking at the charts above it appears as if there is very little correlation between the Computer Anxiety score and the other two scores as the distributions do not look similar it may be that there is something more than meets the eye.

To calculate whether there is more correlation than can be judged by looking at the bar charts above, the responses to the CTS and GTS have been plotted on a scatter graph against computer anxiety in fig 7, with R^2 calculated. As can be seen in Chart 5, R^2 for both CTS and GTS is less than 0.1. This suggests almost no correlation between CTS, GTS and computer anxiety.

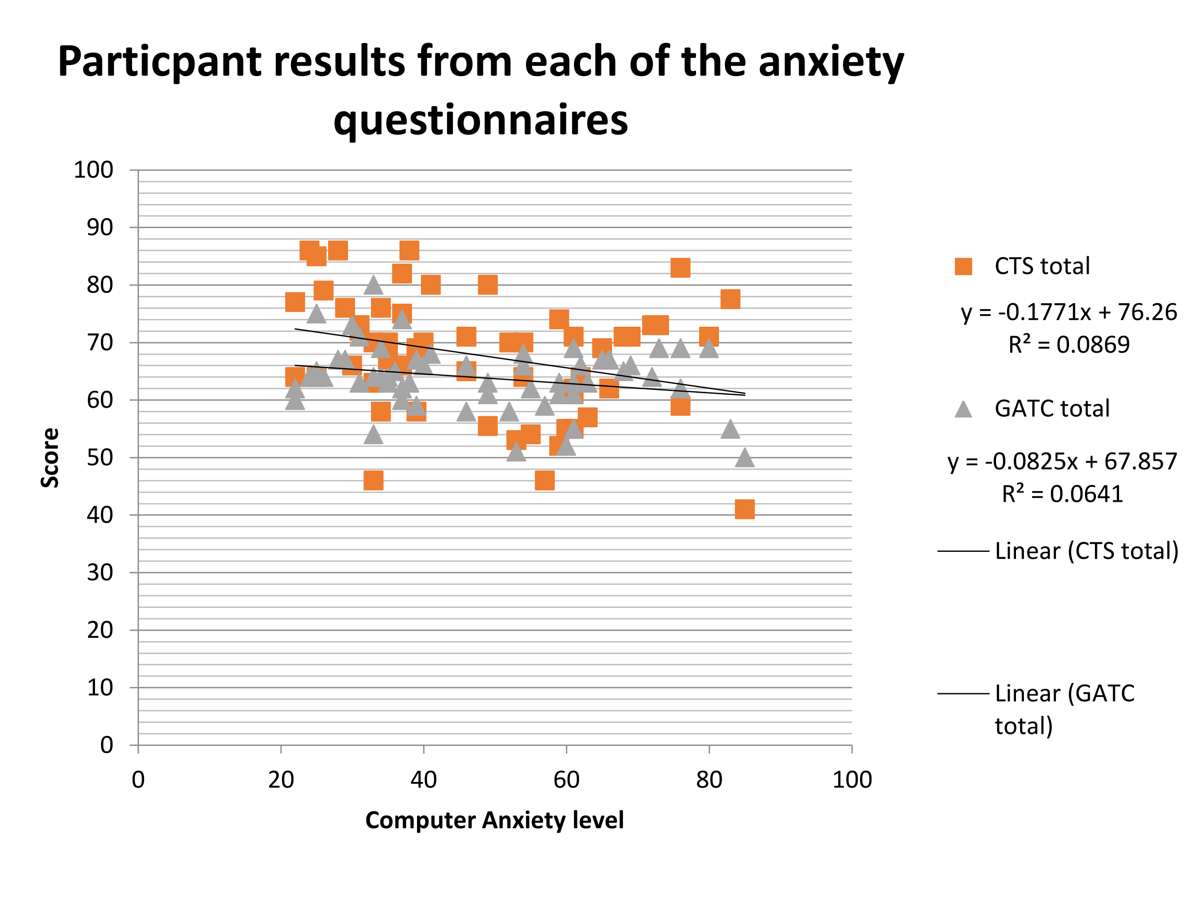


Chart 5 Individual scores from CTS and GATC compared with computer anxiety levels

In Chart 5 we also can see that while the level of computer anxiety increases the results from the other two questionnaires seem to decrease. This is expected as the CTS and GATC are looking for positive results i.e. the more positive the thoughts or attitudes about computers the higher the score.

The trends therefore are as expected. The R^2 formulae show that the relationship is very weak i.e. <0.1 and therefore is not a significant relationship.

However, there are some anomalies within individual responses. For the majority of respondents, a low anxiety score is linked to a high level of positive thoughts and attitude, and higher levels of computer anxiety lead to lower levels of positive thought. However, there are some participants who present another picture entirely: those who have indicated that their level of computer anxiety is quite high, yet have positive thoughts and attitudes to technology.

Although the scatter graph and R^2 calculation seems to indicate that there is very little correlation between computer anxiety and either CTS or GTS the EXEL correlation tool was used to check if there is any correlation between the three questionnaires with the results shown in Table 7

	CARS total	*CTS total*	*GATC total*
CARS total	1		
CTS total	-0.29482	1	
GATC total	-0.25313	0.482629	1

Table 7 Correlations between the three questionnaires

In Table 7 we can see that a positive correlation exits between the CTS and GATC, although this is not strong as it is only just > 0.4, and very weak inverse correlations exist between CARS and both of the other questionnaires with values <0.4.

For the three elements combined as seen in Table 8, the proportions of the different levels of technophobia are shown.

	Raw numbers	As a percentage of the whole
None	11	19.30%
Moderate	16	28.07%
High	30	52.63%

Table 8 numbers and percentages from phase 1

This distribution is not as expected since Rosen and Weil report that with their university student studies 61% were found to have No Technophobia while only 25% showed moderate/high technophobia (Rosen and Weil, 1992). The population surveyed in phase 1 not only showed that computer anxiety is a continuing problem, but surprisingly at a higher level for this group, almost double, than previous research had found although this is a different context so direct comparisons cannot be made other than tentatively.

Thus, the answer to question 1 is that there is evidence that computer anxiety still exists in a significant minority of the student population.

Personality element

Looking at the distribution of the dominant traits for the participants, agreeableness is the most represented with emotional stability being the least represented. 12% of the group did not have a dominant trait (Chart 7).

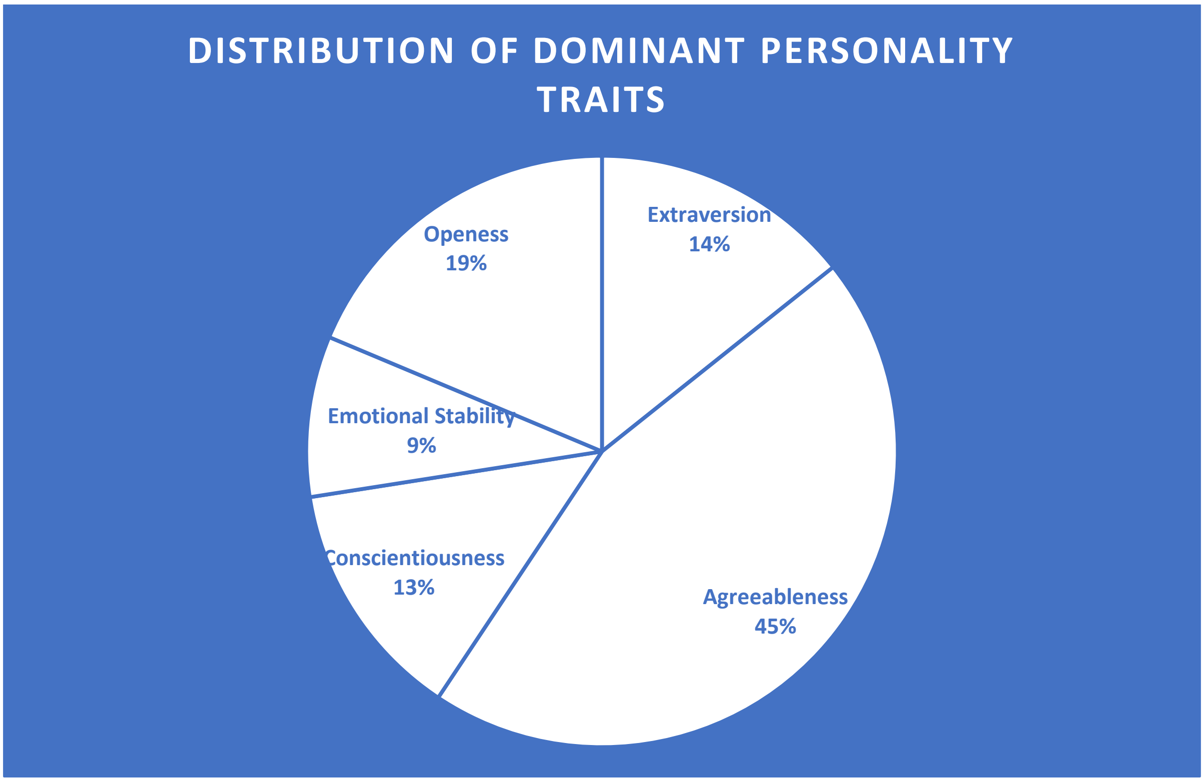


Chart 6 Personality traits in the sample

There is very little correlation between the traits as illustrated in Table 9. This is as expected as the traits are identified as independent traits which are unrelated to each other (Matthews, Deary and Whiteman, 2003).

	Extraversion	*Agreeableness*	*conscientiousness*	*Emotional Stability*	*Intellect/Imagination*
Extraversion	1				
Agreeableness	-0.08797	1			
Conscientiousness	-0.0303	-0.13834	1		
Emotional Stability	-0.04388	0.075698	0.308077	1	
Intellect/Imagination	0.189645	-0.12758	0.265329	0.325499	1

Table 9: Correlation between different personality traits

The highest correlation is between emotional stability and intellect, but this is still less than 0.4 so can only be considered as a weak correlation. This reinforces the view that the traits are independent of each other.

As the traits are bi-polar i.e. a low score in emotional stability could be interpreted as a strong indication of neuroticism it is also worth understanding the trait at the other end of the scale.

Trait (high score)	Explanation	**Trait (Low score)**	Explanation
Extraversion	Risk taker and extrinsically motivated	**Introversion**	Intrinsically motivated, risk avoidance
Agreeableness	Trusting, apt to concur	**Challenger**	Tending to antagonism, prefers to work alone
Conscientiousness	Competent and focussed	**Flexible**	Sometimes lacking in direction, but adaptable
Emotional stability	Resilient but not risk averse	**Neurotic**	Adversely impacted by bad news and strongly reactive to negativity
Openness	Fantastical and excitable, open to new ideas	**Preserver**	Closed to new experiences, resistant to change

Table 10: The identifiers of each of the personality traits .

Personality and Computer anxiety considered together

There were only few respondents that answered both questionnaires so there is not enough data to perform a chi-squared test, although the distribution of the individuals' highest and lowest scoring personality traits against the different levels of computer anxiety can be seen in Table 11.

	Personality traits				
Computer anxiety	**Introvert**	**Challenger**	**Flexible**	**Neurotic**	**Preserver**
Low	2	8	0	0	0
Medium	0	2	0	0	0
High	2	7	4	0	0
	Personality traits				
Computer anxiety	**Extraversion**	**Agreeableness**	**conscientiousness**	**Emotional Stability**	**Openness**
Low	6	0	1	0	3
Medium	1	0	1	0	0
High	5	0	2	2	2

Table 11:The distribution of personality traits across the different levels of computer anxiety

The trait of challenger (or low agreeableness) seems to be the most common for high levels of computer anxiety but a more robust statistical test will be used.

The next analysis was done using the scores given to each trait compared with the total score from the CARS questionnaire. For ease of presentation only the descriptor at the high end of the scale will be shown in the labels for each trait. This analysis was to see if there was a relationship between the level of computer anxiety and the score given to each trait.

	Total Anxiety	*Extraversion*	*Agreeableness*	*conscientiousness*	*Emotional Stability*	*Intellect/Imagination*
Total Anxiety	1					
Extraversion	-0.1256	1.0000				
Agreeableness	-0.3883	0.1728	1.0000			
conscientiousness	0.0415	-0.4220	0.2276	1.0000		
Emotional Stability	-0.5179	0.0453	-0.0193	-0.1348	1.0000	
Intellect/Imagination	-0.2879	0.5364	0.2523	-0.1066	0.2948	1

Table 12: Correlation between Computer Anxiety and Personality Trait

We can see that there is a correlation between Emotional Stability and Total Anxiety of 0.52 (Table 12). Although this is more than 0.4 it is still considered to be a weak correlation. The personality traits are thought to be independent however there is a weak correlation in this sample between intellect and extroversion, which is stronger than that between anxiety and emotional stability.

	CTS total
CTS total	1
Extraversion	0.063427
Agreeableness	0.213977
conscientiousness	0.055963
Emotional Stability	0.143879
Intellect/Imagination	0.314991

Table 13: Correlation between CTS and personality traits

In Table 13 we can see that there is no correlation between CTS score and any of the personality traits and there is a similar story when we look at GTAC scores and personality traits as shown in Table 14

	GATC total
GATC total	1
Extraversion	-0.02777
Agreeableness	0.274476
conscientiousness	0.1507
Emotional Stability	0.058252
Openness	0.183559

Table 14 Correlation between GTAC and personality traits

Having seen that there is some correlation i.e. a relationship between the CARS score and some personality traits, the next step is to see if that relationship is strong enough so that it can be used to predict the value of the dependent variable. This is done with regression analysis.

Testing for the hypothesis that personality can predict computer anxiety, and the null hypothesis that personality cannot be used to predict computer anxiety.

If we look at regression (Table 15), we can see that there is a significant relationship between some items.

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*	
Regression	5	2526.4	505.28	3.192	0.027	
Residual	21	3324.3	158.3			
Total	26	5850.7				
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	105.09	20.759	5.0626	5E-05	61.92	148
Extraversion	0.0165	0.2166	0.0763	0.94	-0.43	0.5
Agreeableness	-0.417	0.1838	-2.269	0.03	-0.80	-0
conscientiousness	0.0645	0.1831	0.3522	0.73	-0.32	0.4
Emotional Stability	-0.57	0.1995	-2.856	0.01	-0.99	-0
Openness	-0.052	0.2946	-0.178	0.86	-0.67	0.6

Table 15: Anova test results for computer anxiety and personality

The ANOVA test shows the probability of getting an F Value of 3.192 or larger if there were no interaction between the variables. Given that this value is less than 0.05 the null hypothesis that personality traits cannot predict computer anxiety is rejected.

This does not mean that personality can be used, rather that we cannot say that personality traits definitely cannot be used.

In the more detailed section of the results, Agreeableness and Emotional stability are both negatively correlated with Computer Anxiety as indicated by the t-stat. This is to a significant level as noted by the p values of less than 0.05.

If only these two factors are considered in the regression the results as shown in Table 16 are found.

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	1353.37	676.68	4.01	0.03
Residual	23	3876.79	168.56		
Total	25	5230.15			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-45.62	35.13	-1.30	0.21	-118.29	27.04
Agreeableness	1.35	0.56	2.44	0.02	0.20	2.50
Emotional Stability	1.98	0.89	2.24	0.04	0.15	3.81

Table 16: Anova results from Agreeableness and Emotional Stability on the level of computer anxiety

The ANOVA test shows the probability of getting an F Value of 4.01 or larger if there were no interaction between the variables. Given that this value is very low it can be concluded that it is very unlikely that this value is arrived at by chance, and likely that the values of Agreeableness and Emotional Stability are, in some way related to the value of Computer Anxiety for this sample.

This suggests that both these factors have a part to play in determining the level of computer anxiety in an individual. Note that they are both negatively associated with the level of computer anxiety i.e. the lower the level of both agreeableness and emotional stability the higher will be the level of computer anxiety, or to put it another way, the stronger the traits of challenger and neuroticism are, the higher the level of computer anxiety will be.

Regression Statistics	
Multiple R	0.508687
R Square	0.258762
Adjusted R Square	0.194307
Standard Error	12.98291
Observations	26

Table 17: Regression Statistics

The R^2 value for this regression is 0.258 which suggests that just over 25% of the level of Computer Anxiety can be explained by these personality traits for this group (Table 17).

It also indicates that 75% of the variation is caused by other factors not considered in this part of the research.

If the data is organised so that respondents are grouped into computer anxiety levels of high, medium and low (represented by 3=high, 2=medium and 1=low) a multinomial linear stepwise regression test can be run using SPSS.

Computer anxiety is the dependent variable. Agreeableness was allocated in the first block with the other traits in the second stepwise block.

The resultant model confirmed that only these two factors contributed to the level of computer anxiety. (Table 18)

Model Summary[c]

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.353[a]	.125	.088	.932	.125	3.424	1	24	.077
2	.550[b]	.303	.242	.850	.178	5.879	1	23	.024

a. Predictors: (Constant), Agreeableness

b. Predictors: (Constant), Agreeableness, EmotionalStability

c. Dependent Variable: CompAnx

Table 18: Stepwise regression of agreeableness and emotional stability against computer anxiety

Looking at the R^2 value Table 18 it can be seen that Model 2 accounts for 30.3% of the variance in the level of computer anxiety. However, the adjusted R^2 is quite a lot lower

(.303-.242 = .061 or 6.1%) so if this model were applied to the general population it would account for only 24.2% of the variance.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.978	1	2.978	3.424	.077[b]
	Residual	20.869	24	.870		
	Total	23.846	25			
2	Regression	7.226	2	3.613	5.000	.016[c]
	Residual	16.620	23	.723		
	Total	23.846	25			

a. Dependent Variable: CompAnx

b. Predictors: (Constant), Agreeableness

c. Predictors: (Constant), Agreeableness, EmotionalStability

Table 19 The ANOVA test for computer anxiety against personality traits agreeableness and emotional stability

The Anova test (Table 19) shows that both models are helpful in predicting the value of computer anxiety but that the second model with a Sig of 0.016 is quite significant as this value is <0.05 but not highly significant as it is still >0.01.

With that in mind when we review the Model parameters it would be wise to focus only on model 2 (Table 20).

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	.403	.923		.437	.666					
	Agreeableness	.069	.037	.353	1.851	.077	.353	.353	.353	1.000	1.000
2	(Constant)	-4.787	2.300		-2.081	.049					
	Agreeableness	.101	.036	.519	2.774	.011	.353	.501	.483	.867	1.153
	EmotionalStability	.141	.058	.453	2.425	.024	.264	.451	.422	.867	1.153

a. Dependent Variable: CompAnx

Table 20 review of the model parameters

Looking at the Beta values it can be seen that Agreeableness has a slightly higher impact than Emotional Stability although both elements make a significant contribution to the model.

Question 2: That computer anxiety and neuroticism (the low end of emotional stability) are positively related was found to be supported for this cohort.

Question 3: That computer anxiety and openness are positively related was found to be unsupported for this cohort.

Question 4: That computer anxiety and openness are negatively related was found to be unsupported for this cohort.

Question 5: That computer anxiety and agreeableness are negatively related is supported for this cohort.

3.2.6 *Discussion*

In this section, the results will be discussed and comparisons with existing research explored. Firstly, the two different facets of the research will be discussed separately and in the final section a discussion about the interrelatedness of the two will be discussed.

Computer Anxiety

The findings for this cohort around computer anxiety are not within the range as seen in the literature.

It could be expected there has been some impact due to higher levels of exposure to technology (Prensky, 2001a) and this should have moved many people from the moderate anxiety range to the low to no anxiety range. This is seen in this sample with nearly half of the group in the no-low anxiety range.

However, there is still a group who find interacting with technology to be problematic and this proportion is bigger than expected from the literature with almost half of the sample presenting in this range.

There are almost no participants presenting in the mid-range. It is to be wondered if this is a digital divide rather than the one postulated by Prensky (2001) and others.

Given the prevalence of technology any problems or anxieties may be more significant now than they were when the original studies were conducted. Interacting with technology is not an option anymore and the stakes are higher which may add to people's anxiety (Saade and Kira, 2007).

Although there is a large group in the moderate to high section, there is no one presenting with very high levels of computer anxiety (max value 85). It is possible that people who experience very high levels of computer anxiety would not have applied to a UK university degree course as the application procedure is completed on-line. Given that avoidance is a strategy employed by the computer anxious (Scull, 1999; Roemer and Orsillo, 2002; Korukonda and Finn, 2003) this might have deterred the very anxious.

The participants were volunteers, people who chose to engage with the research. The avoidance strategy mentioned above might have had a part to play in that those with computer anxiety do not like even talking or thinking about computer related tasks and may have chosen not to engage in the research even though it was delivered on paper.

Personality

The traits were not well distributed across the group with a much higher representation of the agreeableness trait than the other traits. As people with this trait will demonstrate a high level of trust, compliance, modesty, straightforwardness, tender-mindedness and altruism this should make for a collegiate cohort. However, they might not have much criticality as people with this trait can be too quick to concur with others (Huczynski and Buchanan, 2007; Srivastava, 2011). It is also interesting to note that several people scored the same across more than one trait i.e. they did not have a dominant trait. The traits were identified as being independent which is in line with other work (Srivastava, 2011).

Both computer anxiety and Personality

It would have been more useful to this research if the two questionnaires had been delivered simultaneously and this will be considered for further phases. The overlap between the two different studies was small so any findings cannot be generalised but the results indicate areas of interest that may be interesting for further study.

The group presents both with high levels of agreeability and surprisingly higher levels of computer anxiety than expected. Korukonda found that, agreeableness was negatively related to levels of computer anxiety (Korukonda, 2005). Looking at the cohort for this research one could conclude that the half of the cohort that did not present agreeableness as a dominant trait included those students who had higher levels of anxiety, and this is what the data found. Agreeableness was negatively correlated to computer anxiety. This is contrary to other research which found that agreeableness was positively associated with intention to use technology (Devaraj, Easley and Michael Crant, 2008) although anxiety was not specifically discussed here it could be inferred.

Subsequent research (i.e. conducted since this data was gathered) seems to “suggest that global Internet use is positively related to Extraversion, Neuroticism, and Conscientiousness.” (Mark and Ganzach, 2014, p. 274). Given that computer anxiety tends to cause avoidance we could infer that these users do not have computer anxiety and note that neither agreeableness nor its opposite trait of preserver appear in the make-up of these users.

The analysis came up with two slightly different findings. When the computer anxiety level was a raw number, then a model could be made which had a probability of prediction of 25%. When the data was changed to categorical i.e. the scores were grouped into High, Medium or Low, then the prediction reliability was around 30.3%. Both methods are still significant and indicate for this cohort there is a negative correlation between the two personality traits of Emotional Stability and Agreeableness, and the level of computer anxiety that an individual might feel. This is in line with other research (Korukonda, 2005).

What may be happening here is that the data can be seen to have a level of correlation. i.e. that the values of one variable can be seen to increase or decrease as another variable increases or decreases in value. What is not seen is that one or more variables can be used to predict the value of another variable. This would be indicated by a significant result from the regression analysis.

While the correlation is an interesting finding, and statistically significant, it is not helpful for the practitioner in predicting who will need support as many of the potential sufferers will not be identified by analysis of personality traits.

The traits identified as being the strongest factors relating to the level of computer anxiety in this cohort are Agreeableness and Emotional stability. Korukonda (2007) did some similar work but included the scores from all three surveys (CARS, CTS and GATC). He split his cohort by anxiety level and explored the differences in personality traits between the different groups. Overall one of his findings was that the three traits of Emotional stability, Openness and Agreeableness were negatively correlated with high computer anxiety.

He also found that when looking at regression, only Neuroticism (the opposite of emotional stability) and flexibility (a type of cognitive orientation) were significant predictors but with a low R^2 value (29.4%), suggesting that other factors are likely to play a part in determining the level of computer anxiety.

It might be considered that students who report as having neurotic and challenging traits may be anxious in many areas, although this assumption is disputed by work which suggests that anxiety in one area does not predict anxiety in another for instance math anxiety does not correlate with computer anxiety (Anderson, 1996; Korukonda, 2007).

In summary, for this small cohort it looks like personality may have a part to play in determining the level of computer anxiety. The main traits that seem to be involved in this are emotional stability/neuroticism and agreeableness/challenger. These are not at a level that supports their use as predictors alone as the model only accounts for less than 30% of the variance of the level of computer anxiety.

3.2.7 *Limitations*

There was a very small sample that could be used to analyse the correlation between personality traits and computer anxiety. Any results or findings from this group are an indication that more investigation could be of interest but cannot be generalised in any way. The sample group was self-selecting from within a limited pool of first year undergraduates at a small university.

The research instruments were delivered independently and although efforts were made to connect the two items there was very little overlap between the two. This meant that any correlation results were based on a very small sample.

3.2.8 *Conclusions and Suggestions for Further work*

Although the relationship between personality and computer anxiety is interesting, these results indicate that there are obviously other factors which influence the level on computer anxiety. It feels like there ought to be a link between personality, specifically the trait of emotional stability, and computer anxiety, but the findings do not fully support this thought. Reviewing the literature around anxiety, it seems likely that for a state of anxiety, personality traits have no bearing. As the research progresses my understanding of computer anxiety is growing. It seems to be a complex condition that incorporates both trait and state. So, while a particular personality trait accounts for around 30% of the level of computer anxiety, this might only be for those individuals that feel anxious all the time with a transient emotional state accounting for the rest. It is not likely that this transience will be predictable but there may be other factors that prompt this response and identifying them could lead to being able to predict the likelihood of someone suffering from a state of computer anxiety.

As personality does only account for 30% of the variance in computer anxiety level it is likely that there are other factors that influence its severity. Some of the work around computer anxiety causes suggests that early experiences contribute to levels of computer anxiety (Cowan, Vigentini and Jack, 2009). Therefore, the next phase of research explores how people were taught and how they would have preferred to learn. It may be that a discrepancy here leads to poor quality experiences and comparing this with their levels of computer anxiety might indicate that this is something that prompts states of computer anxiety when learning how to do new tasks on a computer.

3.3 Phase Two

This second phase of data gathering was developed to further explore the causes of computer anxiety. Given that personality seems to have some influence but does not tell the whole story, other factors need to be considered and in this phase the focus is on finding out if a person's early learning experiences correlated with their learning preferences and if any discrepancy between these two contributed to their level of computer anxiety. Of additional interest is the comparison between personality and learning preference. The results of this phase suggest that learning preference and personality are not related, any discrepancy between learning preference and learning experience has no impact on the level of computer anxiety and learning preference alone also has no impact. However, this sample group was self-selecting via an on-line delivery method and this may have skewed the results as the levels of computer anxiety were very low.

3.3.1 *Introduction*

It has been suggested that early experience is a vital factor (Cowan, Vigentini and Jack, 2009) and if the support given early on is not in a format that is preferred by the learner, that may be significant (Saengratwatchara and Pearson, 2004) in promoting anxiety about future learning. In this phase, this idea will be explored alongside the personality and computer anxiety questionnaires. It may be that a large discrepancy between how a learner wishes to learn in the future and how they were taught in the past could be related to the level of computer anxiety when learning new tasks.

As, noted in the limitations above, the sample size was small for the first phase of the research, the sample group for this phase was extended to include a wider population: an international, older group who had chosen to engage in on-line learning and a new intake of Business School students. The questionnaire had to be delivered in an online format due to the geographic dispersal of many of the target group. To address the other limitation, of connecting results from different instruments, in this phase all the elements were combined in one package so that it was easier to compare the findings from each element.

This phase concludes that delivering a questionnaire about computer anxiety via the medium of a computer might not be the best way to connect with the computer anxious. Although there were some interesting results from the on-line Masters level group which go against this assumption.

3.3.2 *Methods*

The instruments were packaged into an on-line survey instrument so that a link to the questionnaires could be shared. A discussion of the instruments follows.

The instruments

The following instruments were used in the research. Where an instrument has not been used before it is introduced and explained in more detail below.

- CARS (as used before)
- Personality (as used before)
- Initial learning experience and Preferred approaches

Initial Learning experience and preferred approaches

As these questions were very specific to the situation and the research there were no existing instruments to use. Having reviewed a range of literature around the initial learning experience and other potential learning issues the following questions were devised.

The aim of this set of questions was to ascertain how the participant was taught in the past and how they would prefer to be taught in the future. This was to see if the discrepancy between the two methods could be a useful indicator of computer anxiety.

There were four statements in the first section to discover how the participant had been taught the last time they had to learn a new application and the impact of this learning. The responses were on a five-part Likert scale ranging from strongly agree to strongly disagree.

The first statement was to see how the user had felt when they were introduced to the application. If they had been nervous about meeting new applications in the past this could be replicated each time they meet a new application (Bradley and Russell, 1997; Cowan and Jack, 2011).

1. I felt ok when I encountered the new application

The second statement was to look at the motivation behind the learning as it has been found that understanding why a new application was being introduced mitigated some of the anxiety around learning a new way of working (Shah *et al.*, 2011).

2. I did not understand why I was learning about it

The third statement looked at an element of motivation. If an application could be seen to be useful this seems to encourage engagement with it, and reduce computer anxiety (Terzis and Economides, 2011).

3. I could see that it would be useful

The final statement in this section looked at how often the application was used. Repetition of use and success has been seen to reduce computer anxiety by building confidence and self-efficacy (Simsek, 2011).

4. I use this application a lot

The second section was to discover what particular support had been given and how useful it had been.

There were seven options listed with a space for ‘other’. The options were:

a) with a manual
b) in a supported workshop
c) in a tutor led class with other learners
d) by following an online tutorial
e) independent learning (i.e no support – just exploring on your own)
f) having a one-to-one session with an expert
g) peer tutoring

The support could be rated on a five-part Likert scale with responses ranging from “I found the teaching method extremely helpful” to “I found the teaching method extremely unhelpful and it left me feeling confused” and included an option for not applicable.

The focus then turned to the future with similar questions around what participants would like in the future.

There were two statements to check perceptions, one negatively scored to ensure the participants were answering honestly.

- I am apprehensive about learning how to manage new applications
- I expect I will be able to pick it up really quickly

The same learning options, as above, were presented with users being asked to select which methods they would prefer to be offered the next time they had to learn something new.

Finally, there was a demographical section asking for age range, gender and nationality.

The Sample Group

Using the pragmatic approach, the sample group was self-selected from among the students that could be easily accessed. There was a need to widen the number of participants

For this phase, the sample group was widened to include a group of on-line MA level students – the on-line MA was a flexible route and it was not possible to tell how many of the registered students were actively engaged or using the portal at the time of the survey. The reach could have been as large as 700 or as small as one cohort of 30. The registered students are mature, leaders in their industry and spread around the globe, representing a wide range of nationalities.

The combined questionnaires were also offered to the new intake of First Year Undergraduate Business School students with a similar profile to the group in phase 1. They were given the survey in the same on-line format as the distance learning students. See appendix 2 for a sample of how the instrument was presented on-line

There were 36 out of a possible 120 of the undergraduate students who participated in the research. 96 of the MA level students returned completed questionnaires.

The process

The questionnaires were digitised as this was the only way to reach the MA students. The link to the digitised version was also made available to the UK based undergraduates.

MA students were sent an announcement to inform them of the opportunity to contribute to research. As many are engaged on their own research journeys it seemed likely that they would be sympathetic to the principle of engaging with research. They were directed to the link with supporting explanations of the purpose and clearly told of the voluntary and anonymous nature of their interaction.

The Undergraduate students at the home university were informed about the research in a whole cohort lecture, the voluntary nature of engagement was made clear and the link was posted on the VLE where it was easily accessible.

The link was disabled after a set period and the results downloaded into an EXCEL spreadsheet for analysis.

The cohorts were analysed separately as they had different characteristics, and then the findings compared.

3.3.3 *Findings for the MA Group*

The results from the distance learning MA group were analysed using some regression tests from EXCEL, an ANOVA test and multiple regression analysis using SPSS. Each instrument is considered in isolation initially and then the different combinations are explored to look for relationships between them.

Computer anxiety

The first results to be examined are those from CARS.

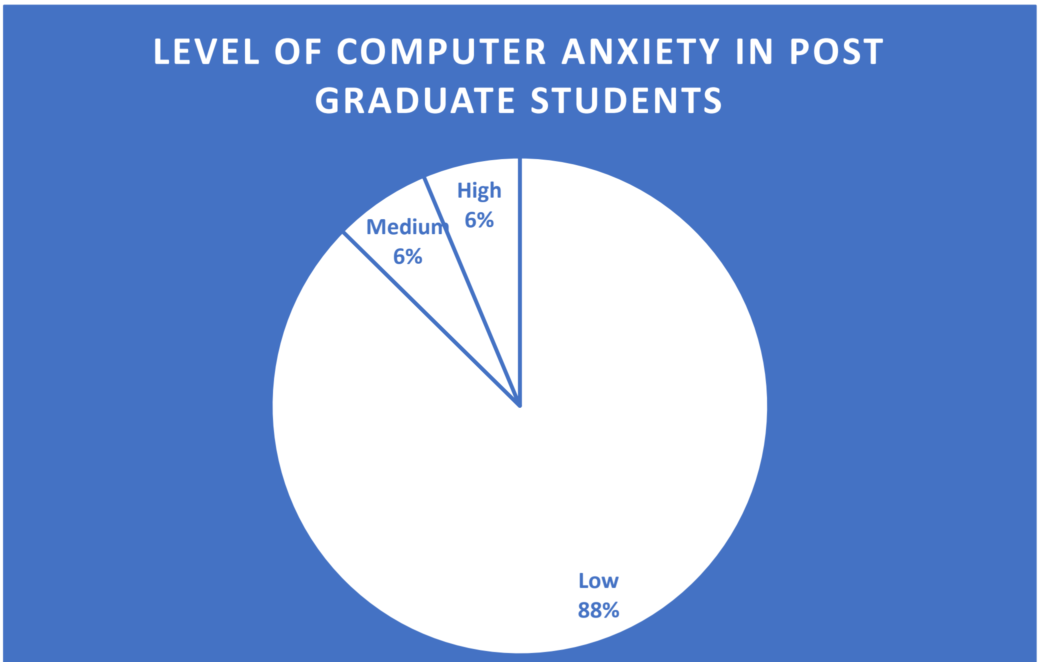


Chart 7 the levels of computer anxiety displayed by the postgraduate group

As can be seen from Chart 7 the majority of the students present with none to low computer anxiety. This is not unexpected as this group have chosen to engage with an on-line programme of learning. What is surprising is that 6% of the group presented with high levels of computer anxiety.

Personality

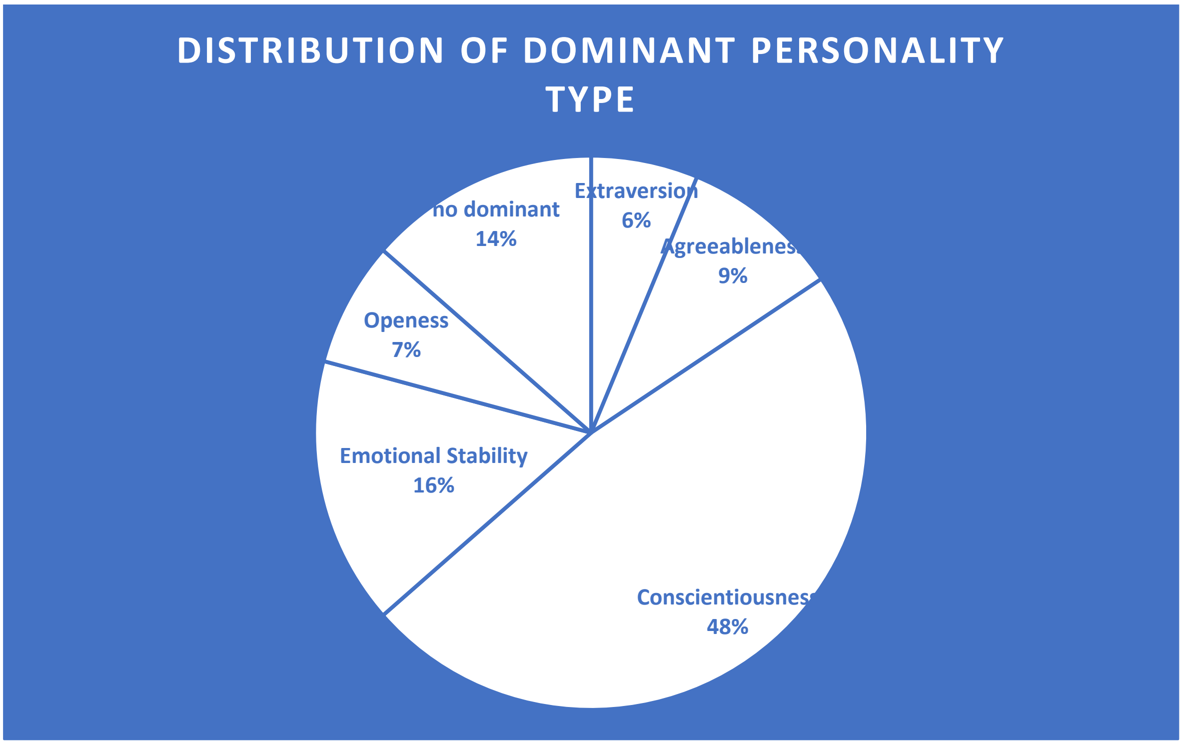


Chart 8 The Distribution of personality traits

From Chart 8 we can see that the predominant trait is conscientiousness with 45% of the group ranking this as their dominant trait. 14% did not have a single dominant trait

Correlations

		extraversion	Agreeableness	Conscientiousness	EmotionalStability	Openess
extraversion	Pearson Correlation	1	.105	.179	.257**	.187*
	Sig. (2-tailed)		.253	.050	.004	.040
	N	121	121	121	121	121
Agreeableness	Pearson Correlation	.105	1	.077	-.129	.188*
	Sig. (2-tailed)	.253		.399	.159	.039
	N	121	121	121	121	121
Conscientiousness	Pearson Correlation	.179	.077	1	.090	.187*
	Sig. (2-tailed)	.050	.399		.324	.040
	N	121	121	121	121	121
EmotionalStability	Pearson Correlation	.257**	-.129	.090	1	.149
	Sig. (2-tailed)	.004	.159	.324		.102
	N	121	121	121	121	121
Openess	Pearson Correlation	.187*	.188*	.187*	.149	1
	Sig. (2-tailed)	.040	.039	.040	.102	
	N	121	121	121	121	121

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

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

Table 21 the correlations between the different traits in this group

It can be seen that there are several correlations between traits for this group with some of them being significant (Table 21). This in contrary to a range of research that asserts the traits are independent (Digman, 1990).

Type of support given and desired

In this section participants were asked to rate the support they were given the last time that they had to learn a new application, and also to consider what support they would prefer to have in the future. They responded using a Likert scale where 1 indicated the support was not given, then the rates 2 – 6 where 6 was the most useful. In the analysis of these two different data sets, firstly, the support that had been given was examined to see if one type of support was more prevalent than others, and how popular this was. Then the type of support desired is examined and finally a comparison between the two.

What support was given in the past

This section explores the data about the types of support given in the past.

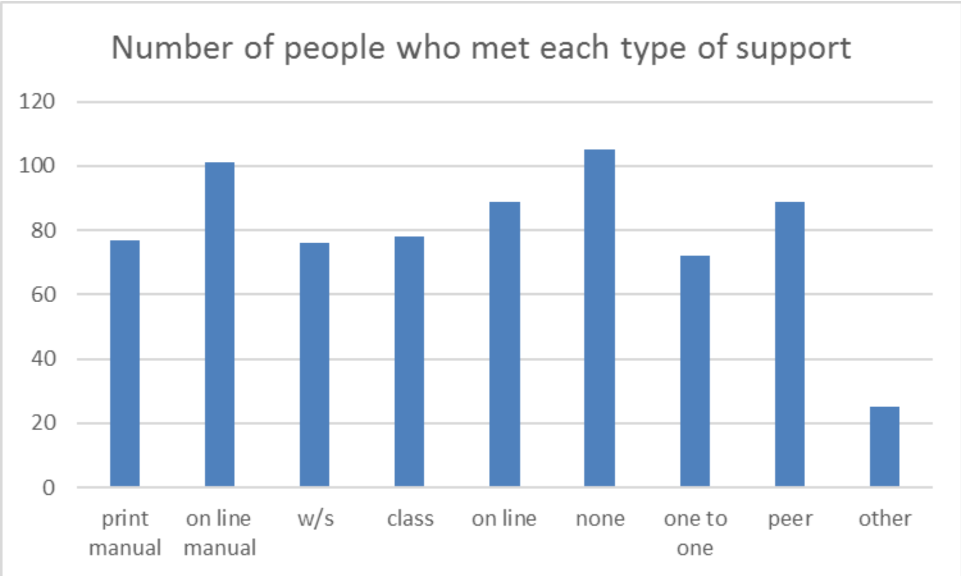


Chart 9 Looking at the group as a whole how many of the different types of support were encountered

From Chart 9 we can see that having no support at all and using exploration to learn a new application (none) was encountered by the most number of participants followed by using an on-line manual (on-line manual). The least encountered experience is other, but this was not expanded so it is not clear what this was. The least identifiable method is one-to-one tutoring with an expert.

If we contrast this with the mean value of rating given to each type of support (Chart 10) we see an interesting difference.

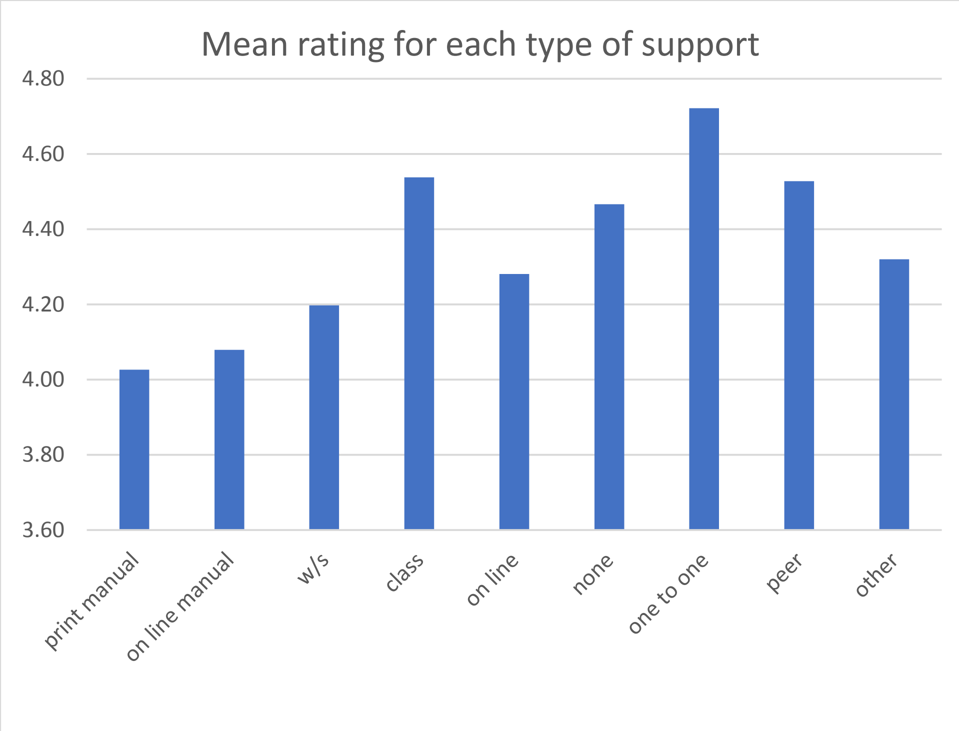


Chart 10 Mean rating given to each type of support

From Chart 10 it can be seen that one-to-one support has the highest mean rating suggesting that although this is the least encountered experience it is most highly valued by those who had experience of it. Learning in a classroom and with a peer are rated at about the same level (4.53, 4.54) with a print manual coming in as the least popular way of being supported.

To see the full range of ratings given to each type of support the number of each score is presented in Chart 11. The ratings were in the range 2 – 6 where 6 was very highly rated and 2 was not helpful. The occurrences of each rating level were counted with the results shown in Chart 11.

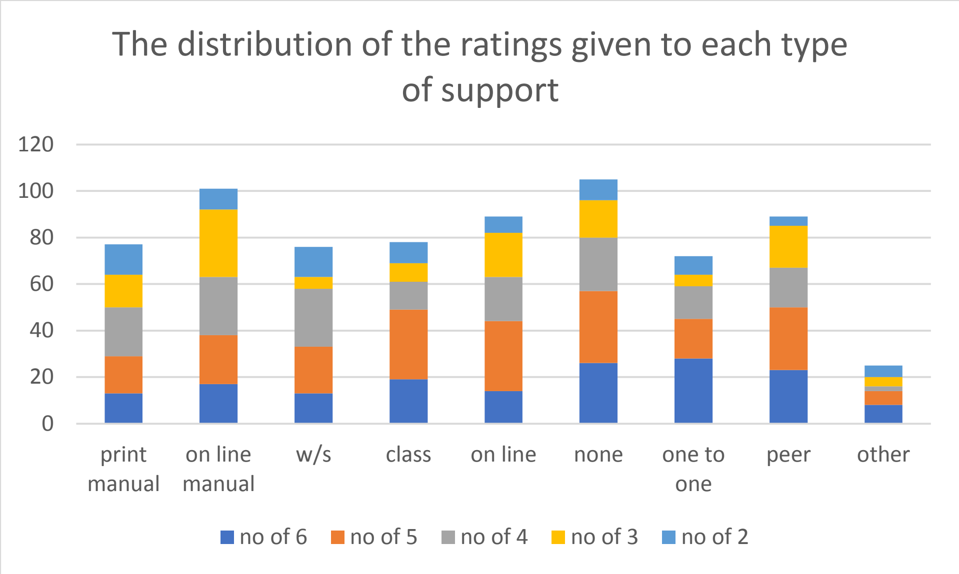


Chart 11 The distribution of ratings given to each type of support

It can be seen in Chart 11 that while 'one-to one' received the highest number of 6 ratings, 'none' was a very close second with 'other' getting the least number of 6's. There was no additional data given by those who chose 'other' so what that support was is unknown.

Support desired

This section reviews the responses to the questions around what support would be desired in the future. Participants were asked to provide a rating to show how much they would like the type of support suggested.

Firstly Chart 12 shows that most people gave a ranking for each of the types of support

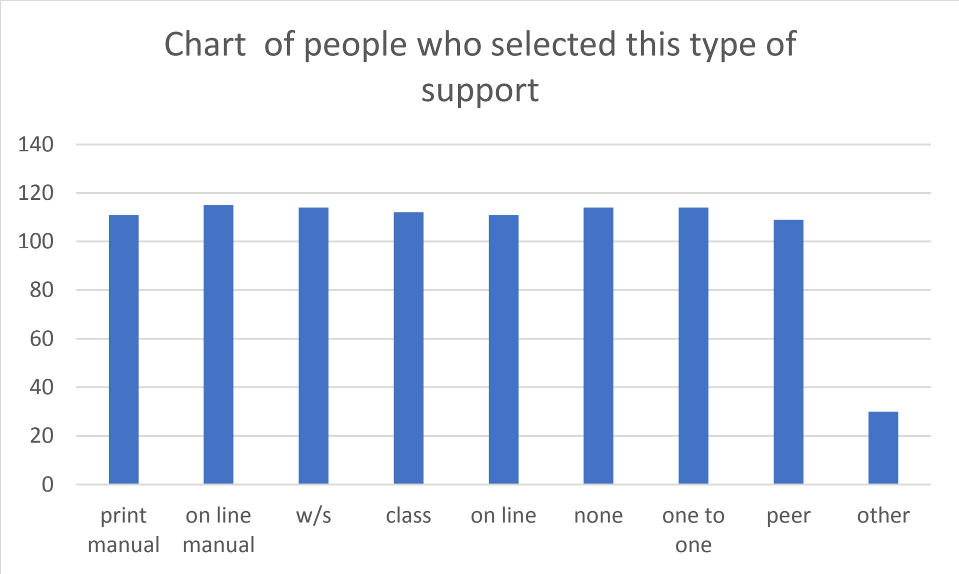


Chart 12 showing number of people who selected this type of support for the future

There were still some people who chose other but without specifying what this might be.

When we look at how useful they think the support will be however we see a different picture (Chart 13).

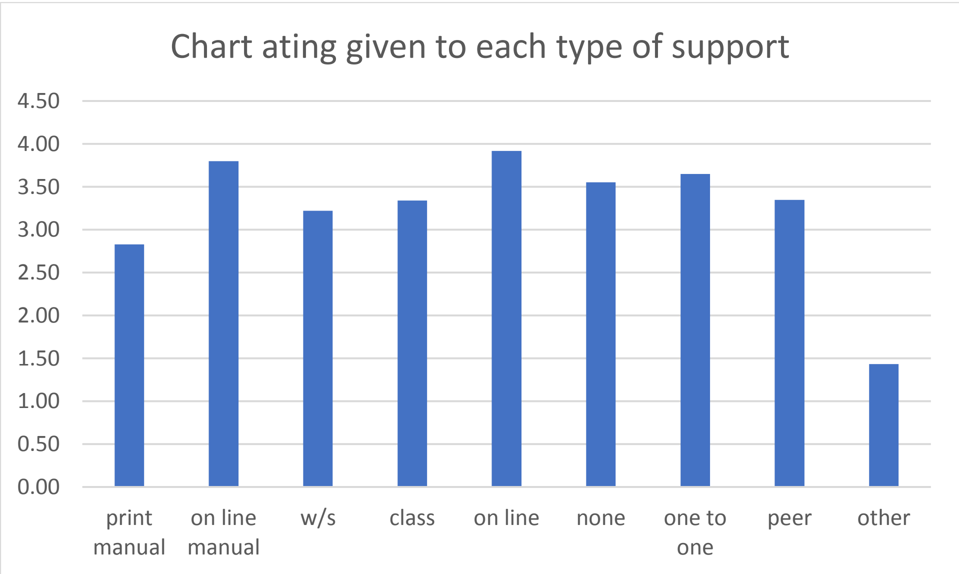


Chart 13 showing the mean usefulness rating predicted for each type of support

In contrast with support that people had had in the past, for the future they felt an online manual and an online training course would be the most useful. Usefulness was rated from 1 to 5 with 5 being the most useful.

The different ratings were distributed across the different types of support as seen in Chart 14.

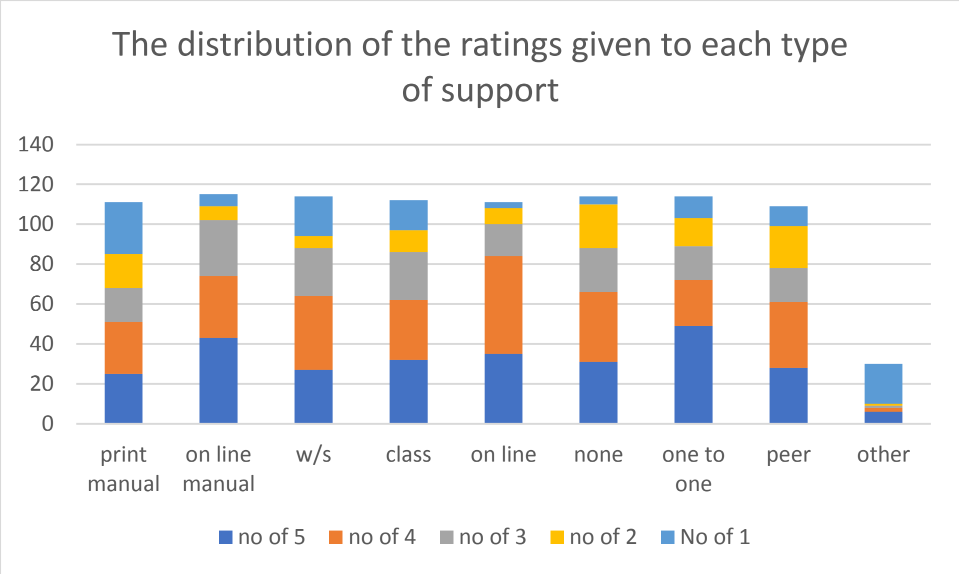


Chart 14 showing how useful people thought each type of support might be

As can be seen in Chart 14, One to one support received the most number of 'most useful' ratings although the mean value does not reflect this.

In summary, it could be said that in the future more people thought that peer support might be more helpful than any other type of support, with an online manual as the next most useful.

Contrasting past and future preferences for support and examining the discrepancies between the two.

It was seen that most people had used an online manual to support them when learning in the past, but that they had not thought it was the most helpful type of support. Despite this, most people suggested that an online manual would be the most helpful support for them to have in the future.

The difference between the 'helpful in the past' and 'useful in the future' rankings are found by subtracting one from the other and squaring the difference.

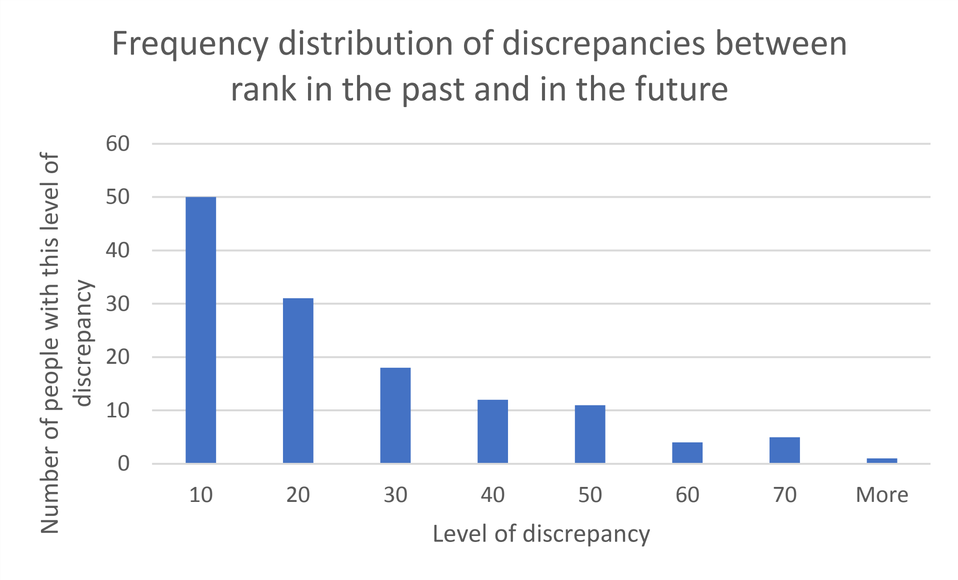


Chart 15 showing the frequency distribution of the difference between support in the past and in the future

It can be noted that the largest group of people did not want to change the type of support from that which they had had in the past as shown by the low discrepancy between past and future. There were some who wanted to dramatically change, and these fell into two camps (Chart 15).

The two people with the highest scores were seen to have had very little support in the past and perceived that all the different types of support in the future might be useful with the exception in one case of a printed manual which they really did not see as helpful giving it a usefulness rating of 1.

The next two highest scores were quite the opposite. It seems that they had been given a range of support in the past which for the most part they had rated highly, but for the future seemed to suggest that none of the support would be helpful other than the print manual. This is an interesting result as they had rated the print manual as nearly useless in the past but felt it would be the most helpful in the future. This is a confusing result.

Computer anxiety and personality

Using the Microsoft excel data analysis tool the correlation analysis for this group shows some limited relationships between some of the personality traits as discussed above, and a strong relationship between computer anxiety and Intellect/openness with a correlation coefficient of 0.68. Table 22 shows the results with values about 0.4 shown in yellow and above 0.6 shown in Green.

	Anxiety	*e*	*a*	*c*	*es*	*i*
Anxiety	1					
e	-0.00034	1				
a	0.121859	0.395894	1			
c	-0.06651	-0.02416	0.041422	1		
es	-0.021	0.508369	0.419126	-0.04294	1	
i	-0.67767	0.150953	-0.08549	0.204818	0.03115	1

Table 22 Showing correlations between different personality traits and computer anxiety

This is not corroborated by the multiple regression analysis as shown below in Table 23

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.69
R Square	0.48
Adjusted R Square	0.32
Standard Error	8.78
Observations	22

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	5	1142.18	228.44	2.96	0.04
Residual	16	1233.10	77.07		
Total	21	2375.27			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	39.88	10.95	3.64	0.002	16.66	63.09
extraversion	0.13	0.22	0.61	0.551	-0.33	0.60
agreeableness	0.03	0.18	0.19	0.854	-0.35	0.41
conscientiousness	0.07	0.18	0.41	0.685	-0.31	0.46
emotional stability	-0.09	0.23	-0.37	0.719	-0.58	0.41
Openness	-0.91	0.24	-3.74	0.002	-1.43	-0.40

Table 23 The summary output from a regression analysis of computer anxiety and the personality traits along with the ANOVA output

Where it can be seen from the regression statistics in Table 23, the adjusted R square value indicates that 32% of the variance of the dependent variable can be accounted for by the value of the other variables.

In the ANOVA analysis the significance F is lower than 0.05 suggesting that it is fairly likely that there is a meaningful correlation between the two datasets.

Looking at the P-value this is only significant for the trait of openness so conducting the regression analysis on just anxiety and openness gives the following result (Table 24).

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.678
R Square	0.459
Adjusted R Square	0.432
Standard Error	8.014
Observations	22

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	1090.81	1090.81	16.98	0.0005
Residual	20	1284.46	64.22		
Total	21	2375.27			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	43.767	6.994	6.258	0.000	29.179	58.356
Openness	-0.876	0.213	-4.121	0.001	-1.319	-0.433

Table 24 The summary output of a regression analysis on computer anxiety and the trait of openness

The regression statistics in Table 24 show a value for R^2 of 0.432 suggesting the 43% of the variance can be accounted for by the value of openness. While this is interesting it is still below half and not of value for the prediction of computer anxiety and suggests that other factors have more influence than this one.

The significance F 0f 0.0005 in Table 24 suggest that it is very unlikely that this regression could be arrived at by chance as does the P value of 0.001.

The outcome of these tests would suggest that openness is a significant factor in the level of computer anxiety accounting for 43% of the variance in its ultimate value for this cohort. This supports the research of (Hudiburg, Pashaj and Wolfe, 1999) but is in contrast to other findings (Anthony, Clarke and Anderson, 2000; Korukonda, 2005)

Computer anxiety and Type of support

Participants were asked to rank the usefulness of the support where 2 equated to useless and 6 to excellent. If they did not use the support, they noted a 1 in the response. Where the response was left blank a note of "No Data" is recorded. The non-responses were excluded from the analysis.

For those with high anxiety the results are shown in Table 25

For those with high anxiety	**print manual**	**on line manual**	**w/s**	**class**	**on line**	**none**	**one to one**	**peer**	**other**
number of 1's	1	2	2	2	1	1	2	0	3
number of 2's	0	0	1	0	1	0	0	0	0
Number of 3's	3	2	1	0	1	2	2	2	1
Number of 4's	3	3	2	3	1	3	2	3	0
Number of 5's	1	3	3	1	5	4	2	3	0
number of 6's	1	0	1	4	0	0	2	1	1
number of responses	9	10	10	10	9	10	10	9	5

Table 25 The ratings given to each type of support for participants with high levels of computer anxiety

We can see that few 6's have been noted for this group but the majority found that being in a class gave them the best support. Although this is a very small group to support a finding it is of interest and may be worth exploring further.

Contrasting with the low-no anxiety group shown in Table 26

For those with no-low anxiety	**print man ual**	**on line manual**	**w/s**	**class**	**on line**	**none**	**one to one**	**peer**	**other**
number of 1's	37	15	37	33	22	10	41	24	28
number of 2's	13	9	12	9	6	8	8	3	5
Number of 3's	11	23	3	7	16	14	3	16	3
Number of 4's	17	20	22	8	16	17	11	13	2
Number of 5's	15	18	17	27	25	26	14	22	5
number of 6's	9	16	9	14	12	24	23	21	6
number of responses	102	101	100	98	97	99	100	99	49

Table 26 The ratings given to each type of support for those with no to low levels of computer anxiety

In Table 26 we can see that the majority in this group (24/99) preferred to discover for themselves how the software worked, closely followed by one to one and peer support. The least useful option being a printed manual (13/102).

Next the level of computer anxiety was tested for correlation between the rating given to the support receieved and also against the support desired. The results show that as no correlation coefficient is above 0.4 that they are no to very weak correlations between these variables. The results can be seen in Table 27

	Support given	*support desired*
anxiety levels	1.00	1.00
print manual	0.16	0.17
on line manual	-0.01	0.04
w/s	0.10	0.02
class	0.13	0.13
on line	-0.01	0.00
none	-0.02	-0.05
one to one	0.07	0.12
peer	0.05	0.13

Table 27 showing the results of correlation analysis between computer anxiety and support given and computer anxiety and support desired.

To see if there was any connection between computer anxiety and the discrepancy between support given and support desired a regression analysis was undertaken using a scatter Chart to illustrate the lack of correlation between these two measures.

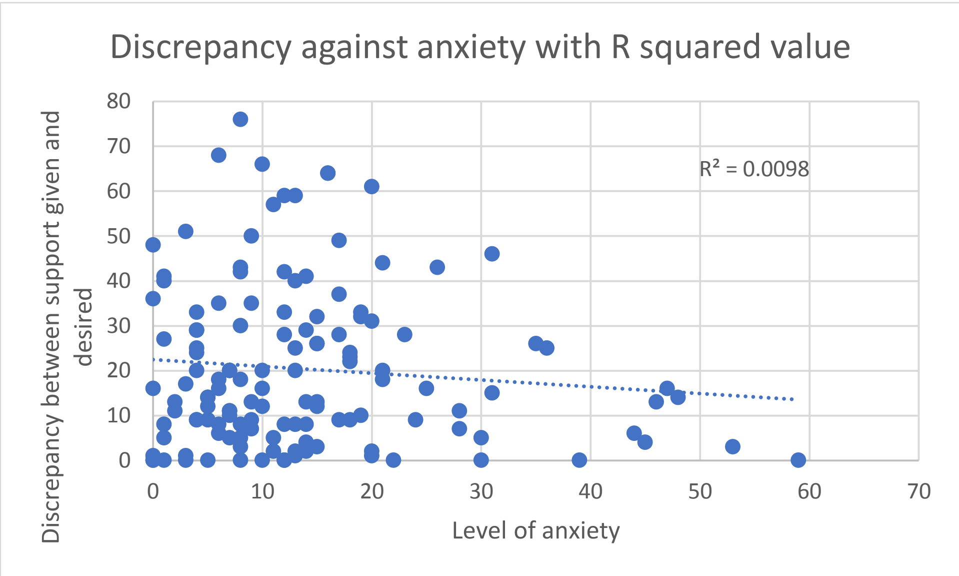


Chart 16 A scatter plot of computer anxiety level against discrepancy between type of support given in the past and that desired in the future

From Chart 16 it is clear that there is no relationship between these variables and this is confirmed by the low value of R^2 which is very close to 0.

Personality and Type of support

To see if there was a link between the type of personality an individual had, and their rating of the different support given, a correlation was performed between all the elements with the results as shown in Table 28

	e	*a*	*c*	*es*	*i*	*print manual*	*on line manual*	*w/s*	*class*	*on line*	*none*	*one to one*	*peer*
e	1												
a	0.05	1.00											
c	-0.13	0.09	1.00										
es	0.17	0.19	0.15	1.00									
i	0.08	0.12	0.23	0.21	1.00								
print manual	-0.06	0.03	0.00	-0.12	-0.11	1.00							
on line manual	0.02	0.02	0.00	-0.01	-0.13	0.28	1.00						
w/s	-0.07	0.00	0.08	0.04	0.00	0.38	0.21	1.00					
class	-0.06	0.08	0.18	0.07	-0.06	0.44	0.28	0.66	1.00				
on line	-0.09	0.00	0.09	0.09	0.03	0.20	0.43	0.25	0.27	1.00			
none	0.02	0.18	0.11	0.01	0.00	0.03	0.26	-0.01	0.21	0.35	1.00		
one to one	-0.10	0.11	0.16	0.04	-0.02	0.25	0.17	0.50	0.47	0.21	0.18	1.00	
peer	-0.11	0.10	0.08	0.03	-0.15	0.17	0.13	0.35	0.40	0.13	0.28	0.72	1

Table 28 showing the correlations between personality trait and type of support chosen

It can be seen that the only significant correlation is the one between One-to-One support and Peer support. This is not surprising as one-to-one can often be delivered by a peer.

The correlation coefficients between any of the personality traits and the value they have given to the support received is minimal to the point of non-existent indicating that there is no correlation between these factors.

Looking to the future desires, the relationship between support desired and personality were considered. The results were not found to be indicative of any correlation between these two pieces of information.

Summary of the findings

For this group of mature distance learners who are in leadership roles the profile shows a group with low computer anxiety, or with high anxiety coupled with perseverance in the face of difficulty. The links between the different elements examined are weak, other than that between the personality trait of openness and computer anxiety which shows as a moderate correlation.

3.3.4 *Findings for UG group*

There were 36 returns from a possible 120. Although more people opened or started the survey there were many who chose to answer none or very few of the questions.

Computer anxiety

For this cohort, the findings indicate that there are very low levels of computer anxiety with 97% returning a value of 0 – 41, i.e. no to low computer anxiety as can be seen in Chart 17

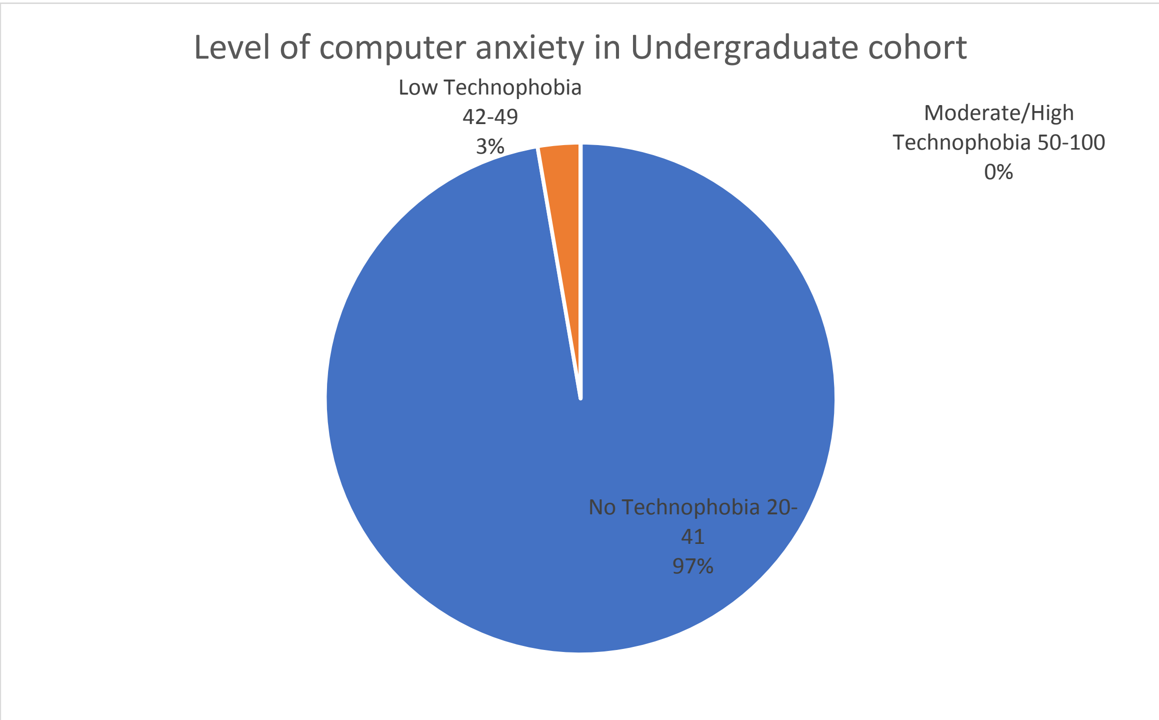


Chart 17 Levels of computer anxiety among undergraduate cohort

Personality

In this cohort the distribution of personality traits shows that the majority of the group present with emotional stability as the dominant trait (Chart 17)

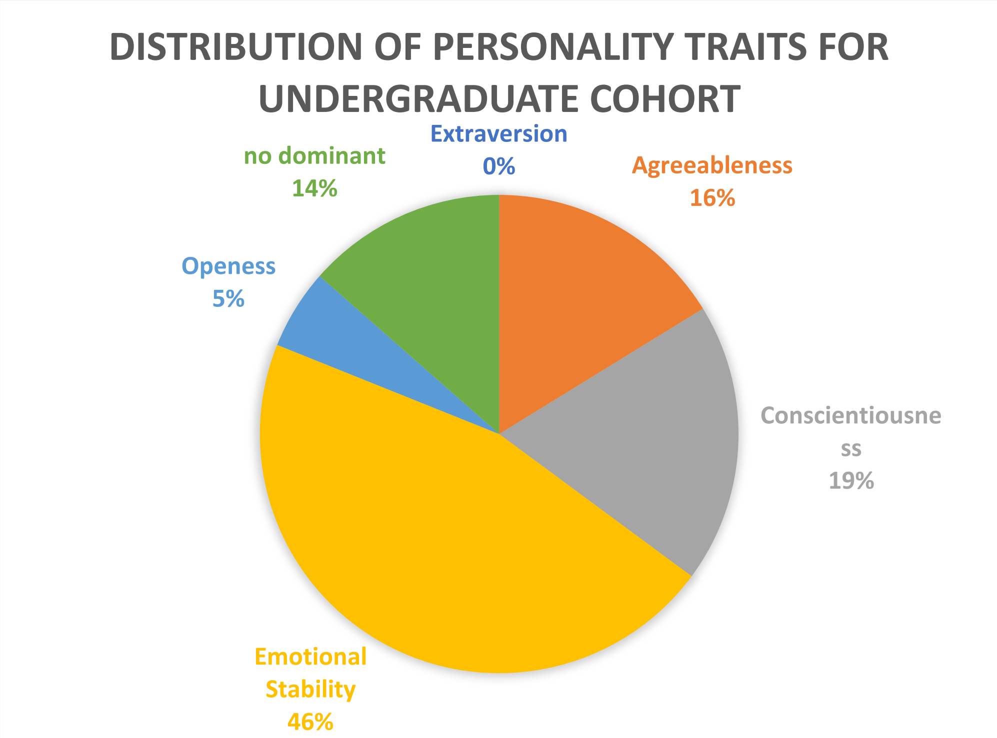


Chart 18 Distribution of personality traits for the undergraduate cohort

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Openness	.251	36	.000	.687	36	.000
Extraversion	.210	36	.000	.867	36	.000
Agreeableness	.295	36	.000	.692	36	.000
Conscientiousness	.165	36	.015	.880	36	.001
Emotional Stability	.252	36	.000	.776	36	.000

a. Lilliefors Significance Correction

Table 29 results from the test of normality for the returned data.

As can be seen from Table 29 above, the Shapio-Wilk constant is below 0.05 for all traits suggesting that none of the data is normally distributed.

To check that the traits are independent as the literature suggests the data was tested with SPSS function correlate, the findings are shown in Table 30.

From Table 30 it can be seen that the traits are predominantly independent with only one significant correlation (at the 0,01 level) between conscientiousness and extraversion. This is a surprising finding. Some people presented with no dominant trait and it may be this which is confounding the findings.

Correlations

		Extraversion	Agreeableness	Conscientiousness	EmotionalStability	Openness
Extraversion	Pearson Correlation	1	.141	.697**	.399*	.190
	Sig. (2-tailed)		.414	.000	.016	.267
	N	36	36	36	36	36
Agreeableness	Pearson Correlation	.141	1	.163	-.110	.229
	Sig. (2-tailed)	.414		.343	.522	.180
	N	36	36	36	36	36
Conscientiousness	Pearson Correlation	.697**	.163	1	.378*	.265
	Sig. (2-tailed)	.000	.343		.023	.118
	N	36	36	36	36	36
EmotionalStability	Pearson Correlation	.399*	-.110	.378*	1	.250
	Sig. (2-tailed)	.016	.522	.023		.141
	N	36	36	36	36	36
Openness	Pearson Correlation	.190	.229	.265	.250	1
	Sig. (2-tailed)	.267	.180	.118	.141	
	N	36	36	36	36	36

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

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

Table 30 Correlations between the different personality traits

What support was given in the past

For this group, the sort of help received most often is none followed by learning in a classroom situation as can be seen in Chart 19. The least encountered type of support (apart from other) was one-to-one although there is not much variation between the different types of support.

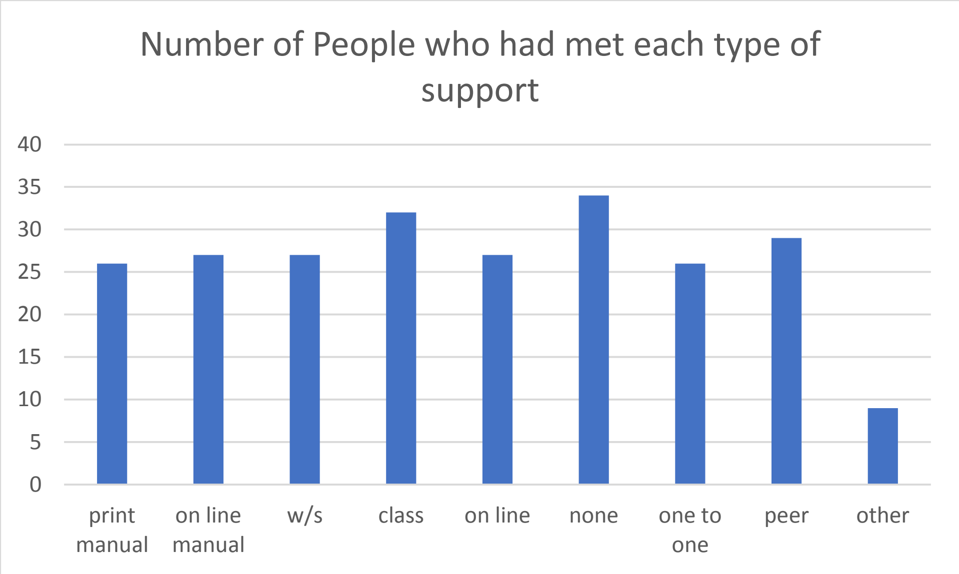


Chart 19 Showing the number of people who had encountered each type of support

When we look at the mean ratings given to each type of support (Chart 20) we can see that the picture is fairly similar with peer support being rated slightly higher than the other options.

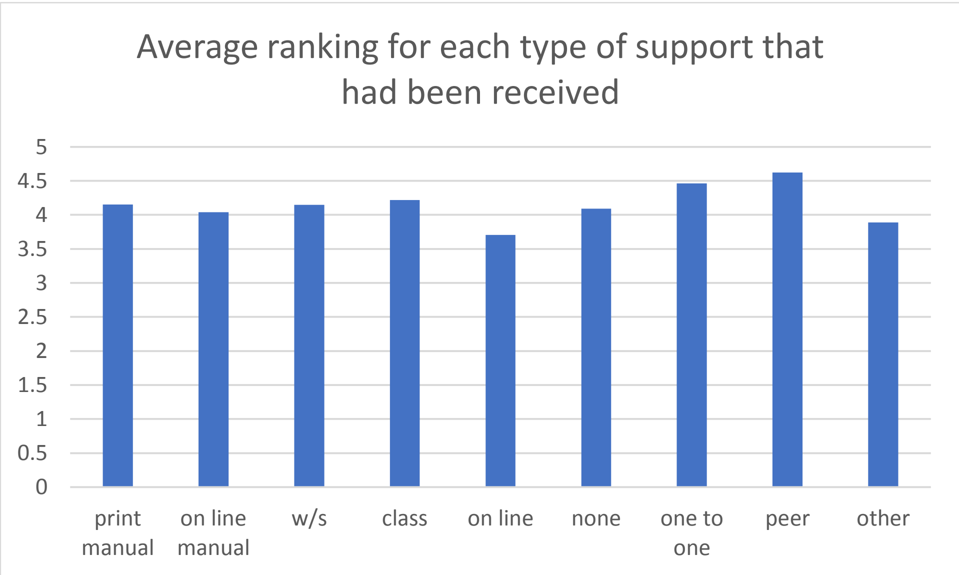


Chart 20 Average ranking for each type of support given in the past

The least popular option is online learning which is a surprise, as one might expect this group to find online learning the best.

To see how the rankings were distributed for each type of support see Chart 21.

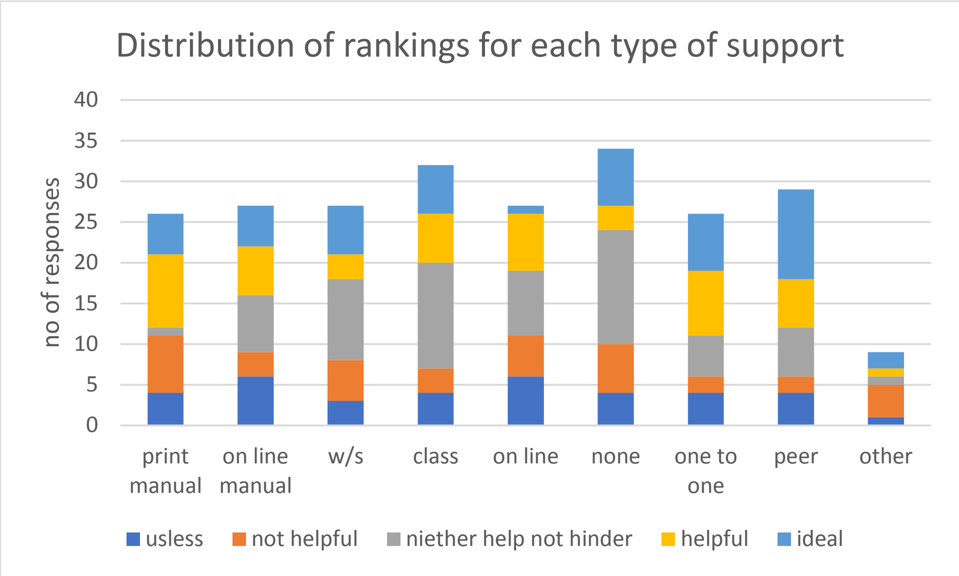


Chart 21 The distribution of scores for each type of support

Opinion seems divided on the value of a print manual with an even distribution of ranks about the centre point. For other types of support, it is not so even with more people sitting in the middle rank. Peer support can be seen to have the most number of high rankings while online course and online manual have the most low rankings. It is of interest that online resources have not been seen as useful in the past.

Support Desired

As for support, given the numbers of people who thought a particular type of support would be useful in the future are shown in Chart 22.

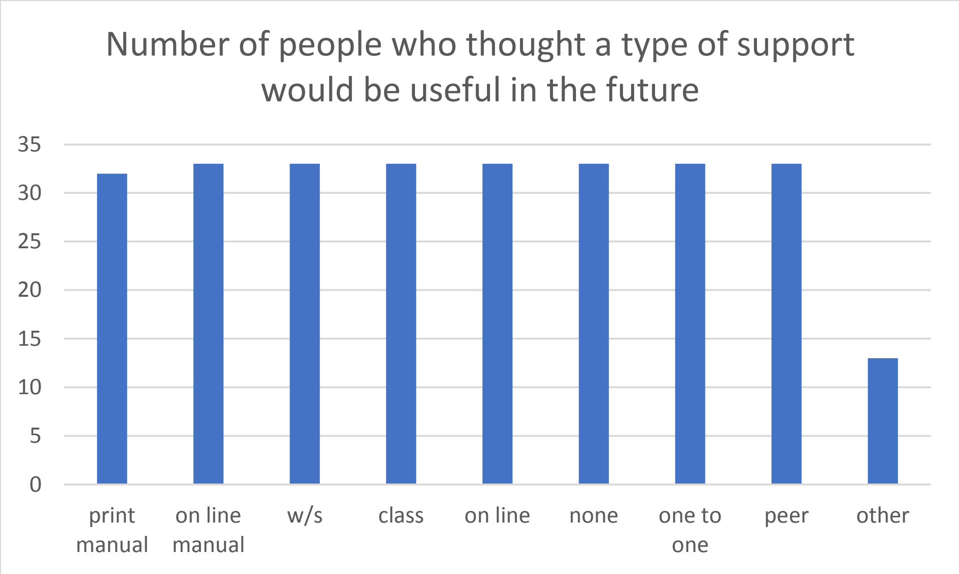


Chart 22 The number of people who thought that a particular sort of support might be useful in the future

It can be seen in Chart 23 that most types of support were considered by most people.

Looking at the mean rankings given to each type of support gives a clearer idea of how useful each type of support is considered to be useful in the future and this can be seen in Chart 23.

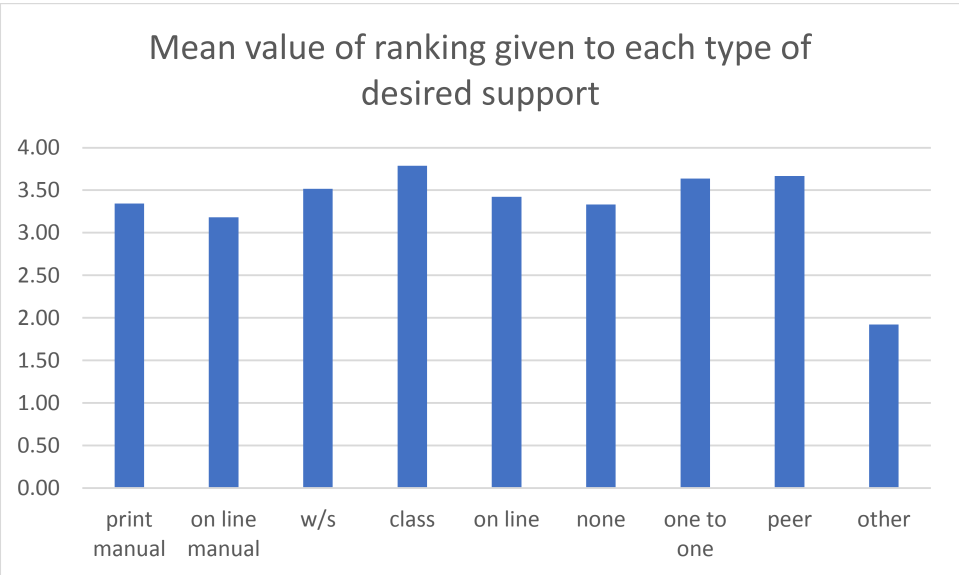


Chart 23 The mean value of the ranking given to each type of support desired in the future

For this group, the most popular type of support, with the highest mean, is having a class while a close second is, getting support from a peer. The online manual is lower than a print manual, which is on a par with no support at all.

Contrasting past and future preferences for support and examining the discrepancies between the two.

When we look at the differences between the sort of support that this group had in the past and what they would like to have in the future we can see that there is little difference as the majority of the group have a discrepancy of less than 10 (Chart 24) i.e. they are happy with how they learnt in the past and wish to have the same type of support in the future.

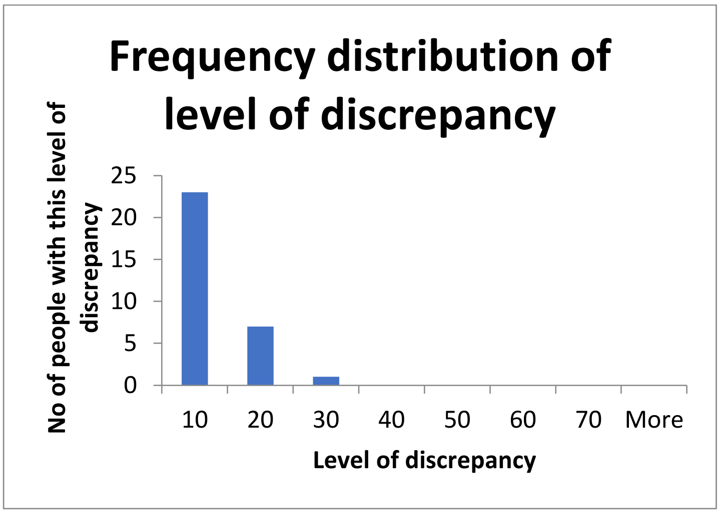


Chart 24 showing the distribution of the difference between support given in the past and desired in the future

Computer anxiety and personality

Using the EXCEL correlation data analysis shows us that there is very little correlation between the personality traits and the level of computer anxiety (Table 31)

	Anxiety	*Extraversion*	*Agreeableness*	*Conscientiousness*	*Emotional Stability*	*Openness*
Anxiety	1					
Extraversion	0.11	1.00				
Agreeableness	-0.45	0.14	1.00			
Conscientiousness	0.07	0.70	0.16	1.00		
Emotional Stability	0.15	0.40	-0.11	0.38	1.00	
Openness	-0.17	0.19	0.23	0.27	0.25	1

Table 31 The correlation between computer anxiety and personality trait

There is a moderate negative correlation between the level of computer anxiety and the trait of agreeableness. i.e. the more a person prefers to work alone the higher the level of computer anxiety.

This needs to be explored further with a regression analysis (table32).

Regression Statistics	
Multiple R	0.500
R Square	0.250
Adjusted R Square	0.125
Standard Error	10.241
Observations	36

Table 32 Regression analysis of computer anxiety against personality traits

From the Adjusted R^2 value of 0.125 we can say that 12.5% of the variance of the level of computer anxiety can be accounted for by the values of the personality traits suggesting that 81.5% of the variance is caused by other factors.

An ANOVA analysis shows a significance F values of 0.11 which is not less than 0.05 so the result is not significant (Table 33).

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	5	1050.17	210.03	2.00	0.11
Residual	30	3146.58	104.89		
Total	35	4196.75			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	27.01	7.13	3.79	0.00	12.45	41.56	12.45	41.56
Extraversion	0.14	0.22	0.61	0.54	-0.32	0.59	-0.32	0.59
Agreeableness	-0.47	0.17	-2.67	0.01	-0.82	-0.11	-0.82	-0.11
Conscientiousness	0.05	0.20	0.24	0.82	-0.37	0.46	-0.37	0.46
Emotional Stability	0.03	0.12	0.28	0.78	-0.21	0.28	-0.21	0.28
Openness	-0.12	0.18	-0.68	0.50	-0.50	0.25	-0.50	0.25

Table 33 The results of an ANOVA analysis

From the results (Table 34) we can also see that only Agreeableness has any relationship to anxiety levels with a p-value of 0.01, but having noted that the relationship is not significant there is little point in exploring this further.

This does not support the findings from research or agree with the outputs from the postgraduate cohort.

From these results we conclude that for this cohort personality traits do not affect the level of computer anxiety.

Computer anxiety and type of support

The link between levels of computer anxiety and the type of support they received in the past and desire in the future is explored in this section as is the relationship between the difference in between support received and desired and computer anxiety.

Table 35 shows the correlation coefficients for anxiety against each type of support in the three different conditions. The first column shows the results when the rating given to each type of support is compared with computer anxiety levels, the second column compares the rating given to support desired in the future and the final column shows the results when the discrepancy between given and desired is calculated.

	Support given	Support desired	Difference
Anxiety	1	1	1
print manual	0.21	0.15	-0.14
on line manual	0.13	0.08	-0.10
w/s	0.17	0.19	-0.02
class	0.10	0.03	-0.11
on line	0.18	-0.20	-0.35
none	-0.24	-0.15	0.10
one to one	0.19	-0.08	-0.24
peer	0.05	-0.04	-0.04

Table 34 showing the correlation coefficients between computer anxiety and each condition being explored

As the results show there is very weak correlation between computer anxiety and any of the other elements (Table 34).

Personality and type of support

If we explore the correlation between emotional traits and types of support ratings both given and desired we can see that there is no or very weak correlation between any of the items with no correlation coefficient above 0.33 (Table 35).

	e	*a*	*c*	*es*	*i*
print manual	0.15	-0.10	-0.24	-0.08	-0.03
on line manual	0.13	-0.04	-0.22	-0.06	-0.13
w/s	0.12	-0.02	-0.30	-0.04	-0.10
class	0.11	0.09	-0.17	0.25	0.05
on line	0.10	0.10	-0.21	0.16	-0.20
none	0.03	0.18	-0.20	0.10	0.21
one to one	0.02	-0.10	-0.01	-0.15	-0.18
peer	0.29	0.14	0.11	0.02	0.13
print manual	-0.15	-0.26	-0.38	-0.23	0.17
on line manual	-0.27	-0.29	-0.34	-0.20	-0.08
w/s	0.06	0.06	-0.33	-0.14	0.01
class	0.43	0.08	-0.13	0.15	0.04
on line	-0.12	0.26	-0.16	0.15	0.07
none	-0.19	0.04	-0.04	-0.04	0.07
one to one	0.16	-0.19	0.20	-0.16	-0.06
peer	0.29	-0.26	0.17	-0.15	0.03
print manual	-0.31	-0.09	0.06	-0.07	0.01
on line manual	-0.21	0.05	0.09	-0.04	-0.12
w/s	0.23	-0.04	0.09	-0.02	0.29
class	-0.31	-0.29	0.03	-0.26	-0.14
on line	-0.13	-0.17	-0.05	-0.28	0.25
none	0.30	0.13	-0.04	0.11	0.09
one to one	0.33	0.18	0.11	0.15	-0.01
peer	0.37	0.28	-0.06	0.09	0.11

Table 35 showing the correlation coefficients for personality traits against types of support given and desired. NB Desired is in the shaded section.

Summary of the findings

For this group of first year entrants to the business school, who completed the on-line questionnaire on a voluntary basis it can be seen that they do not present with levels of computer anxiety that give cause for concern. Their personality profile is as expected and they seem ambivalent about the support they have been given in the past or expect to receive in the future. This does not seem to have an impact on level of computer anxiety, or be related to personality type. This is a small sample of the year group and has been self-selected via the availability of an on-line link and this is likely to have had some impact on the results.

3.3.5 *Discussion and comparison with Phase One*

Computer anxiety

Compared with the group in phase one, the older and more experienced MA students have a lower level of computer anxiety. It may be because they have had longer to develop strategies to manage their anxiety, are more mature in their approach (King, Bond and Blandford, 2002), or alternatively it may be that longer exposure to the technology has reduced their anxiety which would be in line with the findings of other research (Martin, Stewart and Hillison, 2001; Woszczynski, Lazar and Walker, 2003).

The undergraduate group also presented with lower levels of anxiety compared to those in phase one. There could be any number of causes but one that seems likely is that the survey was delivered in an online format and participants were self-selecting. Given that one strategy for dealing with anxiety is avoidance (Rosen and Weil, 1995b) it is not unlikely that students with higher levels of anxiety simply avoided increased interaction by not-engaging with the survey. This conjecture is partially supported by the low numbers of participants.

It is interesting to note that individuals that are presenting with medium to high levels of computer anxiety have still chosen to engage with an on-line learning programme. There are likely to be a range of factors influencing their decision such as availability of learning opportunities or flexibility of learning times as well as their comfort with the use of technology. They have a strong purpose in choosing to engage with learning in this way, and it seems likely that this can go some way to reducing the level of anxiety felt (Sivakumaran and Lux, 2011) or at the very least giving some reason for pursuing the ultimate goal.

As some research has found, if the need or desire to have the outcome is strong enough the participant will engage with technology in spite of the effects of their computer anxiety (van Raaij and Schepers, 2008). This group had at least seven years of working at a leadership level although many of them may not have engaged with tertiary education, and some did not even complete their secondary schooling. Many were self-funding with a view to improving their position. These factors combined to give many of the group an extremely high motivation to do well on the program and engage with all the learning opportunities that were offered. As the group had formed a strong learning community it is also likely that they supported each other, and for those that struggled a bit with anxiety this may have been enough to mediate the anxiety to a manageable level. This is in line with the findings from van Raaij and Shepers (2008).

The undergraduate group, on the other hand, presented with low levels of computer anxiety, or at least those that chose to engage with an on-line survey accessed via a link within the VLE, did. This journey to even begin the survey may have dissuaded those with computer anxiety from even attempting to complete it.

That many people chose to open the link, but then did not complete the questions shows that it was accessible, but indicates a lack of motivation or interest in the subjects or questions within the work.

Personality

In comparison with the group from phase one, the personality mix of the group is quite different with a far greater proportion of the distance learning group presenting as conscientious. This might be indicative of the type of person who has opted to take the particular MA course which was about leading innovation and change. Conscientiousness as described in the Big 5 is around being organised. This would definitely be a trait that someone who was holding down a full-time job, doing an MA and often raising a family as well, would be displaying.

Some research has noted that there is a gender difference around the impact of personality traits and self-efficacy. The research found that for people presenting as female, personality traits can have a strong impact on the level of self-efficacy while they do not for people presenting as male (Saleem, Beaudry and Croteau, 2011). The gender balance of the MA group is 72% male, 28% female and it is possible that this has had an impact when reviewing the correlations between personality and computer anxiety. This may need to be further investigated.

For the MA cohort, openness is a significant factor in the level of computer anxiety accounting for 43% of the variance. This supports the research of (Hudiburg, Pashaj and Wolfe, 1999) but is in contrast to other findings (Anthony, Clarke and Anderson, 2000;

Korukonda, 2005) and to the findings in Phase one, where emotional stability and agreeableness were seen to be contributory factors.

The undergraduate cohort did not show any relationship between personality traits and computer anxiety levels, a finding that is at odds with other research that found a range of relationships between different traits (Anthony, Clarke and Anderson, 2000; Korukonda, 2005)

It may be because computer anxiety is a complex condition that has many factors contributing to its cause and severity including socio-economic background, experience, gender, age, and culture as well as personality (Bozionelos, 2004a; Chien, 2008), and each factor may have more of an impact in some people than others.

Summary of understanding

From this phase, it is apparent that although there seems to be some sort of link between personality traits for some cohorts this is not true or consistent across different groups.

Looking at how people have been taught in the past to see if this early experience has had an impact on levels of computer anxiety did not show any correlations between the two for either cohort. This does not support the findings of earlier research around the impact of previous experience (Cowan and Jack, 2011) although the emotions around first experience was not explored in this research.

Any difference between how people had been taught and how they thought they would like to be taught was not found to be significant or impactful for this cohort.

Further interrogation of preferences for future teaching suggested that those with low levels of anxiety have a broader view as to what might be useful. It is to be wondered if being prepared to access learning in a range of ways helps those learners to be less anxious and it is worth exploring this as a strategy to support those with high levels of anxiety.

3.3.6 *Limitations*

This work was conducted on-line and as such may have allowed the voluntary exclusion of participants who did have computer anxiety. The post-graduate cohort recognise the value of research and were motivated to participate while the undergraduate cohort could not see the value of their participation and so chose not to engage. For those with very low levels of computer anxiety it seemed a silly question to ask, for them, on a par with 'do you get anxious about breathing?' so this too may have diminished their motivation to participate. This will need to be addressed in future work by giving a better context and reason for the research.

3.3.7 *Conclusions and suggestions for Further work*

Even though this research was delivered through an on-line medium, some results indicated that people with medium to high computer anxiety were engaging with learning delivered via computers. These individuals may be experiencing high levels of anxiety but their motivation to engage with learning was driving them to continue to engage with technology. What the long-term effects of this may be are impossible to say, but these are the very people that this work is trying to discover so that they may be supported effectively to either overcome their anxiety or manage the symptoms to avoid damaging their health and wellbeing.

Comparison between the levels of computer anxiety between phase 1 and phase 2 indicated quite different levels of computer anxiety with the second phase returning very low levels of computer anxiety. There are two potential reasons for this: Either the levels of computer anxiety have dramatically reduced as the students participating in this research would have been born in the late 1990s and were of an age to engage with social media and own SMART phones thus increasing their personal experience with technology and possibly reducing any anxiety they might feel about technology in general. Or those who had computer anxiety were employing an avoidance strategy and choosing not to engage with their computer any more than they had to. Whatever the reason it is important to conduct another round of research to find out if levels of computer anxiety have reduced, or if the online method caused an anomaly in the findings.

The next phase of research needs to be delivered on paper but should include the same instruments as this phase to allow for a full comparison.

3.4 Phase Three:

The third phase of the research explores the levels of computer anxiety to see if either the level of computer anxiety has dropped dramatically or if the use of an on-line questionnaire meant that those who are computer anxious opted out of the research. The sample group was a new first year cohort of students from across a range of courses in the Business School of a small university (similar to those in phase 1) This phase is conducted by handing out paper copies of the questionnaire and many of the findings are very similar to phase two, although the levels of computer anxiety are more in line with those from the first phase than those from the second phase indicating that computer anxiety is still an issue for students in this small Business School.

3.4.1 *Introduction*

The results from the electronic delivery method (phase 2) were quite different from the findings from phase one. Overall the level of computer anxiety was much lower in the returns from the on-line survey.

This could be due to the influence of one or more of several possibilities:

- self-selection, after all if someone is suffering from computer anxiety they are probably not going to engage in a voluntary on-line activity
- historic changes in curriculum were bearing fruit and computer anxiety was much reduced in cohorts going forwards
- advances in technology were having an impact and these were manifesting as reduced computer anxiety
- or there was some other reason as yet unknown

It is possible that changes to the school curriculum have had an impact on the cohort of students from the last round of research. If Computing Science was being taught more effectively it would mean that more people would be having a good first experience, they would have had more practice and exposure to computers and the sociological impact could have been lessened. These changes would be expected to reduce the level of computer anxiety, which would be a good outcome. If the reduction in computer anxiety level was seated in curriculum change this would be reinforced by the results from this cohort.

In the three years since the first phase and technology has changed dramatically with the launch of the i-phone and other SMART devices. It is possible that the increase in availability and popularity of SMART phones (Derakhshan and Khodabakhshzadeh, 2011; Tess, 2013; Unknown, 2015; Al-Jundi *et al.*, 2016) was beginning to impact on the computer anxiety levels of the students.

In order to check the results were not an anomaly a further round of surveys was undertaken

The sets of questionnaires used:

- Computer anxiety questionnaire (Rosen and Weil, 1992) as used before
- Brief personality questionnaire (Nettle, 2007) an abridged version with just 10 questions
- Learning preference questionnaire (Flemming, 2014) a new inclusion to look at the way that people perceive their learning preference.
- Previous experience questions as in phase 2
- Future preference questions as in phase 2

This time the questions were delivered all together at the same time on paper. This both avoided the possibility that the computer anxious students were not responding to the questionnaire and allowed a more comprehensive linkage between the different questionnaires. The questionnaires were distributed in a whole group lecture, to the new intake of level 1 Business Management students.

Participants were given time to fill the variety of questionnaires in, although it was clear that participation was voluntary, and this was clearly understood as a sizeable minority of the papers were returned blank.

3.4.2 *Method*

The instruments

Only new instruments will be presented here.

Nettles brief personality questionnaire

Although personality seems not to be a useful indicator for computer anxiety, it is still interesting to see the makeup of the cohort. In order to reduce the burden of answering, a brief version of the Big 5 Inventory was used. This has been developed and used extensively by Nettle (2007) and has a large body of data supporting its value and accuracy (Nettle, 2007). This comprises of only 10 questions, two for each trait.

Learning Preferences

This is a controversial area with loud voices on both sides of the debate although all agree that thinking about how one learns is beneficial (Coffield *et al.*, 2004; Penger, Tekavcic and Dimovski, 2008; Sharp, Bowker and Byrne, 2008; Cassidy, 2010; Rolfe and Cheek, 2012; Dunn and Honigsfeld, 2013; Hatami, 2013; Manolis *et al.*, 2013; Scotland, 2014; Newton, 2015)

One model that has gained traction in education circles is Flemming's VARK model (Flemming, 2014). This looks at whether people see themselves as preferring to use one of the four main learning methods: visual, aural, read/write or kinaesthetic. As this is a common tool for talking about learning in primary schools and had been when the majority of the cohort where in that setting, it is likely that they would have heard about it and be comfortable with the premises presented.

The instrument used to identify preference was a self-reporting questionnaire with a range of positively and negatively scored questions relating to each preference type.

The Sample Group

The pragmatic approach was continued, and convenience sampling meant that a new cohort of level 1 business students was invited to take part in the research. Although it can be difficult for those with anxiety to admit to the anxiety it was hoped that the anonymous nature of the research would encourage full participation. The students were studying a wide range of courses within the business school with some having to meet some simulation software as well as the usual suite of office type applications. The university is encouraging the use of citation software so this too would be something new that students would have to come to terms with.

The process

A paper copy was handed out in a whole cohort lecture and students given time to complete it. The context for the research was explained and it was made clear that participation was voluntary. The papers were returned anonymously although there was the potential for students to include their email address if they were prepared to take part in further research.

The analysis

The quantitative data was analysed using EXCEL and a range of tests including:

- Descriptive statistics
- Correlation
- Chi Squared test
- Regression analysis

The qualitative data was minimal as few participants offered additional comments

3.4.3 Findings

Of the questionnaires handed out to the year group of 170, 159 returns were made, with 67 of those being from females, 78 from males and the remainder declining to indicate gender.

The group was predominantly British (125/159) with the remainder being Chinese, American, Indian, Hungarian, Libyan or declined to say.

Computer anxiety

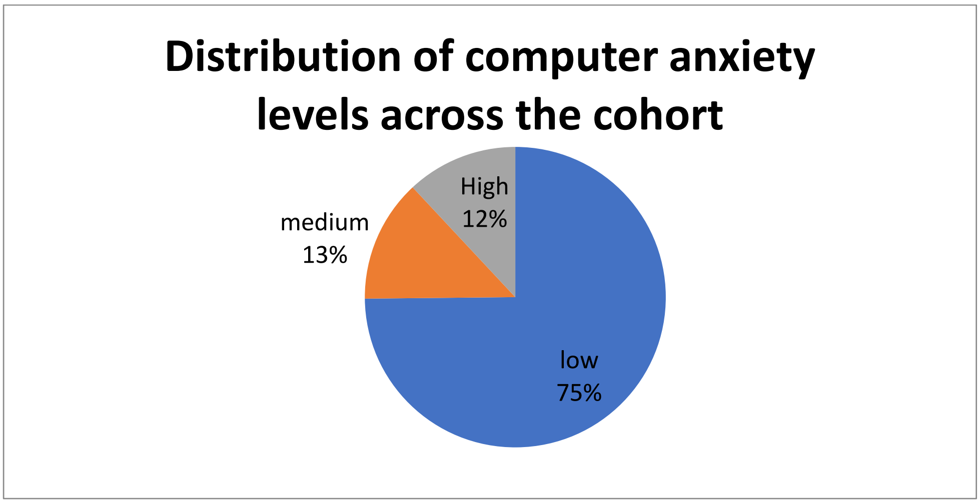


Chart 25 Levels of computer anxiety in the group

The mode is in the range 20 – 30 i.e. in the low range typified as low computer anxiety, while the mean is 34.4, in the range typified as low computer anxiety – the threshold being 42. As can be seen from Chart 25, 25% of the group reported as suffering from medium to high computer anxiety, with 13% of the group affected by medium levels of computer anxiety and 12% presenting with high levels of computer anxiety (Chart 26)

When the data was separated by gender it appeared to show some minor differences as seen in Chart 26. While the bulk of those presenting as male reported slightly lower levels of computer anxiety than females, the spread was greater with the highest level of computer anxiety expressed by a male.

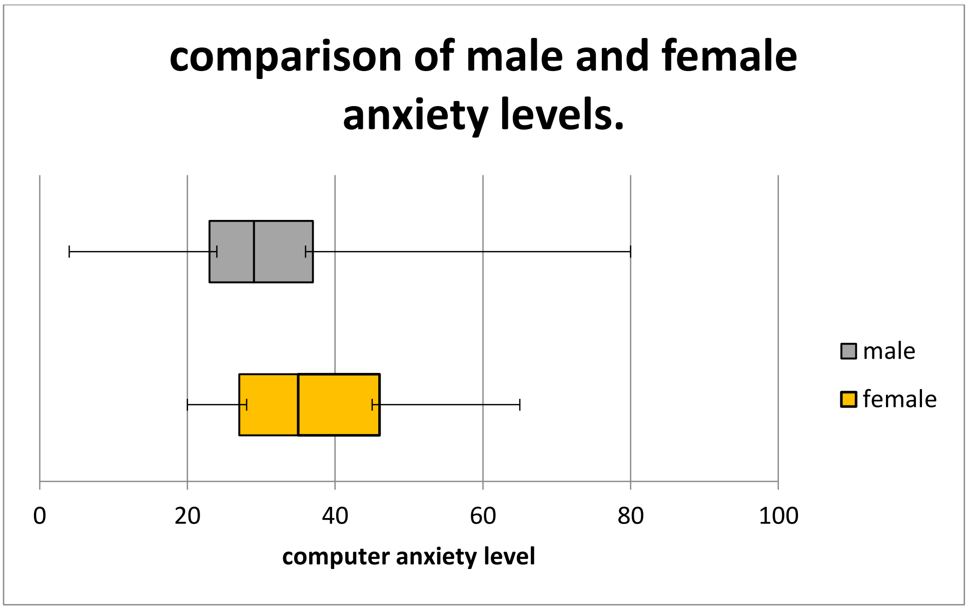


Chart 26 Comparison of computer anxiety levels across gender where one was stated

Female participants in this sample presented a higher level of computer anxiety than the male participants with only 66% expressing a low level of computer anxiety while 86% of males saw themselves at this level

However, following a Chi Squared analysis against the null hypothesis that gender has no impact on the level of computer anxiety this was found to be true with a 98% degree of certainty (Table 36).

gender	male	female	other	**total**
low	68	44	7	**119**
med	7	14	4	**25**
high	4	9	2	**15**
Total	**79**	**67**	**13**	**159**
Degrees of freedom	4			
expected frequencies				
low	59.12579	50.14465	9.72956	
med	12.42138	10.53459	2.044025	
high	7.45283	6.320755	1.226415	
Xsquared				
	1.331934	0.752957	0.765759	2.85065
	2.366194	1.139964	1.871717	5.377876
	1.599666	1.13568	0.487954	3.223299
sum of differences				11.45183

Table 36 The Chi Squared analysis of computer anxiety against gender

The cumulative probability is 0.98. therefore there is a 98% chance that the sample standard deviation will be no more than 0.95

Looking at the Chi-Square distribution this falls in the Significant section i.e. p = 0.02.

The null hypothesis is:

H0 the variables of gender and anxiety are independent

And the opposing hypothesis is:

H1 the variables of gender and anxiety are related

The null hypothesis that computer anxiety is independent of gender is found to be supported. This is in line with much research that found ambiguous relationships between gender and computer anxiety (King, Bond and Blandford, 2002; Sam, Othman and Nordin, 2005; Mazloumiyan *et al.*, 2011).

Personality

Looking at the personality responses if the raw scores are taken into account there is a representation of all the personality types in almost equal proportions with a slightly higher proportion given to the neurotic trait (Chart 27)

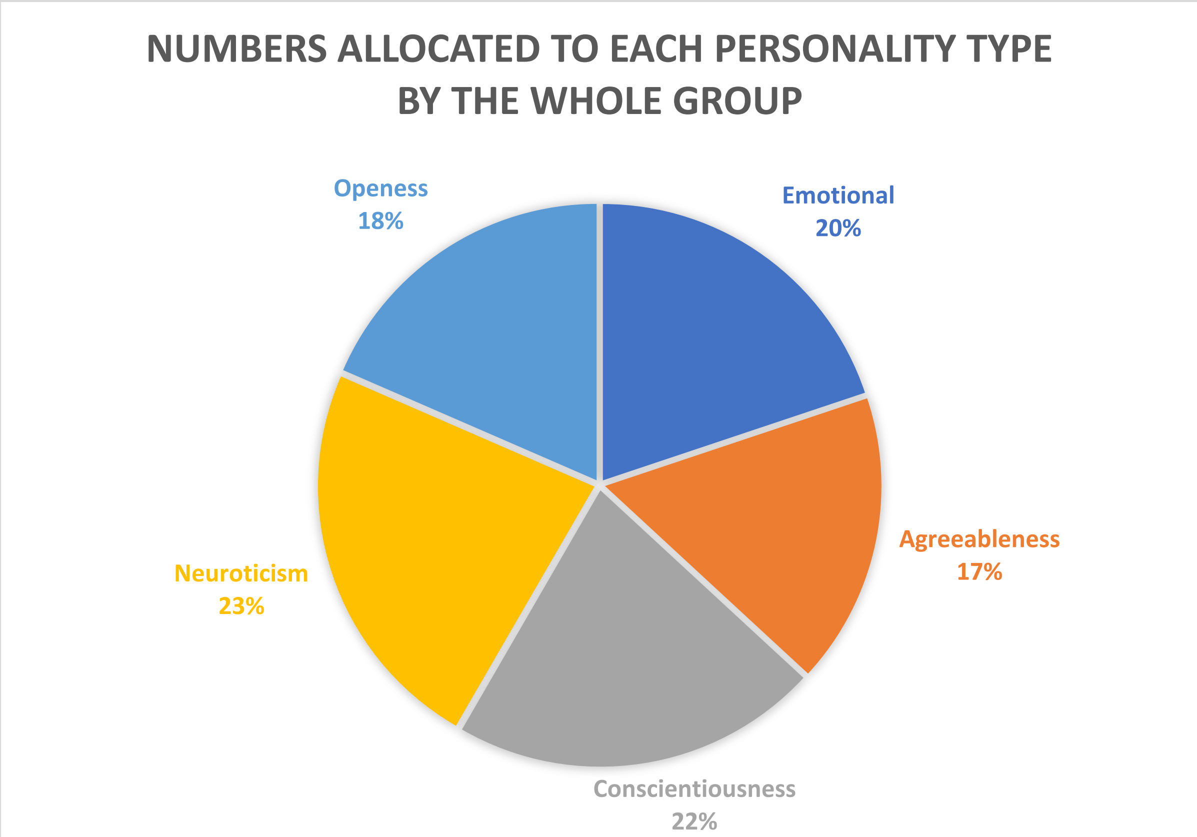


Chart 27 Raw personality data

There were several instances where no one trait was dominant, e.g. someone had the same scores for Emotional stability and Agreeableness but lower scores for the remaining traits. If these participants are grouped together we can see the preferences of the rest of the group in Chart 28.

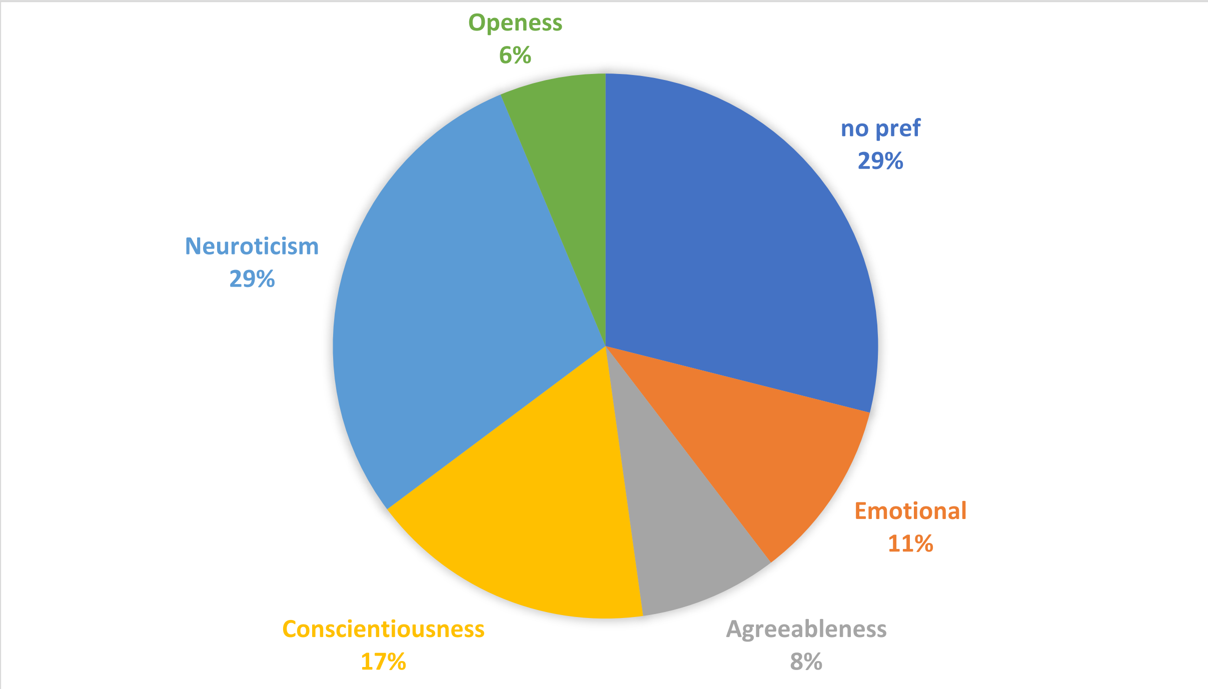


Chart 28 Distribution of personality types where a preference was expressed, including those where there was no dominant personality trait (indicated by no pref)

Chart 28 shows that when there was a single dominant trait, the lowest occurrence of these was for openness, with agreeableness also scoring quite low. The strongest preference was for neuroticism.

A substantial proportion of the group had equal scores for two or more traits shown as "no pref" on the Chart – this suggests a balanced personality rather than one in which a specific trait is dominant.

Learning style

The learning styles of the group were fairly evenly distributed across the group if raw scores were compared. (Chart 29).

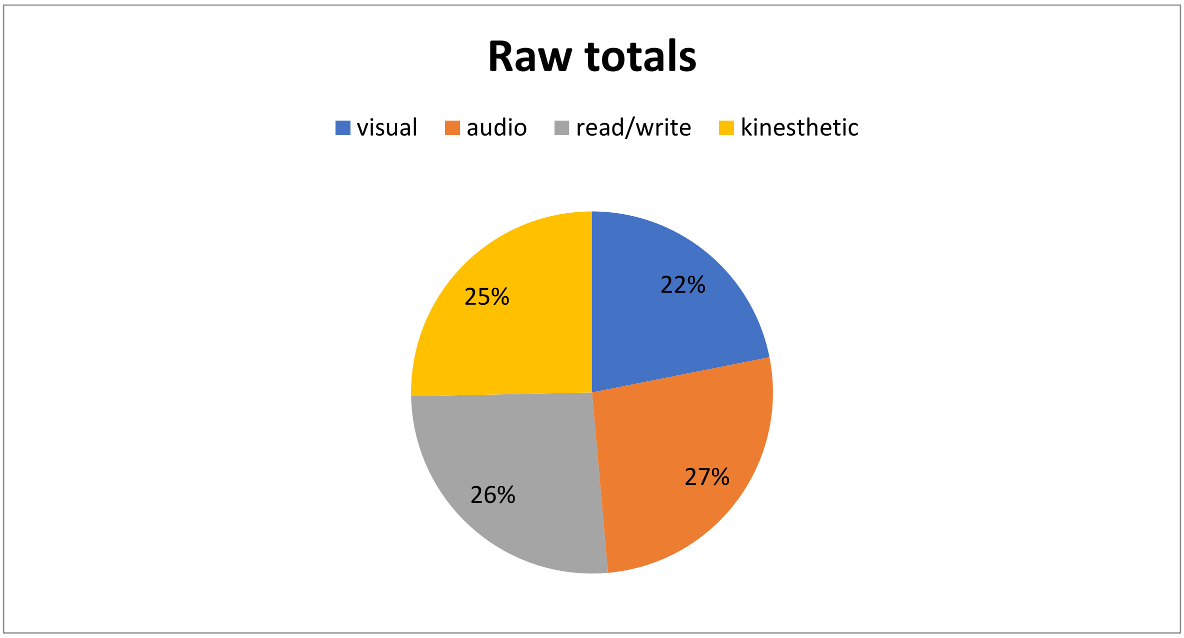


Chart 29 showing distribution of learning styles

Comparisons of the mean scores for each learning style in the different gender groups are shown in Chart 30.

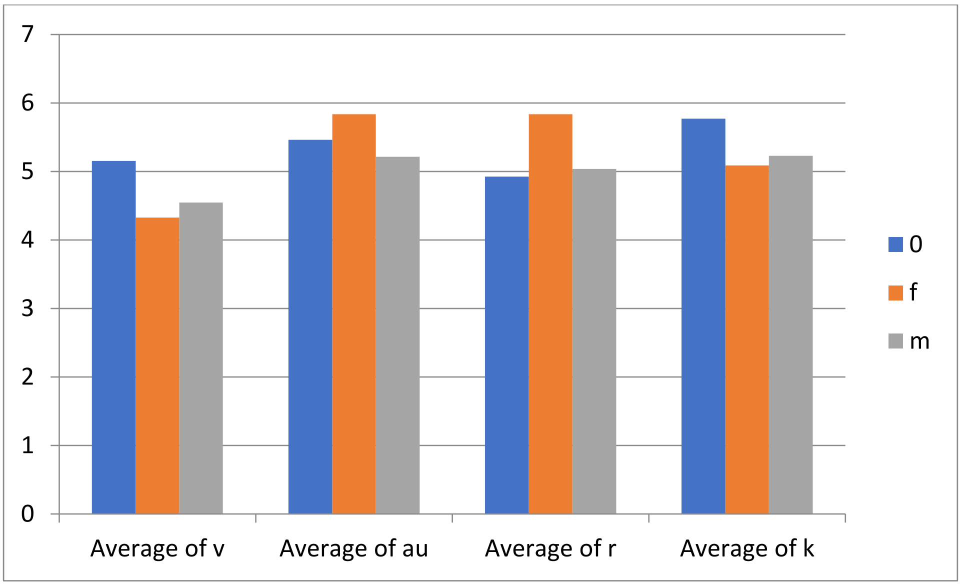


Chart 30 Showing Learning preference scores against gender

From Chart 30 we can see that females in this group tend to favour audio(au) and read/write (r) learning styles while the males in the group are slightly higher than the females in their preference for kinaesthetic learning and visual learning. The ‘other’ group are quite strongly kinaesthetic learners.

If the scores are turned into percentages of the total points awarded for each individual and then tested for correlation, we can see that there is very little correlation between the different preferences apart from that found between the preference for reading and writing and kinaesthetic learning which is moderately strong at 0.47 (Table 37)

This is as expected as the learning styles are presented as being independent variables.

	visual	*Audio*	*Read/Write*	*Kinaesthetic*
visual	1			
Audio	-0.37	1.00		
Read/Write	-0.16	-0.23	1.00	
Kinaesthetic	-0.18	-0.06	-0.47	1

Table 37 Correlation of learning preferences

Support offered and rated

The type of support varied with ratings being given only for those each person experienced. Participants were asked to rate their responses on a 5 part Likert Scale with 1 being not very highly and 5 being very highly.

See Table 38 for the number of ratings given to each type of support

Type of support	manual	workshop	tutorled	on line tutorial	independent	one-to-one	peer
No of ratings	29	27	45	27	40	30	30
Mode	4	4	4	4	4	5	4
Mean	3.86	4.07	4.19	3.78	3.65	4.38	3.76

Table 38 ratings for each type of support with mean and mode

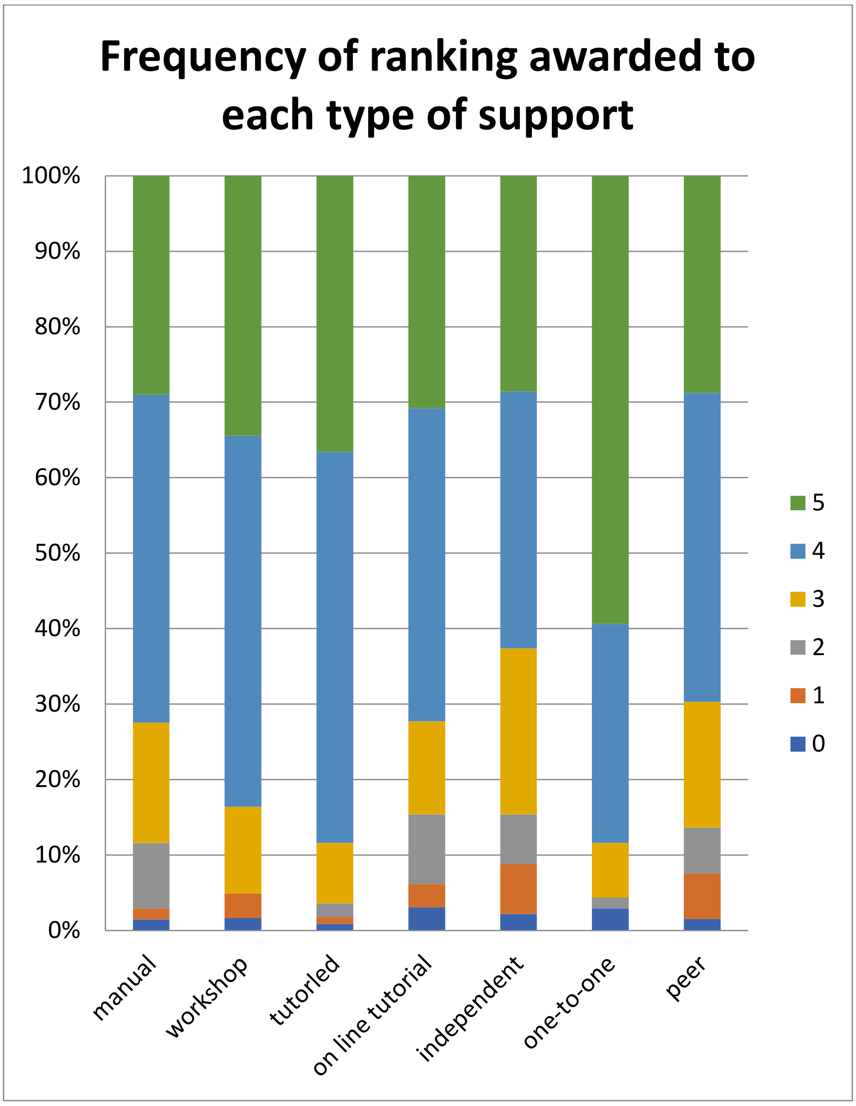
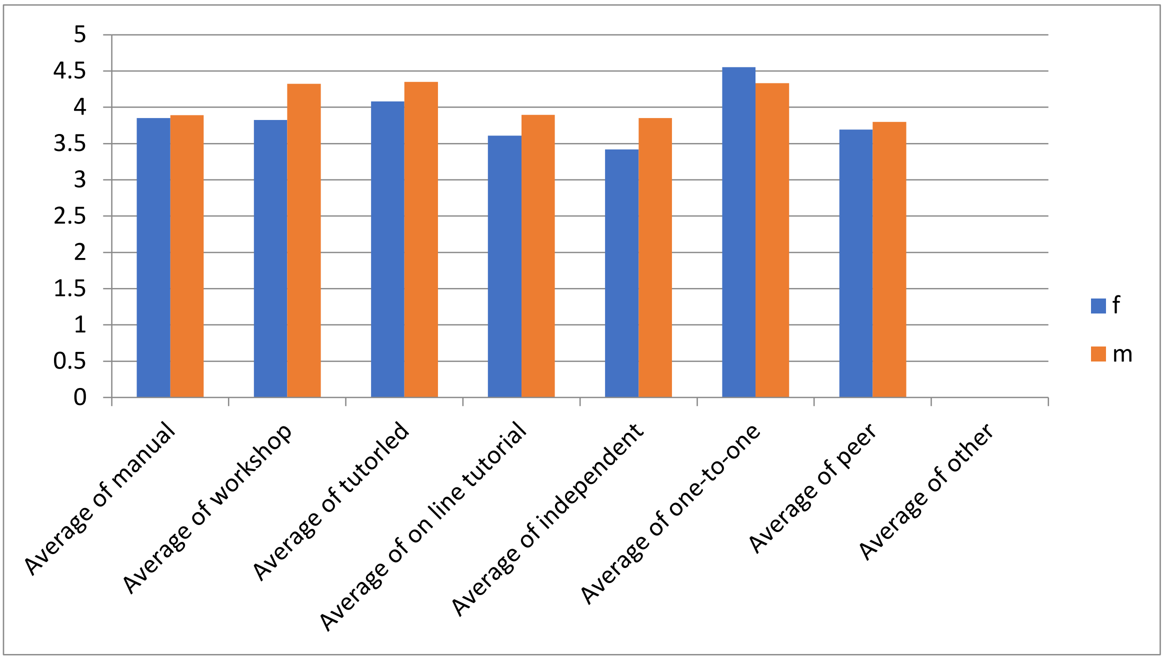


Chart 31 the proportion of responses of each level for each type of support

From Chart 31 it can be seen that On-line tutorial got the highest proportion of low rankings while one-to-one support was rated the most highly for this group.

Splitting the preferences by gender (where one was expressed) it can be seen that the average rating given by the males is higher than those ratings awarded by the females, other than in tutor-led where the females rated this more highly (Chart 32).

Chart 32 showing average scores given to each type of support



As

The sample size was not large, with fewer than 30 responses for five of the types of support, it would not be sensible to do further statistical analysis on this data.

Comparing learning preference with computer anxiety

There is little to no relationship between the level of computer anxiety and the learning preference as expressed in this questionnaire. It can be seen from the graphs (in appendix 3) that there is no pattern or trend of computer anxiety v learning preference and the R^2 value is very low. The R^2 values are summarised in Table 39 below (see appendix 3 for supporting scatter diagrams).

Learning preference	R^2 value
Visual (graphical)	0.0023
Read/ Write	0.0012
Audio	0.024
Kinaesthetic	6E-05

Table 39 The Correlation between computer anxiety and learning preference shown by R squared values

Comparing Personality with computer anxiety

As can be seen from Table 40, (scatter diagrams are in appendix 4) showing the value of R^2 for the correlations between computer anxiety level and personality trait, there is also little to no relationship between level of computer anxiety and score given for individual personality traits. The highest value of 0.09 for the Neurotic trait does indicate that earlier research pinpointing this trait might have some slight support here, but the values are so low that they cannot be considered as indicative of any correlation.

Personality trait	**Value of R^2**
Extrovert	0.009
Neurotic	0.0902
Openness	0.008
Agreeableness	0.0307
Conscientiousness	0.0004

Table 40 Correlation between computer anxiety and personality trait

Comparing computer anxiety with support given

There is a similar story when we compare levels of computer anxiety with the preference for type of support (See appendix 5 for supporting charts)

Preference	R^2 Value
Tutor-led	0.025
Using a print manual	0.047
Online tutorial	0.0014
Workshop	0.0522
Peer support	0.0077
Independent learning	0.0643
One-to-one learning	0.0652

Table 41 R values for computer anxiety and support preferences

As can be seen in Table 41, the highest R^2 values are still below 0.1 suggesting that there is very little correlation between any of these types of support and computer anxiety level.

	v	au	r	k	manual	workshop	tutorled	on line tutorial	independent	one-to-one	peer
v	1										
au	0.11965	1									
r	0.246647	0.211043	1								
k	0.238612	0.250542	-0.04265	1							
manual	-0.08494	0.004657	0.075292	0.06129	1						
workshop	-0.0994	0.005699	-0.12602	0.141685	0.481545	1					
tutorled	0.033834	0.042438	0.036573	0.033871	0.234165	0.374621	1				
on line tutorial	0.002616	-0.06509	-0.09458	0.21114	0.343107	0.615999	0.231295	1			
independent	0.022044	-0.01326	0.015707	0.092682	0.289885	0.290035	0.230957	0.38616	1		
one-to-one	-0.07416	0.004297	-0.0792	0.057454	0.380493	0.543587	0.21913	0.416158	0.213471	1	
peer	0.060652	-0.01013	-0.0538	0.119163	0.457783	0.557163	0.334937	0.449039	0.301388	0.443224	1

Table 42 showing no correlation between support preferred and learning preference

Correlation between learning style and learning support

If we draw up a Table showing correlation between learning preference and the type of support a user had we can see there is little to no correlation, we can also see that there is little to no correlation between the different preferences or between the different types of support (Table 42)

Comparing personality with learning style

There is no correlation between personality and learning preference as seen in Table 43 below

	v	*au*	*r*	*k*
e	0.159416	0.059608	-0.04516	0.201809
ag	0.137318	-0.01447	0.205972	0.04373
c	0.029042	-0.03372	0.174019	-0.05557
nu	0.126998	-0.09343	0.031822	0.016067
o	0.033477	0.023875	0.140011	0.140409

Table 43 Showing no correlation between learning preference and personality trait

Comparing support and personality trait

This correlation diagram (Table 44) demonstrates that there is no relationship between how people describe their personality and how they think they wish to be supported. There are some weak relationships between the different types of support.

	e	*ag*	*c*	*nu*	*o*
manual	-0.09959	-0.03869	-0.00486	-0.03371	0.060614
workshop	0.046006	-0.07713	0.006969	0.043942	0.09793
Tutor led	0.011558	-0.03633	-0.01439	0.005513	0.056942
on line					
tutorial	0.056017	-0.05462	0.021829	0.005912	0.214543
independent	0.067679	-0.11302	0.128764	0.190275	0.29974
one-to-one	-0.02402	0.024017	-0.0258	0.04491	0.021249
peer	0.065456	-0.08551	-0.0607	0.008924	0.0764

Table 44 Showing no correlation between personality and type of support

3.4.4 *Discussion*

From the findings presented above, it can be seen that there is very little to connect the four items that were used to explore the issue of computer anxiety and predicting its level in participants. There seems to be very little to connect the items to each other either. This is in line with much of the findings from the previous phases, although it does undermine the links found between levels of computer anxiety and personality traits

The correlation between personality and level of computer anxiety is very weak and does not bear out the findings of either phase 1 and 2 or previous work (Korukonda, 2005). This lack of supporting findings does bring into question the possibility of predicting the level of computer anxiety using personality traits and this avenue will no longer be considered.

Although learning styles of themselves are controversial (Coffield *et al.*, 2004; Cassidy, 2010) the way in which people describe themselves is interesting and may have given some insight into the likelihood of that person suffering from computer anxiety. However, this was not found to be the case and the learning preference of subjects did not seem to be related to their level of computer anxiety.

The lack of correlation between the self-reported learning preference and the suggestion for how each person would like to be supported in the future has several implications. It is not possible to predict the type of support each individual would prefer based on past experience. It does not really seem to matter how the support is offered as long as there is support but, if this is offered in a range of ways, an individual can choose the most appropriate method for their context and needs in any given moment.

Overall the finding suggest that computer anxiety is likely to be a complex issue with a myriad of causes that cannot be explained simply. It is perhaps a coming together of previous experience (Cowan, Vigentini and Jack, 2009), predisposition to anxiety (Krishnan and Nestler, 2008), ability of the teacher (Hawi, 2010), importance of the task (Tu, Wang and Shu, 2005), peer pressure and other stresses outside of the computer experience, not forgetting the attitude of the person when approaching the task which has been seen to be very important too (Torkzadeh and Van Dyke, 2002).

3.4.5 *Limitations*

As with all the work, the results are based on self-reporting. The group is self-selecting in that participation in the research is voluntary. The scope is limited to a small business school in a newer university and these factors may not be true of the wider community.

3.4.6 *Conclusion and suggestions for further work*

It is apparent that computer anxiety is still an issue with first year undergraduates in this small university in the UK. The participants were predominantly in the under 25 age group so there might be some level of surprise that this is the case, but it clearly is, and in this cohort an issue across the genders.

The lack of correlation between learning styles and preferred supporting method might come as a surprise to those advocates of learning preferences as it does not seem to support those theories. It might be that in the case of these adults their strategies in specific situations has overwritten their natural preferences, or that the materials were not explained clearly enough to allow them a considered response. Sometimes habit can overwrite preference, while in other situations anxiety about trying a new way of learning can inhibit change even if that may be helpful.

What this finding suggests as a way forward is to always present learning materials in a range of media so that students can engage with the ways that help them the best. It does appear that while one to one is rated as the most successful, tutor led classes are the most prevalent, which does fit with the educational system in the UK. It might be an opportunity to turn away from those and instead try some alternative approaches.

In further work, and to address the limitation of the sample being taken from a small business school the work needs to be extended to a wider population. There seems little value in continuing to assess personality or learning preference, so the exploration will be limited to assessing the level of computer anxiety. As some years have passed since the first phase, the instrument being used has become very dated, so a different measure should be used in the next phase. However in order to maintain some credibility a cohort from the Business School will also be surveyed so a comparison can be made between the two different contexts.

3.5 Phase Four

This final phase of data gathering reflects the findings of the previous work by no longer looking to personality or learning preferences but focusses on checking that levels of computer anxiety exist in a wider sphere than a small business school and look to using a different measure as the initial instrument is quite dated. It is also useful to use a different instrument in case it is the instrument itself that is generating the findings. The findings suggest that mature students have lower levels of computer anxiety than first years, but that even among computer science students there are still people who are challenged with anxiety around their interactions with technology.

3.5.1 *Introduction*

Given that the research had been taking place over a period of significant technological change it seemed to be important to check that computer anxiety was still a problem among the wider population and was not just specific to the students in a small Business School. This phase was used to explore the incidence of computer anxiety among the wider population with an alternative questionnaire to check whether different instruments still detect a level of computer anxiety. The reach of the sample group was extended to see if the problem was also present in different courses at different universities given that there has been some research to suggest that different professions have had in the past, different levels of computing anxiety (Monnickendam, 1993)

3.5.2 *Method*

The instruments

The instrument used this time was the Computer Anxiety Rating Scale developed by Heinssen (1987) and later validated by Chu and Spires (1991). This has been used in a wide range of research (Lambert, 1991; M. J. Brosnan, 1998; Brosnan, 1999; Durndell and Haag, 2002; Chou, 2003; Schulenberg and Melton, 2008; Tekinarslan, 2008; Chou and Tsai, 2009; Shah *et al.*, 2011; Shah, Hassan and Embi, 2012) and found to be a useful indicator of levels of anxiety.

For this instrument the boundaries for the different levels of computer anxiety are

- Low: less than 31.85
- Medium between 31.85 and 55.31

- High above 55.31

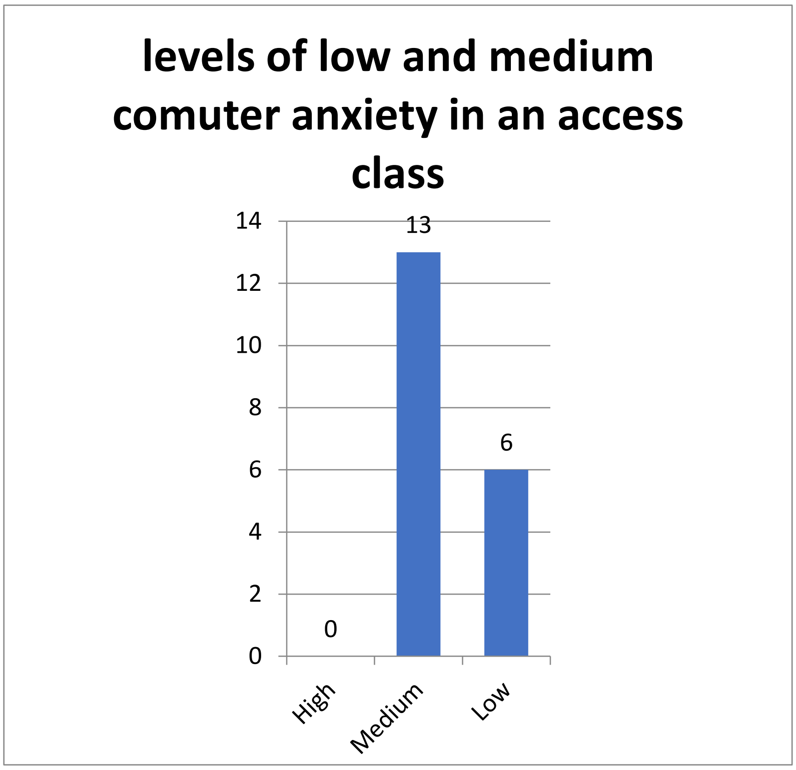
The sample group

There were four distinct groups, three from a large Russell Group University and one from a smaller post 92 Business school. The Russell group students were from three different levels, a foundation class, a degree level computing science class and a master's level cohort who were not from a computing background but had chosen to take a Masters course in the field of computing. The final cohort was first year Business School Students from the smaller university as before.

In line with the pragmatic and convenience sampling approach used throughout this study, students were given the opportunity to partake in the research, but this was purely voluntary. Students understood this as evidenced by the return of incomplete and empty questionnaires.

The process

Paper questionnaires about computer anxiety were distributed at the beginning of the classes and students were given time to fill them in. It was made clear that the responses were anonymous and partaking would have no impacts for the participants.

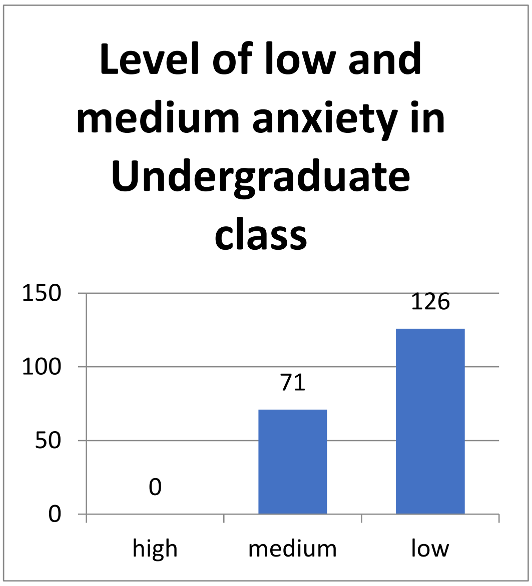


Mean	34.63158
Standard E	2.094563
Median	35
Mode	42
Standard D	9.12999
Sample Va	83.35673
Kurtosis	-0.54292
Skewness	-0.52556
Range	32
Minimum	16
Maximum	48
Sum	658
Count	19

Chart 33 The levels of computer anxiety in an access class

3.5.3 *Findings*

Chart 33 shows that of the 19 returns from the access class nearly 70% of the population was presenting with medium levels of computer anxiety. There were no students with a high level which is to be expected as this was an access class in a School of Computing

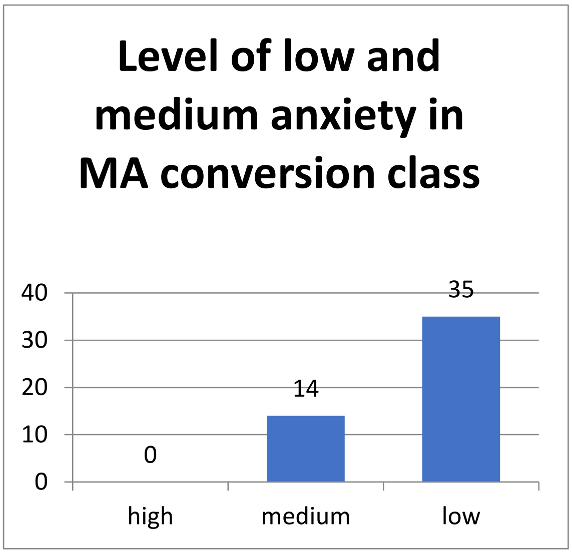


Mean	30.28
Standard E	0.51
Median	29.00
Mode	28.00
Standard D	7.21
Sample Va	51.95
Kurtosis	0.18
Skewness	0.56
Range	40.00
Minimum	15.00
Maximum	55.00
Sum	5965.00
Count	197.00

Chart 34 The levels of computer anxiety in a first-year computer class

Science at a Russel group University.

In this group, of 197 participants, as expected, there is a much lower level of anxiety across the participants with a mean of 30.3. About a third of the group were presenting with medium levels of computer anxiety and none presented within the high range (Chart 35).



Mean	30.14286
Standard E	1.130138
Median	29
Mode	31
Standard D	7.910963
Sample Va	62.58333
Kurtosis	0.978672
Skewness	0.99065
Range	36
Minimum	19
Maximum	55
Sum	1477
Count	49

Chart 35 Computer anxiety levels in a MA computing class

As can be seen from Chart 35 the proportion of participants with medium level computer anxiety is lower again than the previous two groups. It still has a significant proportion of people presenting with some levels of computer anxiety. The makeup of this group was predominantly international. One of the factors that contributes to a level of computer anxiety is fluency in English (Aydin, 2011; Rahimi and Yadollahi, 2011b) although it would be expected that at this level of study in an English University that fluency would not be a problem.

It can be noted that the levels seem to decrease as the experience of the students increase but as this is not a longitudinal study no such conclusions can be drawn.

Because the groups are different cohorts it is not possible to make any definitive conclusions about this but it may be because they have had useful and supportive training that has managed to alleviate their anxiety, or that they are more experienced and this has alleviated their computer anxiety.

The Masters level group had chosen to do this conversion course, onto a computing course from an unrelated undergraduate degree. It is not likely that someone with computer anxiety would have chosen to do this, what is surprising is that some people with medium levels of anxiety have chosen this course.

In contrast the group of Business School Students do have some members with high level anxiety although this is a very small proportion as can be seen in Chart 36 In spite of this there is still a higher proportion of students presenting with low levels of computer anxiety than in the access course group, although the proportion is less than that presented in the other two cohorts.

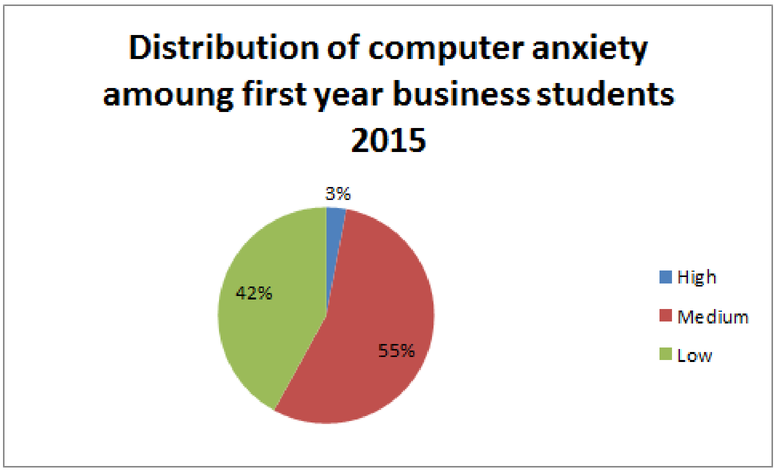


Chart 36 Distribution of computer anxiety among first year business school students

It is interesting to note that across all the cohorts at least of 25% of the participants presented with medium levels of computer anxiety.

From the histogram (Chart 37) we can see that the distribution is slightly skewed, with the mode being in the 20 – 30 bracket i.e. low anxiety.

This contrasts with the findings for students in a Business School where 3% of the population had high anxiety and over half of the class was at the medium anxiety level

The thresholds for the levels of anxiety are

- Low: less than 31.85
- Medium between 31.85 and 55.31
- High above 55.31

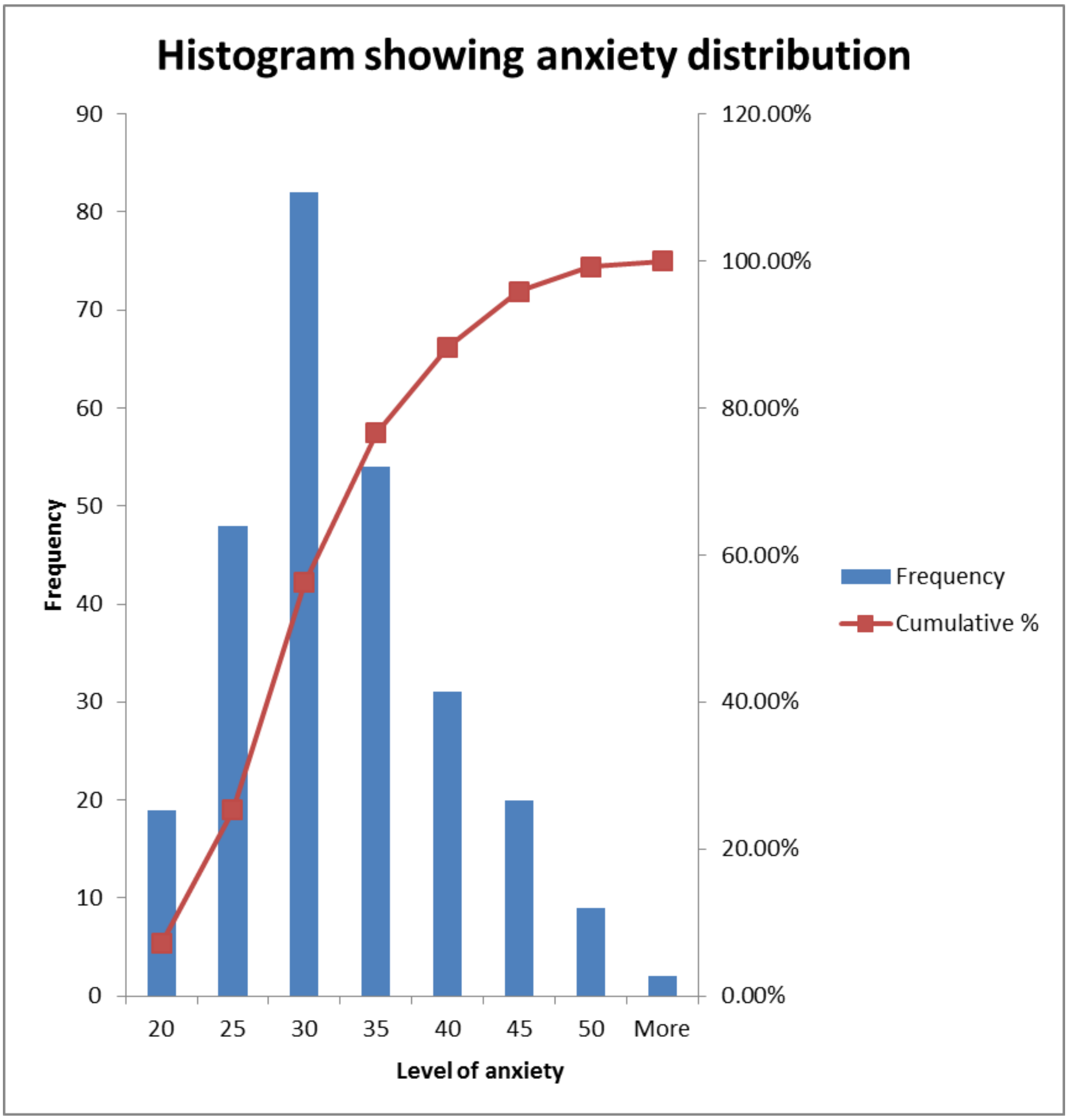


Chart 37 Showing the level of anxiety and cumulative frequency

3.5.4 *Discussion and comparison with earlier Phases*

Taking the percentages of medium and high levels of computer anxiety from all the phases it can be seen from Table 45 that there is no discernible pattern of decreasing levels of computer anxiety over time

Phase	1	2	3	4	4	4	4
Year group	1st year UG 2012	MA level post experience 2013	1st year UG 2014	Access course 2015	1st year UG 2015	Masters level 2015	1st year UG 2016
Percentage of participants presenting with medium to high level of computer anxiety	54	12	25	68	36	29	45

Table 45 Levels of computer anxiety across all the phases

If we just compare similar cohorts i.e. 1st Year UG the picture is not any clearer (Table 46) . It does need to be remembered that the final group used a different instrument, so the numbers may not be directly comparable, but it is interesting to note that this alternative instrument did still show a level of computer anxiety that educators need to be aware of if they are to support the students in their classes effectively. It may also be of interest to employers as this cohort will be going into the work place in the near future.

Phase	1	3	4	4
Year group	1st year UG	1st year UG	1st year UG	1st year UG
Percentage of participants presenting with medium to high level of computer anxiety	54	25	36	45

Table 46 Comparison of first years only

3.5.5 *Limitations*

This work, although across a range of levels, was not longitudinal so we cannot say that positive experiences and practice have decreased the levels of computer anxiety for individuals.

3.5.6 *Conclusions and suggestions for Further work*

Computer anxiety is found in a wider context than just the small business school. Even students on a computer science course were found to suffer from it. The level did seem to be lower for students at higher levels of education but as this was not a longitudinal study no conclusions can sensibly be drawn from this observation.

From this phase of the work it can be concluded that computer anxiety is still an issue that affects students and, it can be assumed, those leaving university to enter the world of work. This finding supports the findings of Rosen, Korukonda and many others as discussed in the literature review. The fact that this is still an issue suggests that it is a persistent anxiety like Maths Anxiety and other social anxieties which will not be cured by exposure or experience. However, like other anxieties there may be strategies to manage the symptoms and address the causes. What these strategies are is something that needs further exploration.

Further work is needed around finding out the strategies of people who are not anxious and discovering what the triggers for anxiety are in those suffering from computer anxiety. Conversations and discussions with a range of people are key to developing an understanding of these issues and these are discussed in the final section of this chapter.

3.6 Phase Five: Qualitative research

This section brings together the wide-ranging qualitative input that contributed to the final instrument. Over the course of the research there have been many conversations with people who were anxious in general, who were anxious about using technology and who were not anxious at all. People were interested in the work and offered insights spontaneously while others asked for support in the moment and then wanted to talk more about the concept. None of these conversations were audio recorded as a result, although the spirit of them is captured here. This section confirms that computer anxiety is a separate anxiety from general or social anxiety, that different people want different sorts of help and that those who are not anxious have a wide range of help-seeking strategies which they are willing to teach to their more anxious colleagues.

3.6.1 *Introduction*

The qualitative comments are grouped into two sections. The first section details conversations that I had with two people who suffer from other types of anxiety and demonstrates that computer anxiety is quite separate from other anxieties. Their experience in being supported through their other anxieties allowed them to make suggestions for strategies that might be useful in supporting the computer anxious. The two people are discussed together firstly under the theme of computer use and then bringing together their ideas for support for others. They conclude that being in control is important so presenting a range of support options and letting the sufferer choose is key. They also felt that having someone to turn to was also important.

The second section features comments from a number of people who suffer from computer anxiety. These were made while the individuals were working with technology in a classroom setting. The first part of this section focusses on one individual and their development over time. It notes their own progression and what seemed to help them. The second section is a collection of general observations from a wider class setting.

3.6.2 *Discussions with people suffering from social or other types of general anxiety*

I met with two people who suffer with a range of anxieties, but who did not suffer from computer anxiety. I explained about my research and they agreed to talk to me. Because they were anxious I was not able to record the sessions, but made notes after the event The analysis of their comments will be prefaced by a brief profile (generalised to maintain anonymity), the context for the conversation and an explanation of the consent given.

Participant 1 (referred to as Bill)

Profile: Bill is a well-respected professional in his field. He works with a range of different people, sometimes in large groups, in face-to-face settings. Although he finds this can be stressful he has developed a wide range of coping strategies so that many people would be surprised to discover his personal anxieties.

I talked to him initially about his use of TweetDeck and other strategies for managing on-line interactions and in the course of the conversation discovered many useful parallels with this research. My research around computer anxiety was discussed and consent freely given to include the conversation in my work.

Participant 2 (referred to as Ann)

Profile: Ann is a working mother who has recently made a career change. This means that as well as learning new information, she is learning about new ways of learning and returning to education after a few years away from it. She has recently been diagnosed as being on the autistic spectrum and she finds interacting with people to be problematic at times. Ann sometimes asks for my help and is interested in this research. She gave her consent to having our discussions included in the work.

Understanding computer use

Bill found working with computers much less stressful than working with people. He found that computers did not take offence, were predictable and mediated his social interactions very successfully. For Bill, communication in a face to face setting is much more exhausting than engaging in a multi-user twitter conference for instance. He sometimes uses the computer as a filter between him and the rest of the world.

Ann, on the other hand, frequently got frustrated at her own lack of technical skills but this did not transfer into anxiety about using technology. Ann’s use of technology is two-fold. She uses social media to connect with help groups and some individuals and she finds this very supportive without being invasive. She is also studying and uses the Microsoft Suite to produce and edit her work. As Ann also has dyslexia and had recently been diagnosed as being on the autistic spectrum she has found the spell checker and editing facilities to have been really helpful in helping her to organise her work.

For both people the idea, that computers are ambivalent and non-judgemental, made them feel more secure. This is a common finding supported by a range of other research across a number of contexts (Barnett, 1995; Hunt and Weintraub, 1999; Klein, Moon and Picard, 2002; Forde *et al.*, 2013; Repper *et al.*, 2013).

Neither Bill nor Ann have computer anxiety. They have developed a range of strategies to help them to solve problems. Bill explores the internet, forums and chat rooms to find the answers while Ann had a struggle at first. Initially this did create anxiety for her, although not computer anxiety, as she was having to interact with 'stupid people at help desks who were not helpful'. Once she had discovered videos and other avenues to find help this was eased.

This method of having a range of strategies to find help coincides with the findings of the small help-seeking study (Lei Wu, 2010), and is supported by the findings from the questions around 'type of support desired' where those more confident were prepared to try a range of learning strategies.

The way Ann and Bill found help was not usually via asking other people, although Ann did resort to this when getting frustrated.

These conversations underline the finding that computer anxiety is a distinct and separate anxiety (Thorpe and Brosnan, 2007).

Ideas and suggestions for strategies to manage anxiety

Both Bill and Ann have a range of strategies that they use to manage their anxiety and the symptoms. These were similar to those discussed in section 2.6 and ranged from using apps to support controlled breathing to having personal mantras and coping behaviours.

We discussed the degree to which they thought they might be useful for people with computer anxiety and they thought giving people a range of ideas to choose from would work best.

One important issue for them was the idea of control: regaining or maintaining control seemed to be a key element in managing their anxieties.

3.6.3 *Discussions with people who seemed to be suffering from computer anxiety*

These conversations were often spontaneous in the classroom setting and therefore could not be recorded. The first section details a long-term teaching relationship with one student who presented as extremely computer anxious but who is now considering a career in IT. The second section gathers together a range of observations from a career in teaching IT.

Student Alice

Profile: Alice is a student who participated in phase one of the research and agreed to be involved in further research. An undergraduate who had come direct from college, Alice recognised that she had computer anxiety, but was aware that computers would form a large part of her working life so was determined to find some way of managing or diminishing her anxiety. I worked with her in two of her three years with us and met her outside of classes to support her development. The options that Alice chose meant that she worked on website design, programming, database design and e-commerce: applications that go beyond word processing.

Alice (not her real name) confessed that computers really scared her, but she wanted to learn how to 'tame' them. This suggestion of a computer with a personality is symptomatic of an external foci (Bandura, 1994) and wrongful attribution (Rascle *et al.*, 2015). Both of which have been identified as potential markers for computer anxiety.

She did however have a strong motivation for conquering her anxiety as she could see that interacting with technology was going to form a large part of her working life. As was discussed in the literature review, strong motivation is a valuable resource in tackling anxiety and learning new things. This finding is also supported with the finding from the distance learning students who presented with high levels of computer anxiety but persevered in spite of this.

For Alice, there was the need for constant reassurance, the presence of an expert for instant support and the need for a book of instructions. These support strategies are common with those found outlined in section 2.6

Over time, Alice grew in confidence and began to take responsibility for success when interacting with technology. It was clear that she was moving from blaming herself for failure to recognising her own responsibility for success. This is in line with the findings from other research (Phelps and Ellis, 2002)

The student's move to acknowledging her own part in any success was supported with some attributional retraining in the form of teacher comments and questions such as "You worked hard to resolve that problem", "What did you do to solve that?" and "Could you explain to x how you did that?". This suggests that a good quality experience was important in reducing computer anxiety as seen in the literature (Monnickendam, 1993; Sun *et al.*, 2008; Gupta, Bostrom and Anson, 2010; Cowan and Jack, 2011).

She began to extend her range of help-seeking strategies too and this resulted in an increasing independence characterised by comments such as "I was going to ask you, but I found the answer already", "Hey look I worked this out". This positive feedback reinforced her growing confidence utilising the inner voice for good and having the self-fulfilling prophesy work in a positive way (Merton, 1948; Smither and Reilly, 2001; Beckwith, Burnett and Grigoreanu, 2006).

Alice's journey showed that, for her anyway, the encouragement of others, explicit teaching of how to find help, expert modelling and peer support helped to diminish the impact of her computer anxiety.

Ad hoc Observations from the classroom

This section brings together a range of ideas and practice that I have noticed or used in my teaching. As the research progressed I became more aware of the practical implications of my own learning, and when reflecting on teaching sessions was able to make better sense of what I had seen. These are not formal observation sessions, but real-life examples that support my theoretical understanding and research findings.

I do most of my teaching in IT rooms teaching subjects such as programming, website design, database design or e-communications as well as study skills. Students come into the space with a range of body language, some eager, some with a degree of trepidation. This is expected from the data suggesting that possibly 25% of any group will have some level of computer anxiety (Rosen and Weil, 1995a). It is interesting to note that most people had SMART phones and were very comfortable using these. It was only when being asked to solve problems or attempt tasks in specific ways using particular applications that anxiety became obvious, or in the run up to assignment deadlines. This is in line with research that suggests it is the idea of being marked or judged that introduces a level of anxiety (Thorpe and Brosnan, 2007; Cowan, Vigentini and Jack, 2009; Tarafdar, Pullins and Ragu-Nathan, 2015).

Common problems included not seeing buttons, information, or closing down popup windows before reading the content. This behaviour looks similar to those exhibited by people suffering from anxiety caused by information overload and appears to be connected to the narrowing of focus described in anxious people (Matthews, Panganiban and Hudlicka, 2011)

To begin to develop the strategies to present in the final model, a range of techniques were applied in the classroom. The first was to offer support by helping them to notice what was on the screen

When supported, students could suddenly see the information “how could I have missed that”, “I just didn’t see that” and also “oh that’s what that means. I didn’t realise”. This shows that having the right support can relax a student sufficiently to allow them to broaden their outlook and spot what they need. Having had success using this strategy they were then able to look around for on screen help themselves.

Students wanted a range of support similar to those returned from the research above. Some wanted to ask their friends, others wanted the tutor to help. Interestingly often the peers demonstrated their help-seeking strategies and began to teach their colleagues how to find the answers for next time. This behaviour of teaching a strategy to self-support is an important idea.

For many it was the presence of the tutor while they embarked on a new adventure in technology that was enough of a reassurance. This suggests the need for some sort of safety net. Others asked for books or supporting literature, but then seldom used them. This again suggests the need for reassurance and the existence of supporting materials is enough rather than the need to use them.

In my classes, a coaching style is used to support all the students. There is a clear expectation at the beginning that it will be hard, but it can be learnt, and they will succeed.

Evidence of previous success is shared, and this does seem to help. This is in line with the advice given to counter the impacts of maths anxiety as outlined in Blazer's (2011) document for schools. Students found the space to be a safe one where making mistakes was acceptable and this also seemed to reduce the levels of experienced anxiety.

Interestingly those students who did not suffer from computer anxiety found the idea of it quite bizarre until discussions took place and they came to realise that not everyone felt as comfortable as they did. This suggests that a level of education might be helpful for everyone to build understanding and engender a more supportive environment.

3.6.4 *Summary of the qualitative research findings*

From the conversations detailed in this section it can be concluded that computer anxiety is a distinct anxiety that affects different people to different degrees but that this can be changed over time. Support is important as is the repetition of positive experiences to build self-confidence which in turn increases competence and self-efficacy. These factors are key to reducing the level of computer anxiety. Strategies of support can be found in the treatment of other anxiety types as well as by looking of the strategies of the non-computer anxious. It also seems to be significant that those who were not anxious around technology found it very surprising that some people are. Education about this topic may be useful for everyone.

3.7 Summary of the research findings

In this section the findings from all the phases and the qualitative input are gathered together with important commonalities highlighted and conclusions drawn. The key findings are listed and extend beyond those initially expected. There is a brief discussion about how to move the work forward and into the development of an instrument which can categorise and measure computer anxiety type and suggest relevant and useful strategies for mitigation.

There were a number of important discoveries over the course of the data gathering and analysis. These were not limited to those that the work set out to make and are summarised here below grouped by the Phase where the learning was first noted. There is some overall understanding that was developed over the course of the research project supported by wider reading which is summarised here too.

Phase One

While personality, as defined by the Big 5, has some impact on the likelihood of a person suffering from computer anxiety, it is neither strong enough or consistent enough to be used as a predictor or indicator for computer anxiety.

Phase Two

- People who have computer anxiety seem to limit their own options by having a narrow focus and limited help-seeking strategies.
- People who do not have computer anxiety seem to be prepared to try a range of learning strategies.
- Those who have higher levels of computer anxiety seem to want to stick with what they know, even if that strategy has not been very successful in the past.

Phase Three

- There is little to no correlation between the personality of a person and the way in which they think that they prefer to learn.
- Self-fulfilling philosophy, or the approach taken has a significant impact on success – as Henry Ford is famously quoted as saying "Whether you think you can, or you think you can't—you're right.".
- Those with computer anxiety seem to fall at the first hurdle while those without attempt to get over it.

Phase Four

- Computer anxiety is still an issue even in computer related classes
- Those at a higher level of education had lower levels of computer anxiety

Phase Five

- Computer Anxiety is a distinct and separate anxiety
- A range of support is important

From the literature and the research journey overall

- Computer anxiety can be exacerbated by environment as well as by the thoughts of the individual therefore it has the potential to be decreased by changing the environment or the thoughts of the individual, or both.
- Some people have a need to see the big picture and not seeing this can lead to computer anxiety.
- Some people have a need to thoroughly understand the whys and wherefores of each problem in order to tackle it with confidence before even thinking about using technology to help.
- Computer anxiety is a complex condition that cannot be predicted. It has this in common with other anxieties in that they can be identified once they manifest but not until then.

Overall the findings indicate clearly that computer anxiety is still an issue. It is a distinct anxiety that affects a sizeable minority of the population at a fairly consistent level across time. As computer anxiety has an effect on performance (M. J. Brosnan, 1998; Buche, Davis and Vician, 2007; Tarafdar, Tu and Ragu-Nathan, 2010, 2011; Brosnan *et al.*, 2011) it needs to be addressed for the benefit of the student and employers.

These findings, when taken together, clearly suggest the next step. It is clearly not possible to predict who might be going to suffer from computer anxiety in the future or to prevent it as there are a myriad of causes including the mind-set of the individual. Instead the focus needs to be on initially supporting those in the moment of their anxiety and then helping them to develop a range of strategies so that they can help themselves in the future.

There do seem to be some proactive steps that can be taken to create the right environment, try to teach students strategies before they start and ensuring any teaching or training is appropriate for the task. These may reduce the incidence or severity of computer anxiety, but further support needs to be available for those for whom these steps are not enough.

The next chapter will address this issue by showing the development of an instrument that finds out the cause of the computer anxiety, the severity of this and suggests some appropriate support. It culminates in a range of models suitable for employer or tutor, employee or student and primary-aged scholars.

4 Chapter Four: Developing the Instrument

It has become clear from the results of the four phases of data gathering, that prediction is not feasible or useful. What is clear is that computer anxiety is still a problem, that different people have different reasons for being anxious and need different sorts of support. This has led to the idea of an instrument that can aid both the discovery and support of computer anxious individuals. This chapter explains the underpinning of the instrument and how a pilot study and conference presentation helped to hone and develop it to a point where it accurately represented how people felt and suggested strategies that were considered to be useful and appropriate. A further chapter discusses an evaluation of this.

4.1 Introduction

This chapter reiterates the range of reasons why a person might be anxious when working with technology and identifies a way to measure this that identifies the causes of the anxiety as well as the degree to which that cause is impacting on the user. It follows that supporting the user is key, so a range of strategies that seem appropriate to the anxiety are suggested

The development process has been informed by conversations and interviews during teaching, presentations at conference and discussions with suffers as well as looking at the findings from the data gathering phases and the conversations that were held around those moments and a summary of how these informed the development is presented in the first section.

In terms of support, initially considerations from the research phases are discussed with reference to other methods that have been tried, then the strategies that have been employed either in literature or in action are described and evaluated. Next an instrument is developed to encompass these elements. Comments on the pilot instrument are considered and an improved instrument completed. Feedback from conference is discussed and a final instrument is developed.

4.2 Considerations in the development phase

As it became clear from the data gathering, there is a level of complexity around computer anxiety that make it very difficult to predict if an individual is likely to suffer from it and if they do, at what level that anxiety might present, or indeed what the underlying cause or causes might be. Therefore, the focus needs to instead turn to the development of a tool that can give a useful measure of the current situation an individual is in, and, crucially, suggest one or more directions for support.

This approach of seeing where you are now and looking forward is grounded in coaching, where the causes of the problem are seen as less important than the plan for moving to an ideal situation i.e. bringing about change (Garvey, Stokes and Megginson, 2010)

However, the plan for moving forward needs to start somewhere, so some way of describing the type of computer anxiety a person is suffering from is needed. There is no point in moving forward in the understanding of the task if the individual needs first to learn how to manage the interface. This is a different approach to that used in the past which has been to typically measure with just one final score.

Secondly the severity of the anxiety needs to be measured to determine the amount of support that is needed.

Finally, some suggestions for how the anxiety or its causes can be addressed need to be made.

The expectation is that this new instrument would not only normalise the idea that sometimes interacting with technology is an anxiety inducing experience, but would also give people a start-point for a conversation in which they can identify the type of support that would be the most beneficial both in helping them to overcome or manage their anxiety and in completing the task to an appropriate standard.

4.2.1 *Measuring type and severity*

A very common way of discovering the current state of a person for research purposes is to use a self-reporting questionnaire (Powell, 2013). As was discovered in the research phase even those who suffer from computer anxiety are prepared to fill in questionnaires about how they are feeling.

However, it seems that people have moved away from the idea of different types of computer anxiety and instead have focussed on returning one measure to indicate an overall level of anxiety(Heinssen Jr, C. Glass and Knight, 1987; Hudiburg, 1992; Rosen and

Weil, 1992; Marcoulides, Emrich and Marcoulides, 2007) and there seems to be little work around taking this result and doing something with it to support the user.

Having one number to indicate computer anxiety would seem to be problematic when it comes to providing support as the type of anxiety is not identified and therefore appropriate support cannot be matched to the need. For instance: an individual might be very anxious because they find a touch mouse pad too difficult to manage. This requires quite a different type of support than if they have a phobia about technology. Training the phobic person how to use the mouse will probably not help to lower their computer anxiety levels. As has been identified and discussed earlier this may be why training programmes are not universally successful in reducing the levels of computer anxiety.

Kalwar et al. (2012) and (Joiner *et al.*, 2007) had both developed measures for different types of internet anxiety. It would seem to be helpful to have a similar style of questionnaire for different types of computer anxiety. Their ideas for separating the types has been utilised but with questions around computer anxiety rather than internet anxiety.

- Operational – Often represented by phrases such as
    - I do not know how to do something
    - I cannot make this work (Howard, 1986)
- Sociological – Often represented by phrases such as
    - I do not really know why I am being asked to do this in this particular way (Sivakumaran and Lux, 2011)
    - The people around me can do this, why can I not? (as observed)
- Psychological – Often represented by phrases such as
    - I do not want to work with this technology/ piece of software (Weil, Rosen and Wugalter, 1990)
    - Computers hate me (Thorpe and Brosnan, 2007)

When developing an instrument for self-reporting, it is common to have all the questions of the same type, such as using a Likert Scale. This makes it easier for the user to fill in, while having a mix of positive and negative scoring may help to avoid user bias or automatic selection of one option (Denscombe, 2010).

It is sometimes easier for people to identify with a statement rather than answer a question, so the tool was developed with a number of statements with which the user could rank on a scale of strongly agree to strongly disagree. A five-point Likert scale was chosen as having five points allows the user the option of choosing a neutral response and the response does not have to be so finely grained as with a seven-point scale.

The presentation of the questions was prefaced with instructions to think about the last time the participant *had to* engage with a new computer package rather than chose to, as it is unlikely that a person would choose to do something that made them anxious. Often, as discussed in the literature review, people who exhibit computer anxiety at work are happy to play games at home. The removal of choice and the idea that any outcome is measurable by *a n other* are both factors in the level of computer anxiety (Weil, Rosen and Wugalter, 1990) and it is important that we support the moments when anxiety occurs.

Question development

In this section the reasoning that underpins the development of the questions and the questions themselves are presented.

For Operational anxiety, the anxiety occasioned by not knowing how to do something, the questions are exploring how the user manages the interaction. It is also to see if their anxiety is related to new learning rather than specifically their interaction with technology (Thorpe and Brosnan, 2007).

These statements can be gathered under the banner of ‘How do I do things?’

- I have strategies to help me when I am stuck
- I do not get too worried about making mistakes
- I panic when I have to learn something new
- Once I have learnt how to do something I am not worried about using it
- I know how to work the technology I have to use

For the Sociological area the questions are exploring the more general thoughts around the interactions that they may have, how they feel others may judge them and how they judge themselves. These behaviours are not as deeply ingrained as those in the final section.

The statements can be gathered under the banner of “Why do I have to do it like this?”

- I never feel overwhelmed by the number of tasks that I have to do
- I am as good as or better at using my computer than those around me
- Other people see me working and judge my competence as poor
- I do not like trying new things as I can never do them
- I think I am not as quick as others and it worries me

For Psychological Anxiety the questions are wider exploring the emotions of the user and their reactions to technology. These thoughts are held as truths by the user and are deeply engrained in their psyche.

These statements can be gathered under the banner of “What is my thinking about this?”

- I find it an interesting challenge when I do not know what to do
- When I see an error message I find it helpful
- I worry that I will break the computer
- Most of the time, I am happy working with computers
- I think that computers hate me

4.2.2 *The Support*

There are two different aspects of supporting people with computer anxiety (Chou, 2001; Torkzadeh and Van Dyke, 2002; Cowan and Jack, 2011; Ozbiçakçi *et al.*, 2011). One is to look at the problem from the point of view of the output, i.e. how to help the sufferer perform better, while the other focusses on the user and how to make them feel better about any computer interaction by helping them to manage their anxiety (Maurer and Simonson, 1991; Saengratwatchara and Pearson, 2004; Gupta, Bostrom and Anson, 2010).

Bloom (1985) felt that focussing on anxiety management might be helpful as once people became less anxious they might be more inclined to learn (Bloom, 1985). He suggested that education about stress, skills training and space to practice would address the issues, so these could be recommended to teachers and trainers and offered as additional training to those identifying as computer anxious.

Self-efficacy (Bandura, 1994) is also advocated as a way of decreasing anxiety as once a person is confident in what they are doing they should be less anxious about tackling it.

It seems that a range of support that addresses both of these aspects would be the most useful. There is also likely to be some overlap between these two areas so the suggestions to follow will note which aspect they are primarily focussed on.

Increasing Experience

As early as 1990 it was discovered that merely increasing computer experience does not cure people from computer anxiety and can in many cases make it far worse (Weil, Rosen and Wugalter, 1990); a finding that is supported by the later work of McIlroy et al (2001). As Weil's work suggests it is important that early experiences are positive and that sufferers need to be identified and supported as early as possible to help them to move forward. However it was also suggested that supported practice can help to increase confidence (Bloom, 1985).

Computer self-efficacy became a focus in 1998 and the suggestion that helping people develop their confidence with computers would reduce their anxiety was postulated (Marakas, Yi and Johnson, 1998). Further exploration of this topic concluded that it is a reciprocal relationship in that increasing computer anxiety decreases self-efficacy while building confidence in the user reduces their level of computer anxiety (M. J. Brosnan, 1998). This is not just about skill level but also supporting their self-belief.

Building on the work of Bloom (1985) it seems that having a series of structured exercises that increase in complexity might be a helpful way of building confidence and skill level at the same time. This concept of scaffolding to develop skills with support and in small steps is a common practice in the educational sector (Bruner, 1986). If the problem lies in a lack of confidence and a low skill level then this might be a useful approach to take and coupled with some coaching, to help build self-belief, could be even stronger. It has been found that supporting training with coaching helps the training to 'stick' better and be more effective (Taie, 2011) so it could be useful to combine these two techniques.

This type of support could be offered for those suffering from operational anxiety and would help the user to reduce their anxiety by giving them greater control and understanding of their environment. This type of support is primarily focussed on improving the productivity and output of the user. There should be a side effect of helping to reduce the level of anxiety felt, as the cause is being addressed.

Desensitising

By 1993 the research around curing technophobia had moved on very little and the main support suggested was long term and based around developing anxiety management techniques such as desensitisation and relaxation training (Maurer and Simonson, 1991) as advocated back in 1987 by Weil et al. If the problem lies in the psychological area then this might be a useful approach to take. This still seems to be the best way forward (Brosnan and Thorpe, 2006) and needs to be delivered by trained professionals. It should certainly be offered as a support for those presenting with high levels of psychological anxiety akin to phobia.

This type of support is primarily aimed at helping the user to manage their anxiety. It is not addressing the cause, or helping the user to improve their productivity directly although this might be an additional benefit.

Normalising the difficulties of learning

In 1995 Doronina suggested that in Russia the first step is for a tutor to demonstrate to the audience that their own process of learning with all the mistakes, fears and ultimate success is the normal route and so computer anxiety becomes normalised and therefore the impact is neutralised (Doronina, 1995). A tutor who already is anxious may not the be best suited to this role as computer anxiety can be contagious (Weil, Rosen and Wugalter, 1990; Mcilroy *et al.*, 2001). The suggestion is that this works best when shared at a first encounter or class and often by the time students reach university it may be too late for this approach, although it might still be relevant when meeting new software. An alternative strategy is to develop the key skills with the use of software designed for the very young (Doronina, 1995) but again for University students or employees, who are familiar with software on mobile devices, this may not be appropriate although the inclusion of play and fun can be useful in engaging reluctant users (Doronina, 1995).

Another suggestion is that explaining to others helps to assimilate knowledge and understanding. Being supported by someone who had been through the same situation and come out the other end was popular and found to be very useful by the participants on both sides of a conversation so peer support could be a good way forward (Repper *et al.*, 2013;

Anon, 2017). As discussed in research phase 2, this is a highly rated approach and is also included as a popular strategy in the help seeking behaviours (L Wu, 2010).

Using peers to support can normalise the anxiety to some extent as both parties can see that they are not the only people to experience computer anxiety, so this will be included.

Using the questionnaire itself may also help to normalise the anxiety, if people can see that there is a tool to measure the level and there are already solutions in place it might help them to realise that they are not alone and therefore be less anxious.

This type of support is primarily aimed at helping the user to manage their anxiety.

Help-finding

One small scale research project that looked at help-finding techniques found that the number of ways a person looked for help was negatively correlated with computer anxiety (Lei Wu, 2010) so it is important that the help that is on offer is relevant and useful and perhaps looking at developing help-finding training into computer courses would be of benefit. This reduction of help finding mirrors the narrowing of focus experienced by anxious people (Graham, West and Roemer, 2012). It seems therefore to be important to ensure that any help is clearly indicated, easy to find and within the field of focus.

If a user knows that they have improved help-seeking strategies this may give them the confidence that helps to reduce their anxiety as prompt asking for help stops the problem from escalating (Blazer, 2011).

This type of support helps both the user to manage their anxiety and supports better output as the user becomes more efficient at finding the help they need to continue.

Using the strategies employed by non-anxious users

It could be the case that identifying the strategies used by non-anxious users and then training the anxious user to approach problems in these ways could decrease their anxiety level, or at least help them to develop better help-seeking strategies, which may decrease their anxiety level over time.

Discussing this with a number of students over several years, the consensus seems to be that they use a range of strategies although the order of implementation is not consistent.

1. Just try things out, i.e. adopt a trial and error approach.
2. Use the help function within the application.
3. Ask someone else if they have met the problem – this might mean actually asking someone or it might mean using a search engine to see if there is a forum or chat room that has discussed the problem and found a solution.
4. Go to the originators website and see if they have an on-line chat or support staff who could help.
5. Ask the tutor.
6. Think of a different way of addressing the problem.

This sequence of attack can be seen in many humorous approaches to problem solving (Image 3)

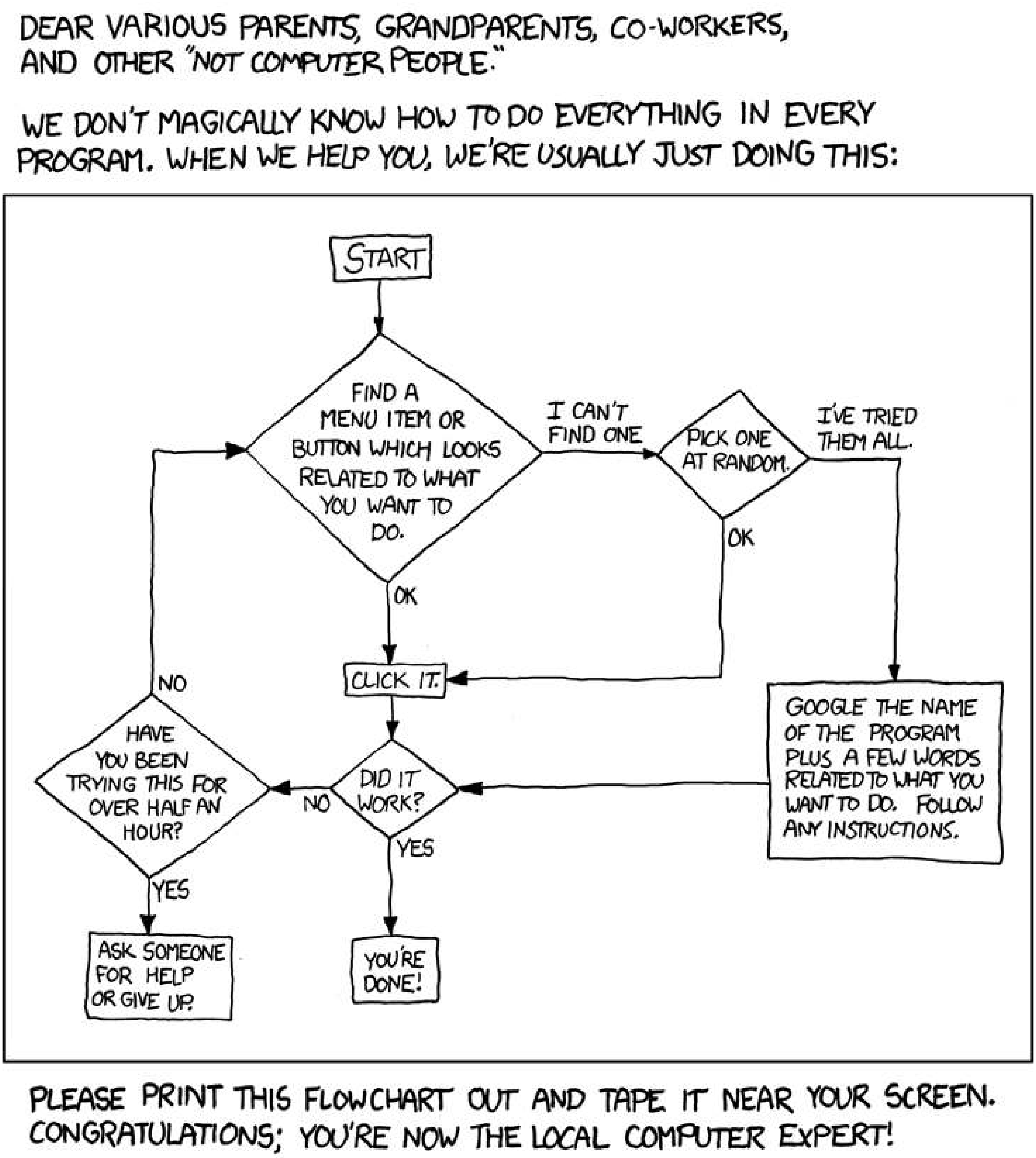


Image 3 Showing common strategies for problem solving application issues. (Anon, 2017b)

In discussions with successful students they told me that they see a problem as a challenge and if a step fails to produce an answer they seem more determined to find a solution. They also suggested that if they cannot find a way to solve the problem in the way that they originally thought they see this as a failing in the application and attempt to solve the problem in another way. This maps to the findings of Phelps and Ellis (2002) who found that those with low computer anxiety had an external focus when they met problems and an internal focus when things were going well while those with high levels of computer anxiety had the opposite thoughts (Phelps and Ellis, 2002). It also maps to those findings that suggest those who are already anxious feel undermined or threatened by error messages (Nettle, 2007) or are unable to fully understand what they mean and request expert help in deciphering them (Chou and Hsiao, 2007).

Sharing these steps with the anxious user may well help them to solve their own problems, thus increasing their self-confidence. It is possible that they may also realise that not everyone knows more than they do, they are just more prepared to look for solutions, and this may also reduce their feelings of incompetence.

This type of support addresses the operational aspect of anxiety, and like help-finding, improved ability in this area will lead to increased output and ultimately to reduced anxiety levels.

Correcting mistaken attributions

As has been seen, people with levels of computer anxiety can flip between blaming themselves for errors but giving the computer the credit when things go well. This is wrongly attributing the source of the outcome.

The work of Phelps and Ellis (2002) suggests that studying attribution theory can challenge and reshape the sufferer's own attitude to their interactions with technology. It may be that incorporating this in computer courses alongside opportunities for reflective engagement can make a significant difference (Phelps and Ellis, 2002).

Looking at attribution theory and having the student apply their learning to themselves would be a long-term solution, helping the student to manage their own anxiety in this area and others.

Training

In this discussion training is taken to mean skills training i.e. training in the use of the equipment or a specific application.

Tarafdar et al (2015) recommend that not only should staff be trained in the use of the applications (how) but they should also be frequently updated and supported to understand why they should use the technology, recognising that just upskilling in the use of technology is not enough to counteract any anxiety felt by the users so this should be kept in mind when developing a specific training course to deal with an individual's anxiety.

There has been a lot of work and research around the benefits of end-user training i.e. training for people who have to use applications rather than those who would be developing them. As this is a significant area of many companies' staff development budgets (Gupta, Bostrom and Huber, 2010) a great deal of effort has been spent to improve the effectiveness of this training (Chou, 2001; Woszczynski, Lazar and Walker, 2003; Saengratwatchara and Pearson, 2004; Gupta, Bostrom and Huber, 2010) although this has not always been effective. Some suggest that this is due to a lack of confidence of the users (Beckwith, Burnett and Grigoreanu, 2006) but the same study also found that for some the lack of confidence (self-efficacy) had no effect on the impact of training. It also seems likely that people who have the same problem require different approaches when they are learning new things (van Doorn, McManus and Yiend, 2012; Beischel, 2013; Doyle and Jacobs, 2013; Dunn and Honigsfeld, 2013; Samarakoon, Fernando and Rodrigo, 2013) . It is this sort of finding that led people towards the ideas of learning styles which have been discussed (Hatami, 2013) and critiqued (Coffield *et al.*, 2004) at length. The thinking now tends towards the idea that people have a learning preference but that this can change depending on the context, the materials and the motivation (Ayersman and Minden, 1995; Salter, Evans and Forney, 2006; Tulbure, 2011; Doyle and Jacobs, 2013; Ganesh and Ratnakar, 2014).

One study, conducted in the early days of computer use in the workplace, found that improving the specific skill of keyboarding had no impact on the level of computer anxiety among the subjects (K. V. Hemby, 1999) so just training in the use of the hardware may not be enough. Other findings suggest that training can be really helpful for people who already have a good attitude towards computers (Torkzadeh and Van Dyke, 2002) but they conclude that careful screening to identify individual needs would be the most helpful way forward as for those who already have a negative attitude training does not always have a positive impact.

It has been found in one case that training in other contexts does not in itself reduce anxiety, but does help the sufferer to deal with it in a less negative way (Clerkin and

Teachman, 2010) and this may be a useful thought to take forward into managing the impact of computer anxiety.

Indeed, it has also been found that forcing people to interact with technology when they feel anxious about it, as happens in the workplace and also as a direct result of the IT approaches used in education, exacerbates the level of computer anxiety (Liu, 2012). This would suggest that making a computer anxious person attend end-user training which does not take this into account may only serve to increase their anxiety levels. There are recommendations that individual differences are taken into account when designing end-user training (Gupta, Bostrom and Huber, 2010) so that, for instance, learning materials are presented in a range of media, and their method of delivery is also varied. This is common practice in many educational settings and is described by the term student-centred learning (O'Neill and Mcmahon, 2005) so it is appropriate to take this approach.

In impromptu discussions with students, who have asked for support, it is clear that they require a range or variety of interventions. Some wish for fellow students to work with them while others require the expert approach and want to work with the tutor. On the other hand, some have asked for a printed manual or book of instructions so that they can learn what to do without necessarily understanding why. This way of working was also noted in the research conducted and discussed in the previous chapter.

The range of requests show that providing support (Sivakumaran and Lux, 2011; Beischel, 2013) in a way that is most suited to the person requesting it is not necessarily going to be easy or even predictable.

Therefore, the instrument will suggest training in a style as preferred by the learner as a mitigation strategy for operational anxiety. In this case, training is taken to mean supported learning. Although training can sometimes be instructional and directive, which does not sit well with the coaching approach, it is a term that is easily understood. There may be some need of coaching at the high end of anxiety at this level in order to help the sufferer to be receptive to the training. To support this, the instrument will suggest coaching to support the training at the high end of the scale. In this way both the skills are being developed and the participant helped to think about problems they may face in a more positive way which should lead in turn to reduced anxiety levels.

Education

Training people about anxiety management and helping them understand what is going on when they are anxious can help them to feel more in control and as a result reduces anxiety (Roemer and Orsillo, 2002)

As with attribution theory(section 2.2.3), knowing about something can help people feel more in control, so knowing about the biology of anxiety, and the reasons for it can help some people to reduce the levels of it.

This type of support would be a long-term solution that could also benefit the user in many other areas of their life and would be primarily focussed on helping them to manage their anxiety.

Coaching

Coaching has often been used as a way of improving performance (Thomas and Saslow, 2007; Taie, 2011) or helping individuals face and resolve a particular problem or issue. For someone suffering with computer anxiety, being able to talk about the problem in a non-judgemental setting and set about resolving the issues could be empowering and it may only require one or two conversations to help the individual move on. Other situations might require more support as the coach helps the individual develop strategies to cope with their anxiety.

It would seem to be helpful for people to be able to see that they are not alone in facing this issue, that there is help to move forward and that people can reduce the level of anxiety that they experience when facing technology. Taking the judgement out of the equation would seem to go some way towards reducing the anxiety around it. Especially as there are indications that having judgement increases computer anxiety whether the judgement is around outcome (Weil, Rosen and Wugalter, 1990) or self-worth (Parayitam *et al.*, 2010)

There is also an aspect of anxiety in this area that is around purpose. Often if people cannot see the point of doing something in a particular way they are not motivated to deal with problems that arise and there are complex and conflicting emotions (Sivakumaran and Lux, 2011). Being able to explore and understand where the work fits into the big picture allows learning to be transferred to new situations (Gupta, Bostrom and Huber, 2010) and helps the user feel in control. Careful questioning and supported exploration can help the user to construct their own understanding if they are unable to ask others.

Coaching could be used both to support the development of anxiety management strategies and to help to increase performance by helping to develop help-finding strategies or other techniques.

Professional help

If an individual is so paralysed by anxiety that they cannot function or use the available tools to do their job, then they need a professional mental health practitioner to support them. Continuing high levels of stress and anxiety can be a threat to mental and physical wellbeing and should be addressed as soon as possible to protect the individual. It seems unlikely that someone who experiences a high level of anxiety when interacting with technology has not been identified and supported already, but it would seem to be important to have a safety net to catch them in case they have been struggling without realising that this is an issue.

While coaching can probably be of assistance at the lower end of the scale in terms of helping the user to develop strategies for managing their anxiety responses, the instrument will suggest that professional help is sought for those who present in the high levels of Psychological Anxiety.

4.2.3 *Summary*

It is likely that there will be some overlap of mitigation strategies as it seems likely that one type of anxiety can cause or lead to another. For instance, if someone is constantly having to use trial and error because they are not sure how to use a piece of software this can lead to a feeling of dread about approaching the task which can spread to affect all interactions and lead from an operational anxiety to a wider sociological one. It is obviously better for all parties if anxiety is caught at the lowest level and mitigated before it can develop into a major problem, so the suggestion is that this instrument is presented to people early in their career or educational journey.

The strategies that support output will be more useful in supporting operational anxiety while those that support the user to manage their anxiety will be more useful for those with psychological anxiety. Sociological anxiety will be a combination of the two.

4.3 Concept and first draft

The questionnaire will be at the start of the instrument. The questions relating to the different types of computer anxiety will not be grouped together but scattered through the list. It needs to be brief so that people will fill it in carefully (Denscombe, 2010) but have enough questions to get a clear view of the situation. As discussed above there will be five questions for each type of anxiety and they will be presented in a mixture of positive and negative statements for the user to agree or disagree with.

Once the participant has selected their responses these will need to be collected together so that they select the most appropriate support for themselves. For this instrument the use of a grid with sections within which the user would find ideas for the sort of support they could seek (Table 47) is suggested.

Severity	Operational	Sociological	Psychological
HIGH	Individual tuition in the area of concern tailored to learning needs	Developing strategies for identifying and then managing anxiety so that understanding of the task can be improved	Referred to a professional psychologist for support
MEDIUM	Seeking of additional support via a group tutorial or training session and training manuals in a range of media	Coaching in strategies for exploring motivation and beginning to manage anxiety	Coaching to develop a range of anxiety management strategies and exploration of the causes of the anxiety with a view to addressing these
LOW	Use of peers and/or resources on the internet to support understanding when required	Discussion with tutor/ manager for explanation about the rationale behind the task	Discussion with tutor/ manager about your concerns and support from a coach
	OPERATIONAL	SOCIOLOGICAL	PSYCHOLOGICAL

Table 47 First draft of a feedback grid for the questionnaire

The questionnaire was assembled and shared with a colleague. They commented that the scoring was unclear. As some of the questions are reverse scored it is a challenge to present a clear scoring strategy. Table 48 below shows the first attempt at presenting this

Fill in your responses below. For questions that are red please subtract your response from 6, e.g. I answered Q 11 with 4 so in the score I would record 2 as this is 6-4.
Add up the score for each column.

Operational anxiety		Sociological anxiety		Psychological anxiety	
Question	Score	Question	Score	Question	Score
2		4		1	
6		7		3	
10		8		5	
11		9		14	
13		12		15	
Total					

Table 48 Scoring table

Once this was explained the colleague filled in their scores and found the results to be appropriate for their situation and reflected how they felt.

The solutions suggested were also considered to be the sorts of things that they would find useful.

4.4 Presentation at conference

In order to gain further comment for the instrument it was first improved based on the comments of the pilot test, and then presented at 2017 York St John Talk about Teaching conference in a workshop with 20 attendees. The concept of computer anxiety was briefly explained and then the instrument shared. Attendees filled in the questionnaire. Following the feedback from the first draft the phrase “6 – your score” was included in the score box for those questions that are reverse-scored and this seemed to help with understanding. Everyone was able to complete the scoring without help and were able to position themselves on the grid. Interestingly even though the concept had been presented with the aim to normalise any level of computer anxiety people were still very keen to explain that really, they were in the lowest category. There are two possibilities for this. On one hand this reaction could suggest that people still feel a stigma attached to the idea that they might be somehow different from everyone else and were anxious to explain away the high outcome. Alternative analysis suggests that it is more likely that there was a poorly worded question that caused a higher score than expected and therefore the results did not represent where people saw themselves.

4.4.1 *The questions*

Overall the statements were deemed to be appropriate and sensible although there were comments and discussions around a few specific statements which are detailed below

Statement 9

"I never feel overwhelmed by the number of tasks I have to do"

Even though the guidelines at the top suggest that the participant thinks about the last time they had to use an application, this statement distracted people from that aspect and they felt it covered all aspects of their work. One comment illustrates this point clearly.

"I often feel overwhelmed, but it has nothing to do with using a computer"

There were some suggestions for a replacement question:

- The amount of information on the screen can overwhelm me or be confusing
- The number of steps to complete the task can be overwhelming

Statement 10

"I know how to work the technology I have to use"

The suggestion from the floor was that people might know a way, but not the best way, or be aware of the full capability of the particular piece of software they were using. After some debate within the group, it was agreed that if a person knows a way that works for them it might be enough to alleviate their anxiety even if it is not the most efficient. Comments included:

"When people try to tell me new things. I say, 'Don't say that, I've just got the hang of doing it like this'",

"I like doing things my way",

"I've got my own way of working".

On the other hand, some people like becoming more efficient:

"I love it when someone shows me a shortcut".

It would seem from these comments that introducing some people to a new technique might be enough to reawaken or even cause anxiety while for others it might be seen as an opportunity to learn more. This fits with the findings around the usefulness of help messages for different groups (Beckwith, Burnett and Grigoreanu 2006). Ultimately it was agreed that this was a useful question to include.

The other questions drew no comment other than that they seemed to be appropriate and the outcomes did marry up with people's self-views.

4.4.2 *The support suggestions*

There was a debate about the order of help suggested with some people feeling that asking for help was not an appropriate first step.

"I would always look in a book or on the internet before I asked someone to help me"

"It seems a bit needy to ask someone for help until you've looked yourself"

But others disagreed:

"It's really easy to just quickly say…."

One of the factors seemed to be the office environment: those working in lone offices wanted to look things up first as it seemed a big issue to get up and interrupt someone else to ask a quick question, while for those in shared spaces it seemed more natural to just ask.

This is interesting and reinforces the complexity of the issue of computer anxiety and the support mechanisms.

There was a discussion about the purpose of the support and the idea that people who did not suffer from computer anxiety often had good strategies for finding help or information when they needed it surfaced and this caused some interest. There was a suggestion about reworking the questions to present the participant with these useful strategies:

"I try a few different things to see if they are the solution" and

“I often look on the internet for help when I do not know what to do next.”

There was discussion about the mixture of positive and negatively scored questions and debate about how people who are already anxious would feel about having to respond in the negative to all the suggestions. Having to disagree all the time could be demoralising and increase the level of anxiety, or alternatively agreeing with a range of negatively focussed statements could introduce new anxiety inducing ideas. This discussion then moved to perhaps presenting the questionnaire in a way that included teaching. This style of questionnaire incorporates supporting strategies as the questions e.g. I always look on the internet for additional help if I am stuck. While this might be helpful in presenting a range of working it could be demoralising for the participant if they answer ‘no’ to all the questions so the group dismissed this approach. They did favour the idea of a list of strategies if supplied as a support mechanism within the instrument.

4.4.3 *Area headings*

The different aspects of computer anxiety grouped under the headings of operational, psychological and sociological caused some confusion.

When these were re-explained as How to do things, Why do things, and one’s reaction to technology this seemed to be more meaningful to people.

“Oh I get it now! That makes a lot of sense actually”

There had been explanations under the different sections in a development version but these were taken out to improve the layout and look of the grid. This level of explanation is obviously useful so in the next draft clearer headings will be used instead, combining clearer explanations with a tidier layout

4.4.4 *Summary of conference comments*

The topic was of interest to the group who were predominantly involved in education at some level. They were surprised that this was still an issue but were prepared to accept that it might be so. There were some useful and interesting suggestions around support and the phrasing of some of the statements which will inform the next version. It was also good to get some feedback on the look and layout of the feedback section of the instrument as well as the content.

The idea that the instrument could be used by employees to ask for support was more appealing to this group than the idea of using it in a learning environment as they thought it was more relevant for older people.

4.5 Summary of developing the instrument

The idea that computer anxiety was still an issue was found to be controversial but after discussion people were prepared to accept that this is a real issue today. Once this issue was accepted there was agreement that it should be addressed. All participants agreed that having something that explains, measures and supports is a useful way forward.

This instrument was seen to address that requirement by individuals and the workshop group with some suggestions for improving it. They agreed that there were different causes and types of anxiety and agreed that the measures captured how they felt about their own interactions with technology.

The improved instrument now needed to be evaluated with a new group of participants and their comments are discussed in the next chapter. The final instrument can be seen in appendices 6,7 and 8.

5 Chapter Five: Evaluation

In this chapter the evaluation of the instrument by a group of students is presented. The reasons for using this particular group are explained followed by a discussion illustrated with quotes from the participants. The chapter concludes with a summary and ideas for further work.

5.1 The Evaluation Group

As some research identified good early experience as a key factor in reducing the level of computer anxiety (Cowan and Jack, 2011), and in other research that computer anxiety was contagious (Weil, Rosen and Wugalter, 1990; Mcilroy et al., 2001) it can be inferred that teachers are an important element in the make-up of an individual's computer anxiety level. Because of this student or trainee teachers and their levels of computer anxiety have been of continuing interest over a period of time (Rosen and Weil, 1995b; Bradley and Russell, 1997; Olatoye, 2009; Shah, Hassan and Embi, 2012). Having a group of student teachers engaged in an evaluation of the model would address a number of issues.

In the first instance, these students would not have been involved in any of the previous research around computer anxiety, so they could evaluate the information given to explain the condition and its impacts. Secondly, they could see if the questions and scoring were appropriate for where they thought their own levels of anxiety were and finally, they could review the strategies to see if they were appropriate and feasible for them to access.

As student teachers are also interested in their learners there was an additional, and unexpected evaluation as they considered using the model in their own classrooms to assess the needs of their own pupils.

The student teacher group was self-selecting and consisted of 20 mixed gender and age students. These students had taken the advantage of a free teaching session around addressing the computing science element of the National Curriculum, either because they were anxious themselves, or because they were interested in the topic. The session was scheduled at the end of the day when all the student teachers had been on placement and were returning to teach the following day.

Their participation in the evaluation was voluntary and the participants understood that there were no implications on their choice to participate. All responses were anonymous and although there was some discussion with individuals, their names were not shared.

The evaluations are gathered into two sections. The first covers the evaluations of the instrument as applied to them as learners. The second section discusses their comments in relation to applying the instrument to their own classes.

5.1.1 *For themselves*

In this section the participants were first asked to review the contextual information so that they understood what the instrument was looking to measure and to check that the instructions were clear. Then they were to score themselves to see if the result placed them in a place that they recognised. Finally, they were to review the corresponding strategies to see if they considered them to be useful and appropriate. There were also some unsolicited comments about the value of the process.

The instructions

There were few comments about the contextualisation other than an initial incredulity that computer anxiety was a thing. Although this was refuted with some passion by others.

“is that even a thing?”

“I get really worried, and my mum can’t look at a computer!”

“I just want to get it right, and sometimes I can’t and that makes me stressed”

The instructions seemed to be clear enough for the first part as they began to record their responses to the statements. However, they were not quite so clear for the scoring section and this caused some confusion. These needed to be improved.

The questions

The group looked at the questions before answering them. Some found the questions gave them pause for thought:

“I think the questions are interesting”

While another felt that the moment of self-reflection was useful and helped them to consider their approach to computing:

“Useful to think about how I feel towards computers”

Another commented that answering the questions helped them to see that they had got better at using computers even though they had remembered feelings of anxiety when a pupil at secondary school:

[I remember] “feeling inadequate at school not knowing how to do something”

This comment underlines the importance of supporting those who get anxious when they have operational computer anxiety. It also confirms the idea that, for this person anyway, computer anxiety was a state that changed with good experiences and practice to improve self-efficacy.

Overall there was agreement that the questions were appropriate and explored a range of feelings and thoughts about the participants' reactions to computers. They were clear and easy to understand with no ambiguity in meaning. The wording and order of the questions has been found to be suitable for the intended audience.

The scores

Once the questions were answered the scores were calculated. This caused a degree of difficulty and overall the feeling was that it was a bit complicated to calculate the final score:

> “I didn’t realise that you had to minus some scores”
>
> “Slightly complex table”

One person commented that they thought the Likert scale was in the wrong order and should have started with “strongly disagree” rather than “strongly agree”. They were alone in making this mistake but contested that it was the norm to present the scale in the other order. Literature and experience seems to suggest that there is not a norm (I Elaine and Seaman, 2007) so this comment will not be acted upon. This person had scored as quite anxious initially which they explained was caused by reading the scale in the wrong way. There were upset at being so categorised; a reaction that is interesting to note and one that might manifest among the truly computer anxious too. Given that emotional stability lists 'not getting upset' as one of it characteristics (John and Srivastave, 1999) and some work indicates that emotional stability is negatively related to computer anxiety (Korukonda, 2005) this should be highlighted as a potential issue in the guidance around the instrument. Other than this exception the whole group found that the scores reflected their ability:

> "The overall scores seemed to reflect my opinion and ability"
>
> "The overall scores matched how I feel about computing"
>
> "I was plotted correctly on the grid"

Overall the scores reflected the position of people and were deemed to be appropriate at identifying the type and severity of computer anxiety for individuals. This suggests that while the process is complex, the outcome is correct. The scoring and calculating system requires review or clearer instructions to make it easier to complete and understand.

The strategies

The suggested strategies were reviewed. As most of the group scored in the low to medium levels for all categories they looked at all the suggestions after having considered the ones for themselves.

For one person they were particularly helpful:

"I now know what I can do to improve my subject knowledge"

And for another they felt that it gave them permission to ask:

"When I am doing something knew (sic) I should always ask for help"

While others felt that the suggestions were appropriate although they did not need to use them:

"Suggestions are what I would do"

"the support suggestions are valid for what I would do"

As many of these participants had low to no computer anxiety it could be inferred that they already have good strategies for problem solving and finding support when they need it. As they did not find anything novel or unusual in the support suggestions, this implies that they are in line with their own and therefore are useful strategies to suggest.

"I will seek support when the need arises"

"I would instinctively use the suggestions as I am the kind of person to ask"

"I think I would always ask around the topic or ask an expert"

Although for one who, it appears, scored a little higher than the others, the suggestion of seeking coaching to deal with their anxiety seemed a bit too much

"Suggestions mostly accurate appart(sic) from Anxiety Coaching – extreme for my level."

But they did concede that it "Could be useful"

It may be that re-terming or further explaining coaching might be needed here.

Overall the strategies were deemed to be appropriate, realistic and fell in line with the strategies employed by non-anxious individuals.

Summary

The group found the instrument to accurately measure how they felt when interacting with technology. They thought the strategies were useful and aligned with their own approaches when they were learning something new or using something that was difficult. Using the instrument had made some of them reflect on their own feelings and think about using different strategies when they next encountered a problem. For this group, although they mostly presented with low levels of computer anxiety, there was still value in completing the exercise as it raised the idea of computer anxiety in their minds and caused them to reflect on their own approaches to technology.

It seems that they found the concept and instrument to be of some significance because there followed some discussion about how they could use this in their own classrooms to better understand the learning needs of their own students.

5.1.2 *Using the instrument as a teacher*

Some of the group felt that overall the instrument could be a useful addition to build their understanding of the individuals in their class:

"an adaptation would be good for analysing confidence"

“Helpful”

“I think it would be a helpful tool to use in the classroom as I would then know which children need support in what areas”

Not everyone agreed:

“I’m not sure that I would use the questionnaire with the children”

“Not sure this is relevant for very young children”

The group was mixed across the key stages with the majority being Foundation and Key stage 1 teachers. It was the key stage 2 teachers who were more able to see the benefit and application for their classes.

The suggestions made both about the questions and the scoring indicated that making an adaptation suitable for Primary School age children would be useful.

The questions

They were clear that the instrument in this format was not quite right for instant use in the classroom:

“I’m not sure they would understand the questions”

“I think this would be too complex to use in a primary school”

The possibility of a simpler version for use with younger children using emoji rather than numeric scores coupled with simpler questions was suggested. This would enable teachers of these early learners to support and enable their pupils appropriately.

The strategies

Overall the group felt that the strategies were sensible ideas that they could incorporate in their teaching environments as a matter of course. The thinking was that this would be conducive to creating the sort of supportive environment that they strove for and would pre-empt any potential problems. This was one of the aims of sharing the work with this group so it was interesting to hear their thoughts on this.

The ideas suggested drew the following comments

“Good for showing the children how to solve a problem”

"…a strategy to get children to ask for help when they need it, especially children with low ability"

"I would feel more comfortable following the suggested strategy when teaching"

"get children to problem solve, build resilience and have a growth mindset"

"more opportunities for children to experiment with their own knowledge"

These comments suggest that the pro-active suggestions are appropriate, easily understood and feasible to implement in a teaching environment, and that these teachers thought that they would be useful.

5.1.3 *Further work: A new instrument*

As a result of this feedback an alternative version of the instrument has been developed with the questions adapted in language to make them easier to understand. All the statements are positively scored to make it easier for the teacher to analyse. The grid has been amended to reflect the new scoring system, and the solutions adapted to be appropriate for the primary classroom. It may well be that this simpler idea also works well for adults as the scoring system was complex in the original version. Further work is needed to evaluate this version with children and perhaps adults too. See appendix 8 for this adaptation.

5.1.4 *Summary*

There are three main positive outcomes from this evaluation:

The concept of computer anxiety is considered to be a valid one that requires attention

The instrument as presented measures and reflects the situation of the individual accurately.

The strategies presented are feasible and in line with the strategies employed by successful users of technology.

One evaluation to reflect upon is that around the act of calculating the score which seems overly complex.

Reviewing the scoring system should be considered, perhaps changing all the questions to be positively scored to reduce the complexity.

An unexpected outcome of this evaluation exercise was the idea of using the instrument in the primary classroom. The summary of thoughts in this area suggest that for use in primary schools the instrument needs to be easier to understand and fill in. The strategies too, may need amending as it is not appropriate for instance to direct very young children to use search engines to find solutions without the support of an adult.

Including these adaptations would make the instrument easier to use and enable all the key stages to use the instrument as its value has been recognised by this group and making it more accessible would open this up to the wider community.

This section explored the evaluative comments made by a group of trainee teachers as they used and discussed the instrument. They concluded that computer anxiety was something that should be supported both for themselves and also in their classrooms for their own students. They felt the measure was accurate and a good reflection of their own position so would be useful in other contexts. Having a range of supporting strategies was considered useful and made them consider changes they could make to their own teaching environments. As an additional benefit these student teachers are more aware of the potential of their students to feel anxious and are less likely to make assumptions about their attitudes to the technology in the classroom. In the next chapter the background, current research and final instruments are presented to provide a conclusion to the work. A further chapter identifies limitations and further work.

6 Chapter Six: Conclusion

The evaluation chapter highlighted some of the key ideas of this work. This chapter draws together those key ideas with the range of findings, the evaluative comments, the implications of those findings and comments and directions for further work. It firstly summarises the discussion around computer anxiety, its definition, the possible causes and the impacts of the condition. The support available is summarised as a pre-cursor to the presentation of the final versions of the instrument which were created to both identify and support people who are dealing with computer anxiety at different levels of education as well as employment. The conclusion leads to the next chapter that looks at the limitations of the work and suggestions for further work are made to address these there.

6.1 Computer anxiety

Computer anxiety is a specific anxiety that is occasioned by interactions with technology for some people. It manifests, as many other anxieties, in a range of ways depending upon severity. At the low end it may be feelings of slight discomfort that are fleeting, through physical symptoms such as increased heart rate, sweaty palms and then on up to complete phobic reactions to the mention of technology. This anxiety may be transient and easily resolved with appropriate interventions, but it can be more severe leading to stress and illness for some people. For others, they manage their anxiety by avoiding the stressor thus limiting their choices and options in a computer saturated world. Medium to high range levels of computer anxiety in the general population has been at around 25% for many years even though the types and proliferation of technology has changed over time. This finding is supported with my own research finding a similar level of computer anxiety among the first-year students of a small university and in early classes within a larger university.

6.2 The implications

When people have an anxiety, a common strategy is to avoid the thing that causes the anxiety. For those with math anxiety, avoiding situations where maths is required is a common response. It is the same for those with computer anxiety. In the workplace, this approach can lead to mistakes, poor performance or low quality of output. For some businesses, this can prove to be an expensive problem that should be addressed. In university, if using the search engine in the library makes a student anxious then they will either not use it or curtail the time spent with it. The impact of this on their studies can be very detrimental: if they do not access the reading then their thoughts will not be as well informed as those that do; if they do not revisit and edit their work it will not be as polished or refined as others in their class and so on. This was found to be the case with the students who engaged with discussion around the issue. They seldom proof read their work but still seemed to spend more time working on it. Often things like formatting took up more time than it should and by avoiding use of reference management software meant that more time was needed to type and check citations and references. This led to mistakes and potential lowering of grades.

For those with computer anxiety, the efforts required to be successful and continue the engagement with technology are exhausting and over time can lead to stress levels that are unmanageable. This in turn can lead to illness and time off work or for those studying, can even cause a student to drop out of their course. In the workplace, this level of stress which leads to illness can end up being very expensive.

6.3 Brief discussion around the findings

From initial, uninformed, observations of students it was clear that there were some people who struggled to enjoy the interactions with technology. Research showed that this had been an issue since computers came into the sphere of the general populous.

As Howard (1986) discovered, interactions with technology were problematic for some people. There was some hope that as technology became more pervasive that this anxiety related to computers would decrease. This was not found to be the case even though computers became an important part of people's work= (Heinssen Jr, C. Glass and Knight, 1987; Weil and Rosen, 1995). As the technology became more accessible it began spreading into homes, became a vital tool for entertainment and with the advent of SMART phones, a seemingly essential piece of equipment. There was a flurry of thinking that this might change how people thought (Prensky, 2001a) but this was found not to be the case (Brown and Czerniewicz, 2010), although the myth of it still persists. Computers and technology are seen as imperative in peoples' work and home lives and in spite of this proliferation of technology, anxiety around computer use is still very much in evidence with research across the globe finding that it crosses cultural and age boundaries

My own research found that it was certainly still an issue within the Business School students with around 25% of them expressing that they had some anxiety around working with the technology (hardware and software) that they had to use to access their learning and produce their assignments. This anxiety was not confined to students at a small university on a non-technical course. Students at a larger institution studying computer courses were found, through this research, with levels of computer anxiety that were in the medium level. This surprising finding suggests that moments of computer anxiety are still evident even in those who choose to work with technology. It is evident that being aware of strategies to mitigate this would be useful for everyone.

6.4 The causes

Why some people have computer anxiety and others do not is not possible to explain. Just as some people will have math anxiety and others will not.

Over the course of this research it has become clear that computer anxiety cannot be predicted due to the complexity of causes, the individual differences of the users and the myriad of contexts those users find themselves in. It has this in common with many of the conditions within the anxiety family. Personality has a part to play (Elizabeth R Towell and Lauer, 2001; Korukonda, 2005, 2007; Wilt, Oehlberg and Revelle, 2011) but it is clear that it is not the full story (Maurer, 1994; Chua, Chen and Wong, 1999; Chou, 2003). Gender does not seem to be a factor per se but the different ways people react to challenge does seem to be related to gender (Venkatesh and Morris, 2000; Tong and Klecun, 2004; He and Freeman, 2010; Ursavaş and Teo, 2011; Joiner *et al.*, 2012b; Hill *et al.*, 2016) and this in turn may impact upon the level of computer anxiety. These findings and thoughts of others have been borne out by the findings of this research. With no consistent correlations between the different factors explored it is evident that just as not every person born since 1992 can be considered to be a digital native, not every person who has a specific profile can be sure of suffering from computer anxiety.

What seems to be important is the quality of prior experience (Rosen and Weil, 1995b; Doyle, Stamouli and Huggard, 2005; Cowan, Vigentini and Jack, 2009; Graham, West and Roemer, 2012). Poor early experiences can lead to a level of computer anxiety among those people who might be susceptible but is by no means a universal impact and can be overwritten for some by later positive experiences. What has been seen by this research is that the type of learning support does not seem to have an impact on later levels of computer anxiety, so it could be inferred that context, and in fact the personality of the teacher might have had a larger impact, but this is hard to measure. It has been found that computer anxiety is contagious, so it may be that the reverse is true and a confident teacher inspires confidence in their class. This idea is supported by the finding that peer support was found to be very popular and highly rated by the participants in this research.

As has been found, two people with the same personality make up, the same experiences and the same background can respond differently to similar situations (Beckwith and Burnett, 2004). People are different and unpredictable, so it is rash to assume otherwise. To address this, the instrument presents a range of strategies. It was evident from the focus groups that people have different ideas about how they rank types of support. For some asking a friend was more likely to be their first step followed by looking at external sources such as a book, while for others looking at external sources was the preferred first step. Some of the causes for this were to do with context such as shared learning spaces, but it might also be related to how people like to learn new things.

Looking at how people were taught, and how they would prefer to be taught showed some interesting differences between those with higher computer anxiety and those with low levels (Chapter 3). Those with low levels looked to explore a range of different ways of learning while those with higher levels seemed to want to stay with the learning they had experienced in the past. This self-limiting behaviour seems similar to the ways anxious people limit the ways that they seek help (L Wu, 2010) and also relates to the narrowing of focus seen in the anxious (Matthews, Deary and Whiteman, 2003). It seems that there would be value in helping those with high levels of anxiety to develop a wider range of strategies and develop their help-seeking techniques so that going forward while the levels of anxiety may not reduce, they might be resolved more quickly.

Having a good quality of experience has a part to play in mitigation too, in that a number of good quality experiences can help a user feel less anxious (Bradley and Russell, 1997). This is supported by the conversations with Alice. As she succeeded at tasks her confidence grew and moments of anxiety reduced. This might also be why, for students higher up the education ladder, the levels of computer anxiety were lower. Learning about technology rarely follows the common pedagogical practice of scaffolding. i.e. starting simple and slowly moving to the more complex, but tends to favour exploratory learning. Although exploration is a fine approach for the confident users, it can be quite disconcerting for those with computer anxiety and a range of approaches should be on offer in order to facilitate a good experience for all. It is not just the applications that can cause anxiety though.

For some people computer anxiety is caused because they do not know or cannot work out how to use the equipment. Howard (1984) classified this as operational anxiety. If people are already lacking in self-confidence they may not be willing to explore new equipment (Lei Wu, 2010) and this leaves them feeling frustrated and foolish. With so many different ways to engage with technology the user can become confused, wondering if it is a touch screen, needs a mouse or has a touch pad and even what gestures to use in order to achieve what they want to do. The two main operating systems (Apple and Windows) have slightly different approaches and these subtle differences can be more frustrating than the obvious ones.

The software too can cause computer anxiety. So many tasks are supported by applications and specific packages that there is a lot to learn and understand. If, for example, someone is unaware of the swipe gesture on a touch screen there are many applications that just do not work. The frustration caused can lead to anxiety really quickly (Bessière *et al.*, 2006). Having on screen help did not seem to be as useful as having a live demo that learners could work along with. A common request that is heard is “please, just show me”. This research found that people really wanted to know how to use the equipment before learning how to complete the task.

For others, the cause is the task itself. This has been classified as sociological anxiety (Howard, 1986), or as it is explained in the instrument ‘The Why Anxiety’. People with this type of anxiety often ask why questions such as: “why does it do that?”, “why do I have to do it like this?”, “why am I doing this?” and “why can I not do this when other people can?” This research found that even competent users want to have the answers to this question. For Mac users Windows seems unwieldy and they want to know why they have to use it, for others who are familiar with specific versions of software the question is around the need for change. These transient moments of computer anxiety can be mitigated with explanations in the moment as suggested in the instrument, but could be avoided by starting any interaction with explanations and contextualisation. This is not the complete answer though.

People are different, some need to know where their task fits into the big picture, why they are being asked to complete it in a specific way and even how to complete the task outside of the environment in which they are being asked to work. The anxiety seems to be increased when they see others being able to work successfully without problems and begin to question their own competence and ability beyond the task. Coaching in the moment could address this issue to some extent, and reassurance and confidence building is an important part of any teaching session. The instrument includes this learning in the support of those with computer anxiety.

The final type of computer anxiety is classed as psychological anxiety (Howard, 1986) which is caused by how the user sees themselves. Often the user will describe themselves as useless with computers. They have a narrow focus and often miss the help that appears on the screen and find every error to be threatening. For these people, the cause may be rooted in the other two types, but often even if these are addressed, this level of anxiety remains. It fits in with the ideas that prejudice is often self-perpetuating (Snyder, 1981), and the self-fulfilling prophecy (Merton, 1948). People who have anxiety caused by this can be recognised by statements like: “I can never do this” and “I’m hopeless with computers”. It is clear that this type of response needs to be addressed over a longer timescale, that minds need to be changed, and new ways of thinking introduced. Coaching is a useful approach to take in this situation, both short in-the-moment responses in a teaching setting, and a longer-term sequence of sessions addressing the deeper concerns. These approaches are put forward as suggestions in the instrument.

Computer Anxiety is a complex condition and its various and often interwoven causes can be tricky to address but some of the suggestions above can be extended and presented together to produce help and support that is both appropriate and useful.

6.5 The help

For many businesses, the solution for dealing with underperforming staff is to send them on a training course. While this may work for those with operational anxiety, teaching them how to do the task, it does nothing for those suffering from psychological or sociological anxiety and may even make things worse. As was discussed in the literature review, any one intervention did not seem to address the problems for everyone.

It is obvious therefore that identifying the type of computer anxiety a person has and then providing appropriate support is the way forward. However, like other sorts of anxiety, those who suffer from it may be embarrassed to admit there is a problem as they might see themselves as somehow different and inferior to others. Part of the solution, therefore, needs to include some sort of normalisation: making it all right for people to admit to having an issue, and guiding them towards appropriate and meaningful help.

Often reframing can be useful. Phrases such as: 'it is not that you need help, but if you want to make it easier to do the job there are a range of techniques available' have been seen to work in the classroom and surrounding any offer of support in this way could make it more acceptable. Alternatively, representing the support as a range of strategies for alternative ways of working might be more acceptable to some people.

This research found that different people liked to have their help delivered in different ways. Everyone is an individual who likes to learn in a particular way, which is where the myth of learning styles came from. It may be, that for those who suffer from a high level of computer anxiety, their way of learning could benefit from being challenged and changed as it seems not to have been too successful in the past. Presenting supporting materials in a range of ways, and identifying successful strategies, allows those with computer anxiety a level of choice and control which in itself may help reduce the anxiety as suggested by the interviewees in chapter 3.

Seeing the range of approaches used by those who are not anxious can suggest ways of working not previously considered, so it is useful to have a mixture of ideas available. In the instrument, therefore, there is a brief overview of a number of ideas and this is supported with an additional document which gives further explanation and also gives the reader permission to mix and match the strategies to their own needs.

6.6 The instrument

There are several versions of the instrument presented in appendices 6,7 and 8.

Version 1 presents the instrument for use by students and employees. Here the focus is on directing the person towards relevant and appropriate support and giving them the questions to ask of their tutor or employer in order to get the support that they need. The main aim of this version is to help the sufferer feel that they are not alone, and to show them that they can get help to mitigate or manage their anxiety. It includes suggestions for strategies that they could try to find a solution themselves if they are scoring highly in the "How do I" type of computer anxiety, and importantly gives them permission to use them.

Version 2 presents the instrument for use by tutors and employers. The idea here is that employees or students respond to the questions but the tutor/employer interprets them and makes the relevant support available. There are suggestions for ways of working to avoid creating situations that might cause computer anxiety such as giving full contextual information when implementing change and making a range of support options available when introducing new software. It is hoped that having a instrument for employers and tutors to use that computer anxiety is recognised and courses or workplaces designed to avoid anxiety inducing situations. This would mean that no one has to have mitigation or support for recovery, although it is accepted that for some people there will always be anxiety no matter how hard the people around them try to avoid this.

Version 3 presents the instrument that could be used in the classroom with younger children. The questions are adapted to be all positive and the responses gathered by circling an emoticon. The number of smiles and grumpy faces indicate the levels of computer anxiety. There are similar suggestions for the teachers to implement in order to support the children. There is the suggestion that many of the ideas could be built into the learning environment thus reducing the likelihood of computer anxiety occurring in the first place.

6.7 Summary

While computer anxiety, in common with other anxieties, cannot often be completely cured, there is a range of strategies that can be implemented to reduce the occasions that it might occur and to mitigate the anxiety if it does occur. Many of the strategies and techniques are similar to those used to manage other types of anxiety: strategies such as breathing, being mindful, talking therapy and peer support. What is different with computer anxiety is that there are a range of causes or triggers that need to be addressed in different ways.

If the computer anxiety has been occasioned by not knowing how to complete the task, then the obvious suggestion is that training be given to overcome this. For the computer anxious person, it may not be the best route to send the sufferer on a course or enrol them in an e-learning program. For some the idea of having an expert or teacher or peer to act as a supporter will go a long way towards making them feel more comfortable. The only way to know the best way forward is to ask the individual. This could be a good time to present the instrument.

Individuals might be embarrassed to admit to the problem or their desired solution, so the instrument put forward by this work is a start point in the conversation. The problem has been normalised by the presence of a measure with suggested steps to take. This may help the sufferer to see that they are not alone with this problem and that there is a way to move forwards. As the instrument is grounded in coaching techniques which are centred on talking the issue through and helping the sufferer to find the best way forward for them it should not be seen as threatening.

If the computer anxiety is more around the issue of not understanding the motivation for using a particular application or method to solve a problem, it may be that the user has suggestions for an alternative, or that they need to see where their work fits into a larger story. In some cases, the interface is difficult for that user because their logic does not match the logic of the interface design. In this case working with someone else might illuminate the logic and enable the user to move forward.

The final set of causes are connected with the individual’s own understanding of the world. They may have strongly held views and beliefs about how the world behaves. Sometimes these beliefs lead to phobias which often require the intervention of professionals, but often they can be challenged with a series of coaching sessions or other interventions.

The world is a challenging place for those with computer anxiety and this work aims to reduce the level of challenge and support both those who are suffering and those who want to help them.

7 Chapter Seven: Limitations and recommendations for further work

This work has been conducted over a number of years which has seen many changes to the environment, school curricula and technology. Many of these changes may have impacts that are not yet seen in the populations at university that have taken part in this research.

7.1 Changes in education

The UK school curriculum has changed bringing an increased emphasis on technology at a younger and younger age. Prospective students who are currently in Primary School have Computing Science on the curriculum. For these people, just beginning their educational journey, they will be learning about computing science for their entire academic life. It is to be hoped that this will have a positive impact on the levels of computer anxiety, but any impact that these changes have will not be seen for several years. The impact of curriculum change is something that has not been explored.

7.1.1 *Further work*

Further work in this area could explore the educational journey taken thus far and see how this journey has had an impact on the levels of computer anxiety by comparing cohorts with different experiences.

7.2 Changes in technology

The impact of increased levels of sophistication of technology has on levels of computer anxiety has not yet been fully realised. As discussed, computer anxiety still exists among the student population as they are asked to relate to technology that they are less familiar with. Having to do something in a certain way as opposed to choosing to do something in the way in which they think it could be done was suggested as a potential cause of computer anxiety, however this was not explored in this research.

7.2.1 *Further work*

It would be interesting to work with those with computer anxiety and see if introducing an element of control and choice over how the interaction happens, what technology is used and when the computer interaction happens, reduces their computer anxiety and supports higher achievement.

7.3 Confounding impact of assessment

In the measurement of computer anxiety there was no account taken of the circumstances the student was in at the time of the measurement. In all the data gathering within this research, the students were in a lecture early in the term and at a distance from any assessment or deadlines. As computer anxiety is a state it is likely that the levels will fluctuate depending upon circumstance. The question of whether their computer anxiety changes depending upon circumstance has not been explored. The approach of a deadline for instance could tip the moderately computer anxious student into higher levels of computer anxiety.

7.3.1 *Further work*

Exploring the impact of external stressors on the levels of computer anxiety could be an interesting avenue to pursue. Taking a longitudinal approach to a study to see if levels change depending upon the proximity and type of assessments for instance would help to understand this.

7.4 Convenience sampling

As the population used in the majority of this research was from a Business School in a small university the findings cannot be generalised to the wider population. There are too many confounding variables such as the self-selection of participants from a population that is already not a good representation of the wider public.

7.4.1 *Further work*

Extending the research to a wider group to include employees as well as undergraduates could confirm the findings in a wider population.

Having a longitudinal study with measures at the beginning of the undergraduate journey and at the end to see if the levels of computer anxiety decreased over time would be interesting. This change could be compared with other cohorts that were introduced to the instrument, to see if the levels of computer anxiety decreased in similar or different rates although this might raise some ethical issues as I believe the use of the instrument would be helpful and depriving some of access to it could be deemed as unfair.

8 Chapter Eight: Contribution to learning

Computer anxiety has been recognised as a state of anxiety that affects some people when they are obliged to interact with technology to complete their work or studies. There are many existing measures that identify and quantify the severity of the anxiety. These tend to return one value, a single measure of overall anxiety.

A growing range of strategies are available to support people who suffer from a range of anxieties. These vary from simple breathing techniques to more complex and long term cognitive behavioural therapy.

Until now, these different strands have not been pulled together. There has not been a single way of identifying and then addressing the particular causes of computer anxiety until the production of the instrument presented here.

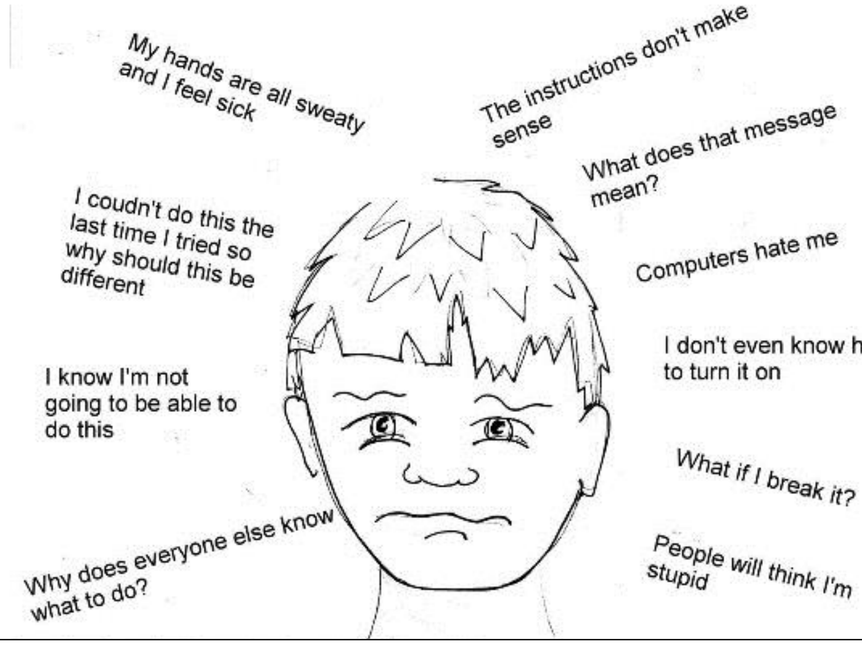
This instrument developed as a result of this work, and presented here, should be considered as the start point in conversations around the causes of the computer anxiety. By normalising the condition and presenting a range of strategies to mitigate the impact of it the affected population should become less anxious and more prepared to self-identify and begin talking. Conversations are the beginning of providing the help or support required by the individuals affected by this type of anxiety.

It is this instrument that is my contribution to learning. The identification of type and level of anxiety coupled with suggestions for mitigation is the first time these two ideas have been put together.

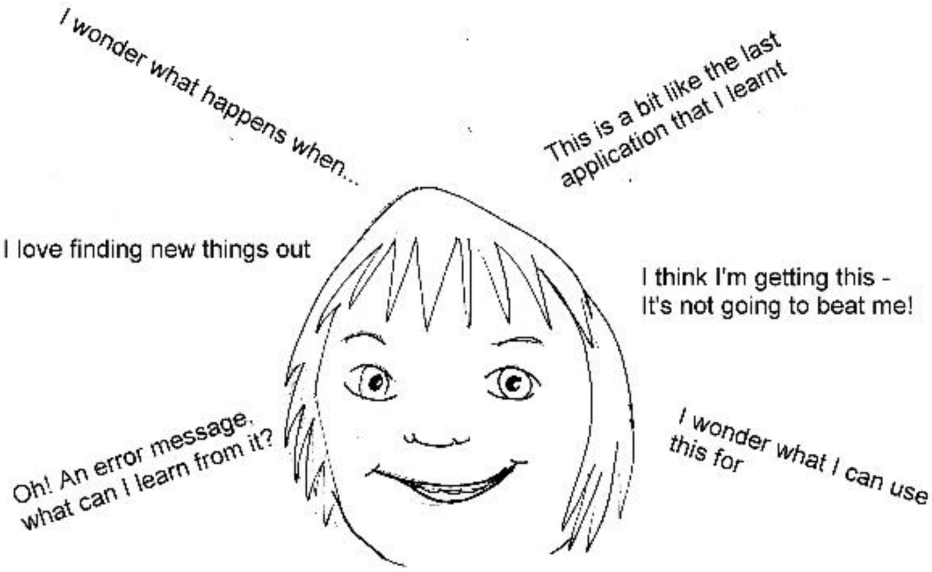
The idea that different causes require different responses is a new one as previously one solution has been presented for a single measure of computer anxiety differentiated only by severity rather than by type and severity.

The instrument is presented here in three forms to cover a wide age range from the employed, through students and primary age children. The three forms together address current levels of computer anxiety and the one designed for primary age children aims to reduce the likelihood of computer anxiety manifesting in the early years.

Computer Anxiety should not be allowed to impact negatively on anyone's experience either at university or in the workplace. This instrument is the first step on the journey to addressing this.



It would be great if people could be supported to stop having these anxiety inducing negative thoughts and move towards have more positive ones.



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Appendix 1: Research Instruments

Personality Questionnaire based on the Big Five Factors

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How Accurately Can You Describe Yourself?

Describe yourself as you generally are now, not as you wish to be in the future. Describe yourself as you honestly see yourself, in relation to other people you know of the same sex as you are, and roughly your same age. So that you can describe yourself in an honest manner, your responses will be kept in absolute confidence. Indicate for each statement whether it is 1. Very Inaccurate, 2. Moderately Inaccurate, 3. Neither Accurate Nor Inaccurate, 4. Moderately Accurate, or 5. Very Accurate as a description of you.

		Very Inaccurate	Moderately Inaccurate	Neither Accurate Nor Inaccurate	Moderately Accurate	Very Accurate
1.	Am the life of the party.	O	O	O	O	O
2.	Feel little concern for others.	O	O	O	O	O
3.	Am always prepared.	O	O	O	O	O
4.	Get stressed out easily.	O	O	O	O	O
5.	Have a rich vocabulary.	O	O	O	O	O
6.	Don't talk a lot.	O	O	O	O	O
7.	Am interested in people.	O	O	O	O	O
8.	Leave my belongings around.	O	O	O	O	O
9.	Am relaxed most of the time.	O	O	O	O	O
10.	Have difficulty understanding abstract ideas.	O	O	O	O	O
11.	Feel comfortable around people.	O	O	O	O	O
12.	Insult people.	O	O	O	O	O
13.	Pay attention to details.	O	O	O	O	O
14.	Worry about things.	O	O	O	O	O
15.	Have a vivid imagination.	O	O	O	O	O
16.	Keep in the background.	O	O	O	O	O
17.	Sympathize with others' feelings.	O	O	O	O	O
18.	Make a mess of things.	O	O	O	O	O

19.	Seldom feel blue.	O	O	O	O	O
20.	Am not interested in abstract ideas.	O	O	O	O	O
21.	Start conversations.	O	O	O	O	O
22.	Am not interested in other people's problems.	O	O	O	O	O
23.	Get chores done right away.	O	O	O	O	O
24.	Am easily disturbed.	O	O	O	O	O
25.	Have excellent ideas.	O	O	O	O	O
26.	Have little to say.	O	O	O	O	O
27.	Have a soft heart.	O	O	O	O	O
28.	Often forget to put things back in their proper place.	O	O	O	O	O
29.	Get upset easily.	O	O	O	O	O
30.	Do not have a good imagination.	O	O	O	O	O
31.	Talk to a lot of different people at parties.	O	O	O	O	O
32.	Am not really interested in others.	O	O	O	O	O
33.	Like order.	O	O	O	O	O
34.	Change my mood a lot.	O	O	O	O	O
35.	Am quick to understand things.	O	O	O	O	O
36.	Don't like to draw attention to myself.	O	O	O	O	O
37.	Take time out for others.	O	O	O	O	O
38.	Shirk my duties.	O	O	O	O	O
39.	Have frequent mood swings.	O	O	O	O	O
40.	Use difficult words.	O	O	O	O	O
41.	Don't mind being the center of attention.	O	O	O	O	O
42.	Feel others' emotions.	O	O	O	O	O
43.	Follow a schedule.	O	O	O	O	O
44.	Get irritated easily.	O	O	O	O	O
45.	Spend time reflecting on things.	O	O	O	O	O
46.	Am quiet around strangers.	O	O	O	O	O
47.	Make people feel at ease.	O	O	O	O	O
48.	Am exacting in my work.	O	O	O	O	O
49.	Often feel blue.	O	O	O	O	O
50.	Am full of ideas.	O	O	O	O	O

COMPUTER ANXIETY RATING SCALE (Form C)

The items in this questionnaire refer to things and experiences that may cause anxiety or apprehen- sion. For each item, place a check ( ) under the column that describes how anxious (nervous) each one would make you <u>at this point in your life.</u>

	Not at all	A little	A Fair amount	Much	Very Much
1. Thinking about taking a course in a computer language.					
2. Taking a test using a computer scoring sheet.					
3. Applying for a job that requires some computer training.					
4. Sitting in front of a home computer.					
5. Watching a movie about an intelligent computer.					
6. Looking at a computer printout.					
7. Getting “error messages” from the computer.					
8. Using an automated bank teller machine.					
9. Visiting a computer center.					
10. Being unable to receive information because the “computer is down.”					
11. Learning to write computer programs.					
12. Thinking about buying a new personal computer.					
13. Erasing or deleting material from a computer file.					
14. Taking a class about the use of computers.					
15. Re-setting a digital clock after the electricity has been off.					
16. Learning computer terminology.					
17. Reading a computer manual.					
18. Watching someone work on a personal computer.					
19. Programming a microwave oven.					
20. Learning how a computer works.					

COMPUTER THOUGHTS SURVEY (Form C)

Please check ( ) the box that indicates how often you currently have each of the following thoughts when you use a computer or think about using a computer.

	Not at all	A little	A Fair amount	Much	Very Much
1. I am going to make a mistake.					
2. This will be fun.					
3. Everyone else knows what they are doing.					
4. I enjoy learning about this.					
5. I like playing on the computer.					
6. I feel stupid.					
7. People will notice if I make a mistake.					
8. This will shorten my work.					
9. I am totally confused.					
10. I know I can do it.					
11. I am willing to give it a try.					
12. I hate this machine.					
13. I'm afraid I'll wreck the program.					
14. I can get help if I get stuck.					
15. What if I hit the wrong button?					
16. This is really interesting.					
17. I'm too embarrassed to ask for help.					
18. Others have learned this and so can I.					
19. I feel overwhelmed by how much I don't know.					
20. I won't be able to get the computer to do what I want.					

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.

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

Appendix 2: Example of the look of the on-line questionnaire as distributed in phase 2

Appendix 2: On-Line instruments

PhD Questionnaire

Page 1 of 6

Thank you for electing to take this survey. It should take not more that 20 minutes to complete. I am interested in your experience with computers, what you are like and how you would like to be supported when learning about new things to do with your computer (applications). My research is around offering more effective and useful support to enhance the learning experience.

Next Save Cancel

This is the welcome page – the other questionnaires form the first two sections, and then the support section and personal data follow.

Support for learning new applications

Here I am interested in finding out how your learning has been supported in the past, and how effective this was for you. I would also like to know how you would prefer to be supported in the future to make the most of new learning experiences. Please include as much detail as you think would be helpful.

For the next group of questions I would like you to think about the last time you had to learn an application for study or work - this might be a learning platform or VLE or a piece of software.

71. I felt ok when I encountered the new application
- Strongly disagree
- Moderately disagree
- Neither agree nor disagree
- Moderately agree
- Strongly agree

72. I did not really understand why I had to learn it
- Strongly disagree
- Moderately disagree
- Neither agree nor disagree
- Moderately agree
- Strongly agree

73. I could see that it would be useful
- Strongly disagree
- Moderately disagree
- Neither agree nor disagree
- Moderately agree
- Strongly agree

Appendix 2: Example of the look of the on-line questionnaire as distributed in phase 2

74. I have used this application several times since I learnt it

- Strongly disagree
- Moderately disagree
- Neither agree nor disagree
- Moderately agree
- Strongly agree

Thinking about how you learnt the application and the support that you were given

75. How was your learning supported and how useful was this for you. Please rate each method that was offered where 1 is "not offered at all", 2 is "useless" and 6 is "really useful".

	1	2	3	4	5	6
With a print manual						
With an on line manual						
In a supported workshop						
In a tutor led class with other learners						
By following an on-line tutorial						
Independent learning (i.e. just exploring)						
One-to-one with an expert						
Peer tutoring (i.e. your friend told you how to do it)						
Other						

Appendix 2: Example of the look of the on-line questionnaire as distributed in phase 2

76. If you selected "Other2 above please give more information here

Back Next Save Cancel

Support for learning in the future

I am interested in finding out how you would like to be supported in the future

Thinking about the next time you have to learn a new application:

77. I am apprehensive about learning a new application
- Strongly disagree
- Moderately disagree
- Neither agree nor disagree
- Moderately agree
- Strongly agree

78. I expect that I will be able to pick it up quickly
- Strongly disagree
- Moderately disagree
- Neither agree nor disagree
- Moderately agree
- Strongly agree

Appendix 2: Example of the look of the on-line questionnaire as distributed in phase 2

Thinking about the next time you have to learn a new application:

79. Please rate how would you prefer to be supported where 1 is "not at all" and 5 is "Ideally like this"

	1	2	3	4	5
With a print manual	○	○	○	○	○
With an on line manual	○	○	○	○	○
In a supported workshop	○	○	○	○	○
In a tutor led class with other learners	○	○	○	○	○
By following an on-line tutorial	○	○	○	○	○
Independent learning (i.e. just exploring)	○	○	○	○	○
One-to-one with an expert	○	○	○	○	○
Peer tutoring (i.e. your friend told you how to do it)	○	○	○	○	○
Other	○	○	○	○	○

80. If you answered "other" in the question above, please explain here how you would like to be supported

Appendix 2: Example of the look of the on-line questionnaire as distributed in phase 2

All about you!

This information is to ensure that I have collected data from a variety of people of different ages and nationalities. It will remain confidential and separated from the data once the study is completed.

By answering these questions you will enable me to check that I have the views of a good cross-section of society. Please remember that your answers will remain confidential.

81. What is your nationality

82. What is your gender

- Female
- Male
- Transgender
- Prefer not to say

83. Where are you studying?

- York St John University
- York University
- Robert Kennedy College
- Other, please specify

84. How old are you?

- 45+
- Between 25 and 45
- Between 18 and 25

Back Done Save Cancel

Appendix 3: Results of computer anxiety VS learning styles

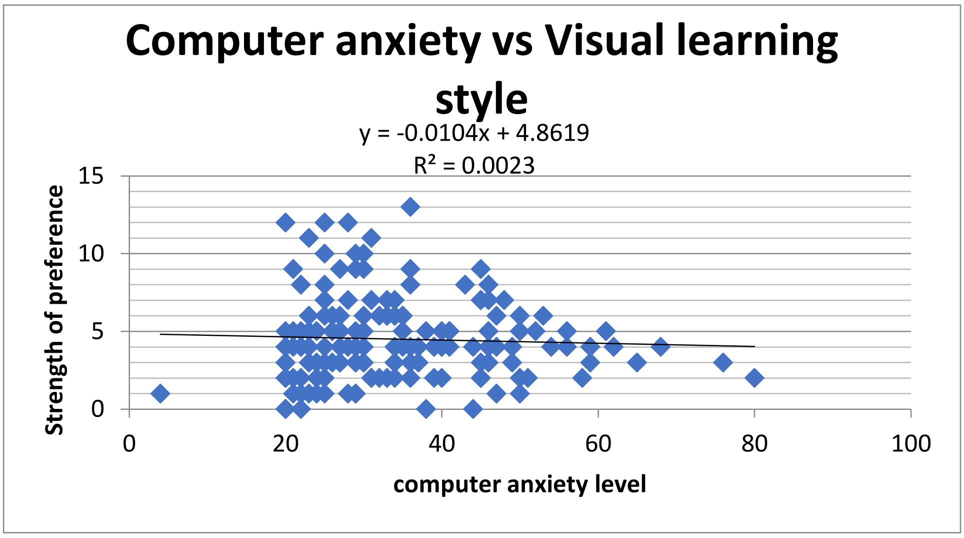

Chart 38 Computer anxiety v visual style

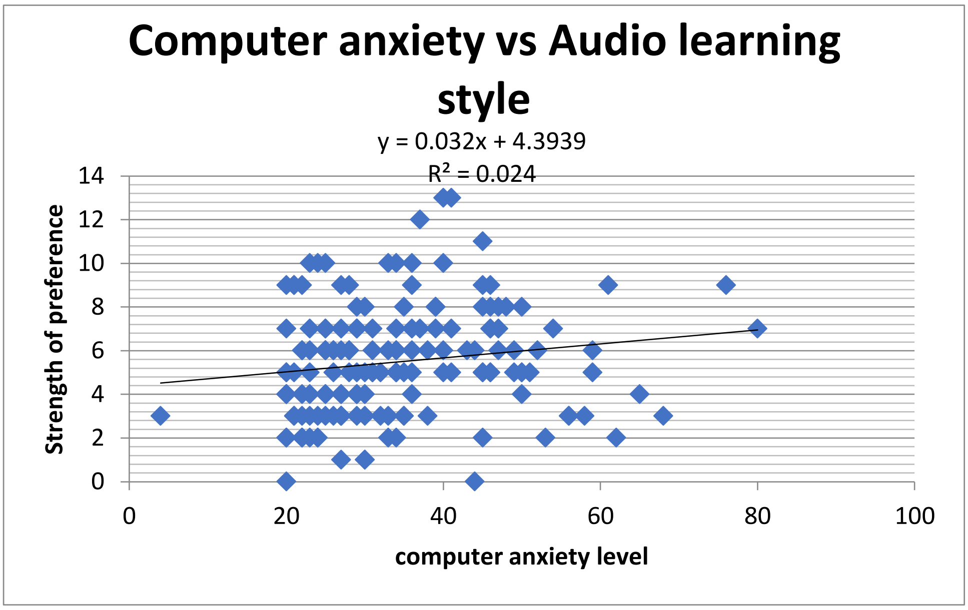

Chart 39 Computer anxiety vs Audio learning style

Appendix 3: results of computer anxiety vs learning styles

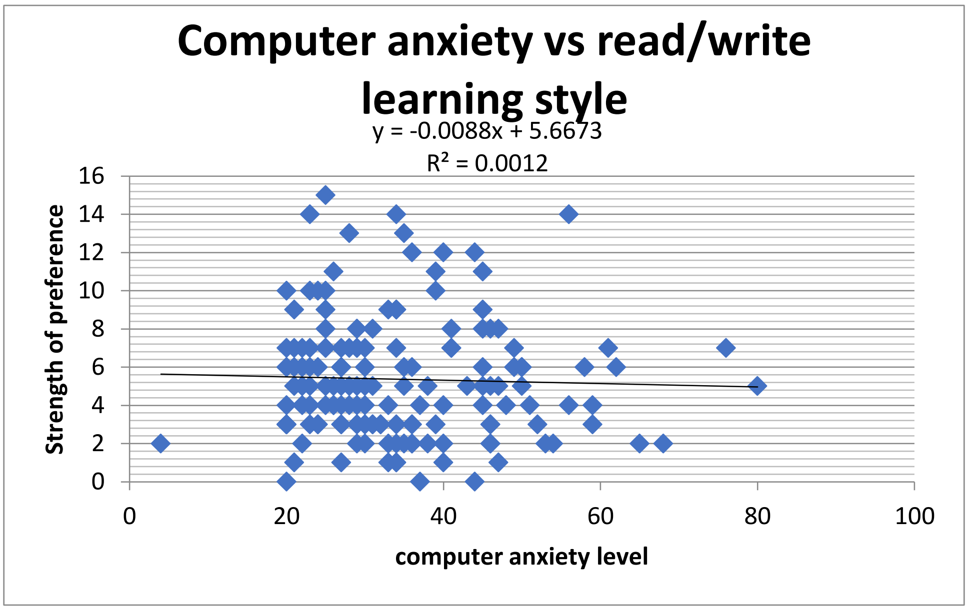

Chart 40 Computer anxiety v read/write learning style

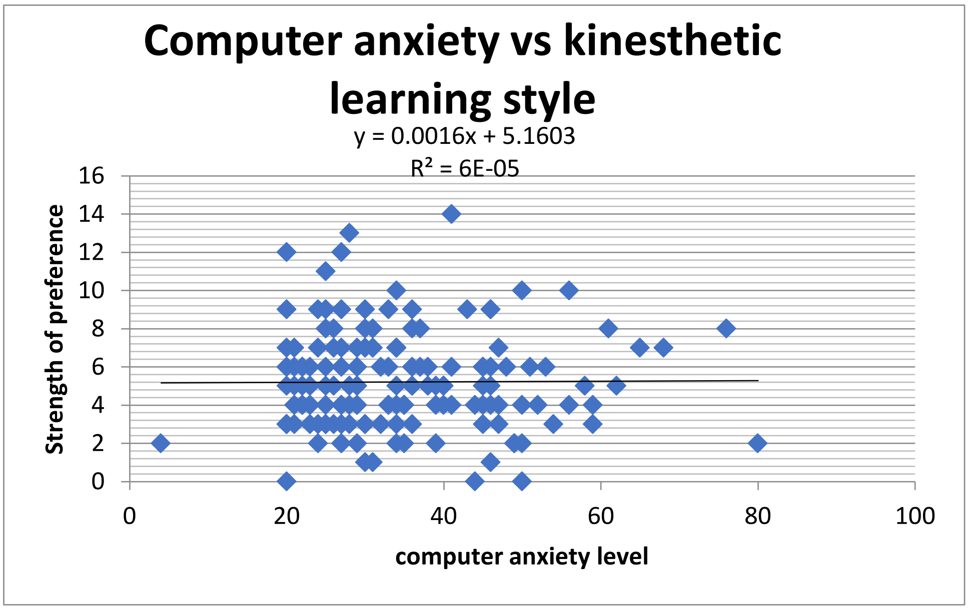

Chart 41 Computer anxiety vs Kinaesthetic learning style

Appendix 4: Results of Computer Anxiety vs Personaliy

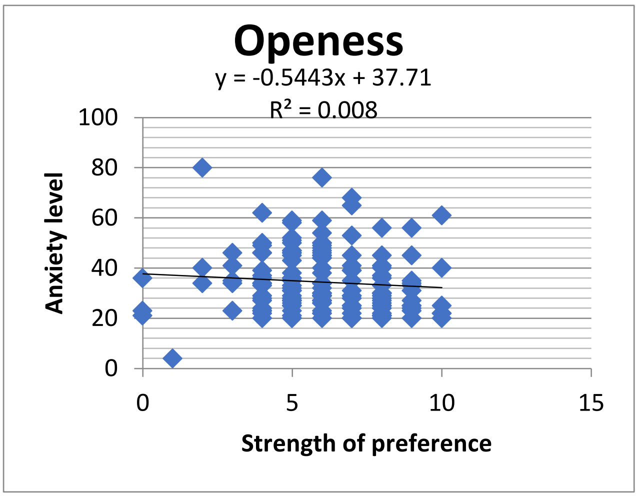

Chart 45 Computer Anxiety and Openness

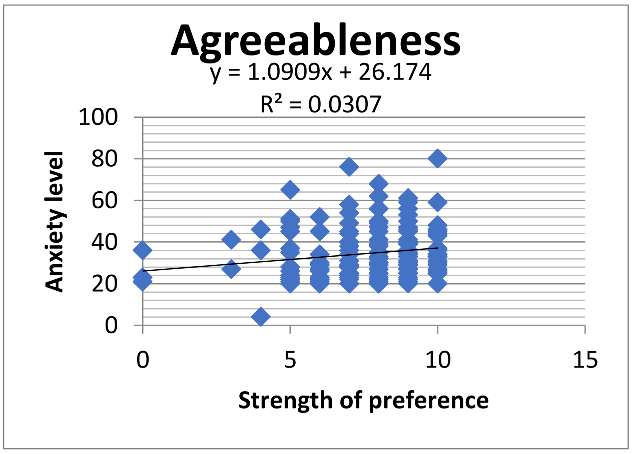

Chart 42 Computer Anxiety and Agreeableness

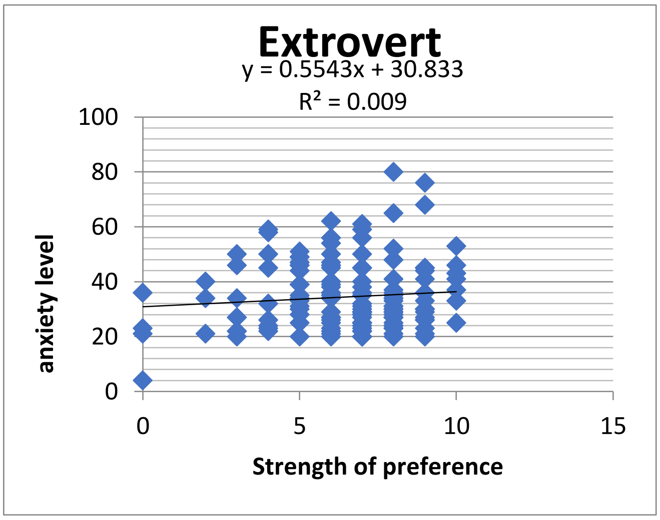

Chart 46 Extroversion and computer anxiety

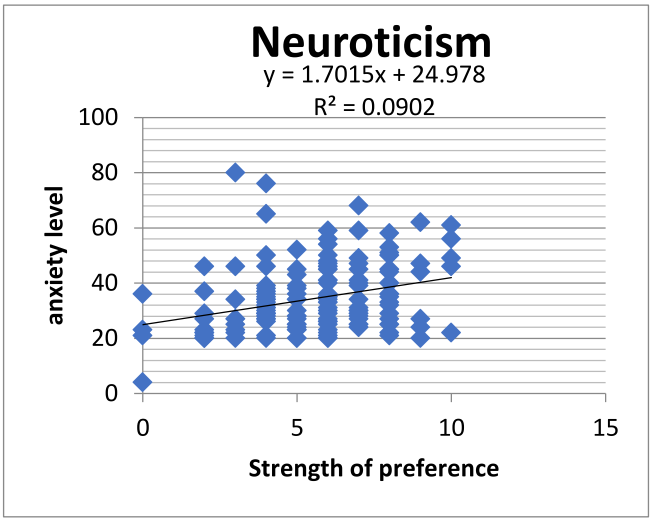

Chart 43 Computer Anxiety and Neuroticism

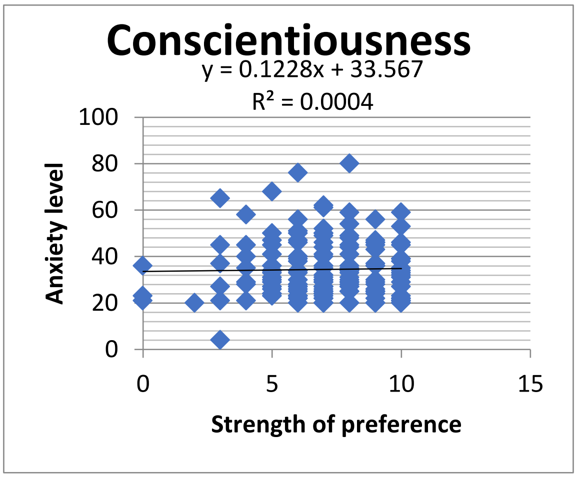

Chart 44 Computer Anxiety with Conscientiousness

Appendix 5: Results of computer anxiety vs the type of support received in the past.

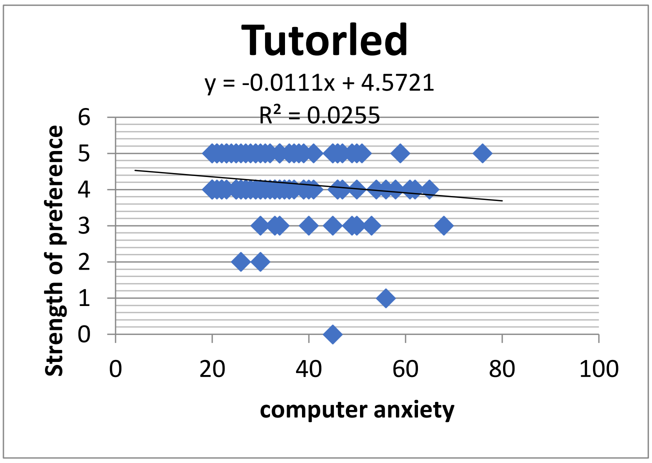

Chart 49 Tutor led and computer anxiety

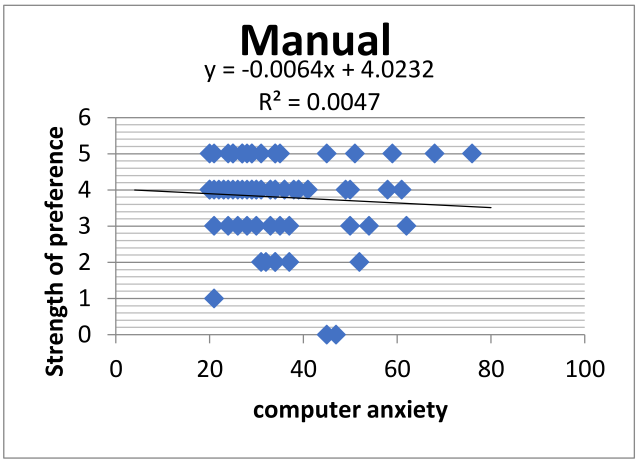

Chart 47 Manual and computer anxiety

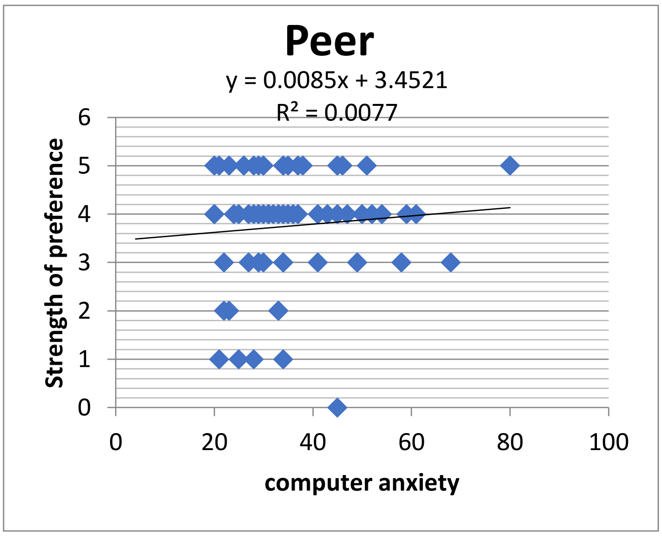

Chart 48 Peer support and computer anxiety

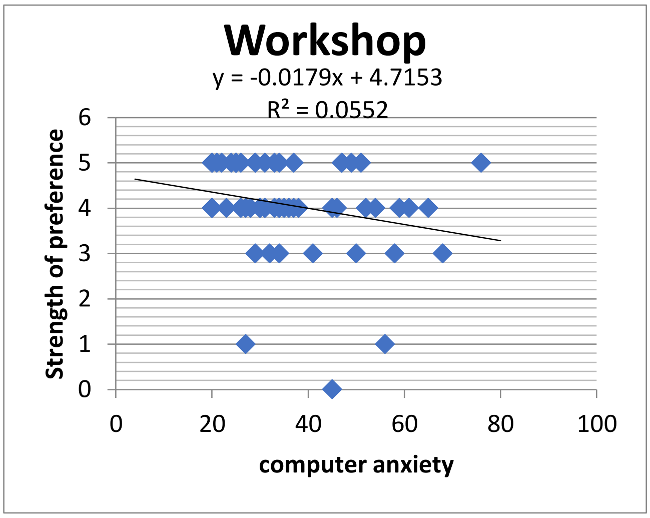

Chart 50 Workshop and computer anxiety

Appendix 5: Results of computer anxiety vs the type of support received

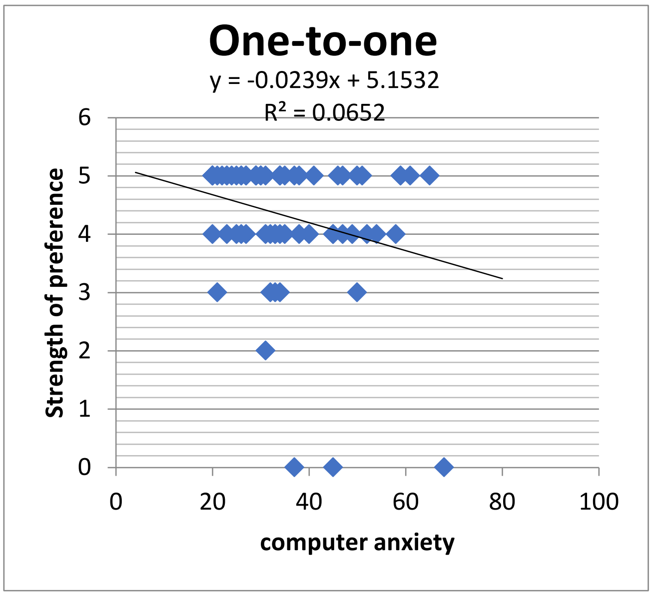

Chart 53 Having one-to-one support and computer anxiety

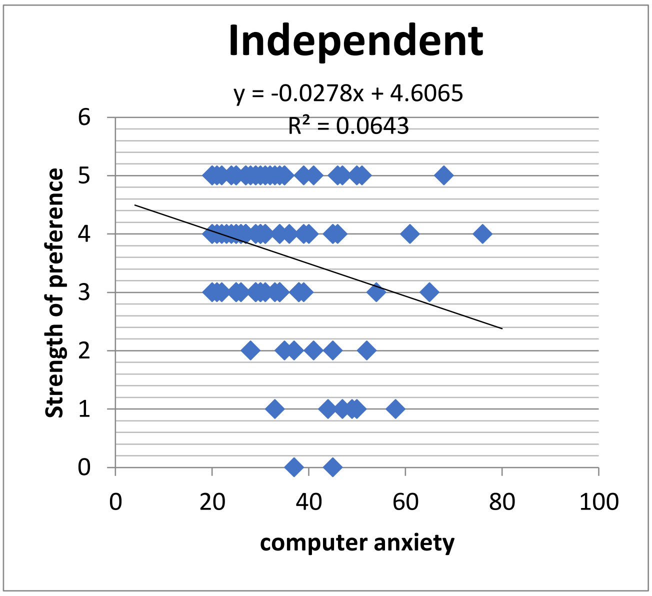

Chart 51 Learning independently and computer anxiety

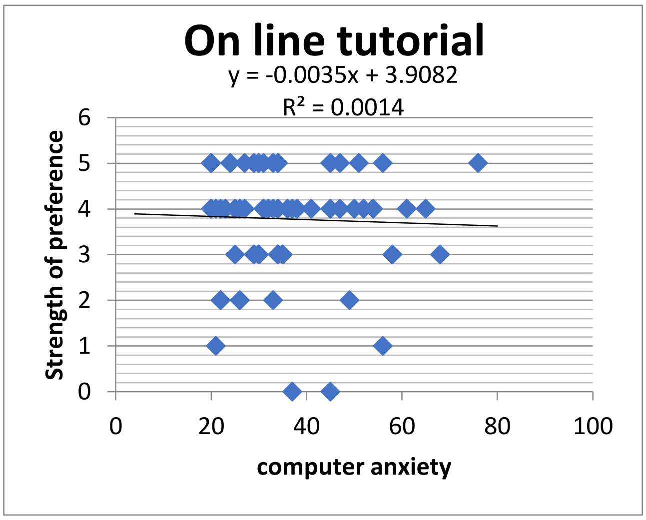

Chart 52 Using an on-line tutorial and computer anxiety

Appendix 6 – The instrument for students and employees

This questionnaire is aimed at you if you are a student or work for someone.

It asks how comfortable are you when using technology?

This questionnaire will help you to clearly identify if you are having some problems when you interact with technology. You probably already know if you don't really like working in certain situations or with particular programs. This instrument will help you find out where in particular the root of your anxiety lies, will make some suggestions for how you could get some help and support.

It is not uncommon to have moments of anxiety when working, but when this anxiety prevents you from achieving your best or is causing high levels of stress then you need to get some support.

Please fill in the following questionnaire

Appendix 6: The instrument for students and employers

For the following statements please indicate how strongly you agree with them.

Statement	Very Strongly Agree 1	2	Neither agree or disagree 3	4	Very strongly disagree 5
1. I find it an interesting challenge when I do not know what to do					
2. I have strategies to help me when I am stuck					
3. When I see an error message I find it helpful					
4. I think I am not as quick as others and it worries me					
5. I worry that I will break the computer					
6. I do not get too worried making mistakes					
7. I am as good as or better at using my computer than those around me					
8. Other people see me working and judge my competence as poor					
9. I do not like trying new things as I can never do them					
10. I know how to work the technology I have to use					
11. Sometimes I can feel overwhelmed by the amount of information on the screen					
12. I never feel overwhelmed by the number of tasks I have to do on the computer					
13. I panic when I have to learn something new.					
14. I think that computers hate me					
15. Most of the time, I am happy working with computers					

Appendix 6: The instrument for students and employers

To see what scores you have please fill in the table below with the score for each question. Where the statement number is in red please can you subtract your score from 6 and put that answer in the box. For example if I scored statement 11 with 5, then I do the calculation 6-5=1 and enter 1 into the box for statement 11.

How do I do things		**Why do I have to do it**		**What I think about computers**	
Statement No.	**Your score**	**Statement No.**	**Your Score**	**Statement No.**	**Your Score**
2		4	6 – your score	1	
6		7		3	
10		8	6 – your score	5	6 – your score
11	6 – your score	9	6 – your score	14	6 – your score
13	6 – your score	12		15	
Total		Total		Total	

Once you have your scores see if you can find where you sit for each of the types of computer anxiety on the grid below

You should be able to see some suggestions for support that might help you to address the particular type and level of anxiety that you have at the moment.

It might be useful to look at the longer supporting information to give you some further ideas and a better understanding of how are you feeling and how you could help yourself to manage your anxiety levels.

If you are studying you can share your profile with your tutors to help them to help you. If you are an employee you might be able to use this information to ask your line manager for specific additional support.

Appendix 6: The instrument for students and employers

Level of anxiety	**Suggestions of support strategies**			**Potential impact**	**Suggested General approach**
(>=20) Explore the ideas here and find one that works for you. Support will help	Ask for training with an expert in a setting that you feel meets your needs.	Ask for coaching to help you to see a way to solve the problem. Explore and try out a range of anxiety mgt strategies	Ask to be referred to a professional for help and support to deal with your phobia	High Impact on individual and work load. Could lead to stress related illness so address it now	Personal intervention by tutor or line manager is probably required to help you through this
(>=15 and <20) There are some ideas here that might help – check them out.	Ask to be directed to a range of support materials and consult with another for optional support	Discuss the purpose/ task of what you are being asked to do. Make sure you are given support to know how to do it too	Ask for coaching around anxiety management. A coach could also help you to the root of the problem	Medium impact in the short term but if not resolved could lead to longer term problems.	Intervention recommended to begin to address issues.
(>=10 and <15) You are probably fine most of the time, but ask for help when you need it to avoid any anxiety	Ask to be directed to a range of support materials or get peer support (this could include looking in forums or other online help	Ask for clarity around the purpose of the task, or reason behind doing it in this particular way	Ask for resources around anxiety management. You may also find that some supported training in the task could help	Low impact in the short term and likely to be resolved or mitigated with appropriate support	Support materials should be made available and some intervention may be needed
Low severity	No changes needed	No changes needed	No changes needed	There are no negative impacts	
	How do I? Relating to task and machine	**Why**/ what is the point? Mixture of self-doubt and task uncertainty	Predominantly about **the person** and their inner dialogue		
	Cause/ type of anxiety				

See where you are on the grid and see a summary of the suggestions that might begin to help you.

If you need extra information please read on…

What the different types of computer anxiety mean and how they can they be addressed

How to do it or Operational Anxiety

This is centred about not knowing how to complete the task. This might be that there is uncertainty around how to use the equipment, hardware or start the application.

Computer anxiety may be caused because, for instance, one is unable to turn the equipment on, does not know how to use the touch pad on a laptop or how to interact with a touch screen or are having to use an unfamiliar piece of equipment.

It is not unlikely that, with the speed of technological change, the way of interacting with a computer is different than the user is used to, or the operating system is unfamiliar. For some people this is an interesting challenge that they enjoy meeting, but for others it causes a level of anxiety.

Often this anxiety can be addressed by asking for and receiving some advice or support. Everyone learns in different ways so please be encouraged to ask for the support to be given in a way that suits you. For some people this can be asking a colleague or friend for help while others prefer a book or manual with instructions. Still others like to look at videos or on line tutorials. The important thing is to access the sort of help that is preferred and most useful.

Once the equipment is understood the next potential cause for anxiety can be that the user does not know how to use the software or program that they are being asked to use. Many applications exist and some have easier interfaces than others. It is not unreasonable to be concerned if the application is new and there does not seem to be a clear way of using it.

Some people have a range of strategies that they use to help them to address this sort of issue and it may be useful to begin to develop these either though watching others, or using a list of help finding strategies. This should be adapted to suit individuals.

Often people turn first to the internet in the hopes that someone else has already addressed this issue or produced some on-line guidance. Alternatively, or additionally often people see if there are any manuals that could be accessed.

Another strategy is trying things out and playing with the application. This can seem a bit daunting if the outcome is not clear so sometimes having an expert nearby can be reassuring. Remember that everyone who is using this application had to learn how to do it in the beginning – it might be tricky at first but it will get easier with practice.

Sometimes, if the task and application is complex, it might be appropriate to attend a workshop led by an expert or trainer. These people can share hints and tips as well as supporting users as they begin to use the application in a safe space. Often the class will suggest participants build a network of people who are also learning and may be helpful and supportive in the future.

Here is a list of the strategies that most people use to help them find answers. Everyone has their own order of attack though so choose the order that seems most appropriate for you.

Strategy List

- Look for on screen help
- Ask a friend/colleague
- Look it up on the internet
- Read the manual
- Ask to go on a training course/ individual tuition
- Just have a go at things and see what happens

Why, or sociological anxiety

This type of computer anxiety can be caused when being asked to complete a task when either it is unclear how to complete the task within the current context, or it is unclear why the task has to be tackled in a particular way. Some people do not need to have the big picture and are happy to complete their task in isolation, but for others it can be very helpful to see where the task fits into the larger story. Often when new applications are introduced the learning curve can be challenging especially as it seems the task ends up taking longer than it used to while the new process is being learnt. This can be one of the causes of this type of anxiety where for example, new learning for little or no perceived benefit is coupled with deadlines for task completion.

This type of anxiety can be avoided by having requests prefaced with clear purpose and rationale, or mitigated by being given this same information. If this is not the case, asking for the information is a reasonable step. It may also be helpful to be supported with a coach to help the development of strategies that address the issues which are the cause of the anxiety. At this level too, sometimes the underlying rationale cannot be explained away due to working conditions or similar, in which case the coach can support the development of anxiety management techniques. It is also important to address any operational anxiety around the task or the use of the application involved in completing the task. The main message here is to ask for information that would help you to feel more comfortable in completing the task.

The person or psychological anxiety

Sometimes it is hard for people to approach any interactions with technology in a positive way for any number of reasons, some of which may not seem rational to others. Like other phobias, such as fear of spiders, there can be a range of reactions and if this is at a severe level professional help should be sort. The good news is that this phobia, like others, can be treated with desensitization techniques. If the reaction is less severe working with a coach to develop anxiety management strategies can be helpful. It may also be the case that someone presenting with this type of anxiety may also need to be supported in both the operational and sociological areas as it is likely that avoidance will have formed a strong part of any coping mechanisms

Summary

The important thing to remember is that it is normal for people to feel anxious sometimes when working with technology, but if this anxiety is impacting on performance then it needs to be addressed. Individuals need to be supported to find the best way of helping them to address any computer anxiety that they might feel and this document should be the beginning of a conversation about this.

Appendix 7 The instrument for tutors and employers

How to support those working with computers

For most people, working with computers is acceptable and does not cause too much anxiety but for a sizeable minority this is not the case. For these people the on-going anxiety can lead to stress and time away from the computer. For some, who employ a strategy of avoidance to minimize their anxiety, this can lead to lower productivity and poorer quality of work.

This document contains a survey which you can give to those who work with computers. For the most part the survey will be returned with low scores, but there are also likely to be some who return higher scores. The model helps you to see how much of a problem the individuals are having and makes suggestions for you about how they can be supported.

Supporting people as they deal with computer anxiety can be beneficial to their productivity and the quality of their work.

Appendix 7 The instrument for tutors and employers

Please put your name here____ For the following statements please indicate how strongly you agree with them

Statement	Very Strongly Agree 1	2	Neither agree or disagree 3	4	Very strongly disagree 5
1. I find it an interesting challenge when I do not know what to do					
2. I have strategies to help me when I am stuck					
3. When I see an error message I find it helpful					
4. I think I am not as quick as others and it worries me					
5. I worry that I will break the computer					
6. I do not get too worried making mistakes					
7. I am as good as or better at using my computer than those around me					
8. Other people see me working and judge my competence as poor					
9. I do not like trying new things as I can never do them					
10. I know how to work the technology I have to use					
11. Sometimes I can feel overwhelmed by the amount of information on the screen					
12. I never feel overwhelmed by the number of tasks I have to do on the computer					
13. I panic when I have to learn something new.					
14. I think that computers hate me					
15. Most of the time, I am happy working with computers					

Appendix 7 The instrument for tutors and employers

To see what scores the individuals have please fill in the Table below with the score for each question. Where the statement number is in red please can you subtract the score from 6 and put that answer in the box. For example if they scored statement 11 with 5, then do the calculation 6-5=1 and enter 1 into the box for statement 11.

How do I do things Anxiety Level		Why do I have to do it Anxiety Level		I hate computers anxiety level	
2		4	6 – your score	1	
6		7		3	
10		8	6 – your score	5	6 – your score
11	6 – your score	9	6 – your score	14	6 – your score
13	6 – your score	12		15	
Total		Total		Total	

Once you have the scores for an individual, see if you can find where they sit for each of the types of computer anxiety on the grid below.

You should be able to see some suggestions for support that might help you to address the particular type and level of anxiety that they have at the moment.

It might be useful to look at the longer supporting information to give you some further ideas and a better understanding of how they are feeling and how you could help them to manage their anxiety levels.

Appendix 7 The instrument for tutors and employers

If you are the tutor or employer please see some suggestions for how you could support your student or employee

Level of anxiety	**Suggestions of support strategies**			**Potential impact**	**Suggested General approach**
(>=20) Offer the ideas is this section to support and help the individual	Appropriate training in a one to one situation with an expert	Coaching to develop self-confidence and challenge negative thinking Direct to a range of anxiety mgt strategies	Refer to a professional for help and support	High Impact on individual and work load. Could lead to stress related illness	Personal intervention by tutor or line manager is probably required
(>=15 and <20) Make these suggestions and follow up on any choices	Direction to a range of support materials and consult with another for optional support	Discussion around purpose/ task – might need some operational training too	Coaching around anxiety management – and getting to the root of the problem	Medium impact in the short term but if not resolved could lead to longer term problems.	Intervention recommended to begin to address issues.
(>=10 and <15) It might be worth including these strategies in the general ways of working to avoid problems	Direction to a range of support materials or offer peer support (to pre-empt ensure this is in place already)	Support to discover purpose (To pre-empt Ensure this is clear when new tasks are allocated)	Direction to a range of anxiety mgt strategies and support in their use. Coaching in the task (to pre-empt include these techniques in inductions)	Low impact in the short term and likely to be resolved or mitigated with appropriate support	Support materials made available and some intervention may be needed
Low severity	No changes needed	No changes needed	No changes needed	There are no negative impacts	
	How do I? Relating to task and machine	**Why**/ what is the point? Mixture of self-doubt and task uncertainty	Predominantly about **the person** and their inner dialogue		
	Cause/ type of anxiety				

What the different types of computer anxiety mean and how they can they be addressed

How to do it or Operational Anxiety

This is centred about not knowing how to complete the task. This might be that there is uncertainty around how to use the equipment, hardware or start the application.

Computer anxiety may be caused because, for instance, one is unable to turn the equipment on, does not know how to use the touch pad on a laptop or how to interact with a touch screen or are having to use an unfamiliar piece of equipment.

It is not unlikely that, with the speed of technological change, the way of interacting with a computer is different than the user is used to, or the operating system is unfamiliar. For some people this is an interesting challenge that they enjoy meeting, but for others it causes a level of anxiety.

Often this anxiety can be addressed by asking for and receiving some advice or support. Everyone learns in different ways so the user should be encouraged to ask for the support to be given in a way that suits them. For some people this can be asking a colleague or friend for help while others prefer a book or manual with instructions. Still others like to look at videos or on line tutorials. The important thing is to access the sort of help that is preferred and most useful.

Once the equipment is understood the next potential cause for anxiety can be that the user does not know how to use the software or program that they are being asked to use. Many applications exist and some have easier interfaces than others. It is not unreasonable to be concerned if the application is new and there does not seem to be a clear way of using it.

Some people have a range of strategies that they use to help them to address this sort of issue and it may be useful to begin to develop these either though watching others, or using a list of help finding strategies. This should be adapted to suit individuals.

Often people turn first to the internet in the hopes that someone else has already addressed this issue or produced some on-line guidance. Alternatively, or additionally users could see if there are any manuals that could be accessed.

Another strategy is trying things out and playing with the application. This can seem a bit daunting if the outcome is not clear so sometimes having an expert nearby can be reassuring. Remember that everyone who is using this application had to learn how to do it in the beginning – it might be tricky at first but it will get easier with practice.

Sometimes, if the task and application is complex, it might be appropriate to attend a workshop led by an expert or trainer. These people can share hints and tips as well as supporting users as they begin to use the application in a safe space. Often the class will suggest participants build a network of people who are also learning and may be helpful and supportive in the future.

Strategy List (not in any order)

- Look for on screen help
- Ask a friend/colleague
- Look it up on the internet
- Read the manual
- Ask to go on a training course/ individual tuition
- Just have a go at things and see what happens

Why, or Sociological Anxiety

This type of computer anxiety can be caused when being asked to complete a task when either it is unclear how to complete the task within the current context, or it is unclear why the task has to be tackled in a particular way. Some people do not need to have the big picture and are happy to complete their task in isolation, but for others it can be very helpful to see where the task fits into the larger story. Often when new applications are introduced the learning curve can be challenging especially as it seems the task ends up taking longer than it used to while the new process is being learnt. This can be one of the causes of this type of anxiety where for example, new learning for little or no perceived benefit is coupled with deadlines for task completion.

This type of anxiety can be avoided by prefacing requests with clear purpose and rationale, or mitigated by providing this same information. It may also be helpful to someone suffering in this way to be supported with a coach to help the development of strategies that address the issues which are the cause of the anxiety. At this level too, sometimes the underlying rationale cannot be explained away due to working conditions or similar, in which case the coach can support the development of anxiety management techniques. It is also important to address any operational anxiety around the task or the use of the application involved in completing the task.

The Person or Psychological Anxiety

Sometimes it is hard for people to approach any interactions with technology in a positive way for any number of reasons, some of which may not seem rational to others. Like other phobias, such as fear of spiders, there can be a range of reactions and if this is at a severe level professional help should be sort. The good news is that this phobia, like others, can be treated with desensitization techniques. If the reaction is less severe working with a coach to develop anxiety management strategies can be helpful. It may also be the case that someone presenting with this type of anxiety may also need to be supported in both the operational and sociological areas as it is likely that avoidance will have formed a strong part of any coping mechanisms

Summary

The important thing to remember is that it is normal for people to feel anxious sometimes when working with technology, but if this anxiety is impacting on performance then it needs to be addressed. Individuals need to be supported to find the best way of helping them to address any computer anxiety that they might feel and this document should be the beginning of a conversation about this.

Appendix 8 The Instrument for use with school children

Please draw a circle around the face that shows how much you agree with the sentence

1. I explore when I don't know what to do					
2. I have a plan to help me solve a problem					
3. I like help messages on the screen					
4. I am not worried about being as clever as other people					
5. I never worry that I will break the computer					
6. I do not get too worried if I make mistakes					
7. I am better at using my computer than other people					
8. Other people think I am as good as them					
9. I like trying new things as I can always do them					
10. I know how to work the computer in the classroom					
11. I always like the amount of information that is on the screen					
12. I like doing lots of different things on the computer					
13. I do not panic when I have to learn something new.					
14. I never think that computers hate me					
15. Most of the time, I am happy working with computers					

Appendix 8; The instrument for Primary School children

Count the number of faces that were picked for each colour

Colour					
Green					
White					
Yellow					

Place pupils scores on the grid and see a summary of the suggestions that might begin to help them

Level of anxiety	**Suggestions of support strategies**			**Potential impact**	**Suggested General approach**
4 or more sad or grumpy faces Offer the ideas in this section to support and help the individual	This child probably needs some one-to-one support to get over the initial hurdles and build their confidence	Coaching to develop self-confidence and challenge negative thinking Direct to a range of anxiety mgt strategies – such as breathing,	Refer to a professional for help and support if this feels appropriate – unless this is resolved the child will be at a disadvantage for their entire life.	High Impact on individual and work load. Could lead to stress related illness	Personal intervention by an adult
2 or 3 sad or grumpy faces Make these suggestions and follow up on any choices	Have clearly labelled books or a FAQ board near the computers and nominated class experts who can help others	Check understanding around the point of the task and deal with any misunderstandings	Coaching around anxiety management & some one-to-one conversations might be helpful here to understand the root of the problem	Medium impact in the short term but if not resolved could lead to longer term problems.	Intervention by an adult recommended to begin to address issues.
1 or more sad or grumpy faces. It might be worth including these strategies in the general ways of working to avoid problems	Have a study buddy system so that children know they can ask someone. Develop an individual or class problem-solving plan (to pre-empt ensure this is in place already)	Explain why you are asking them to do this (To pre-empt Ensure this is clear when new tasks are allocated)	Share some anxiety mgt strategies and support their use. Coaching around the task might be helpful to build confidence (to pre-empt include these techniques in inductions)	Low impact in the short term and likely to be resolved or mitigated with appropriate support	Support materials made available and some intervention may be needed
Only very happy or happy faces	No changes needed	No changes needed	No changes needed	There are no negative impacts	
	How do I?	**Why** should I	I don't want to		
	Cause/ type of anxiety				

What the different types of computer anxiety mean and how they can they be addressed

How do I

This is centred about not knowing how to complete the task. This might be that there is uncertainty around how to use the equipment, hardware or the child does not know how to start or use the application.

Computer anxiety may be caused because, for instance, one is unable to turn the equipment on, does not know how to use the touch pad on a laptop or how to interact with a touch screen or are having to use an unfamiliar piece of equipment.

It is not unlikely that, with the speed of technological change, the way of interacting with a computer is different than the user is used to, or the operating system is unfamiliar. For some people this is an interesting challenge that they enjoy meeting, but for others it causes a level of anxiety.

Often this anxiety can be addressed by asking for and receiving some advice or support. Everyone learns in different ways so please encourage the children to ask for the support to be given in a way that suits them. For some people this can be asking a colleague or friend for help while others prefer a book or manual with instructions. Still others like to look at videos or on line tutorials. The important thing is to give access to the sort of help that is preferred and most useful.

Once the equipment is understood the next potential cause for anxiety can be that the user does not know how to use the software or program that they are being asked to use. Many applications exist and some have easier interfaces than others. It is not unreasonable to be concerned if the application is new and there does not seem to be a clear way of using it.

Some people have a range of strategies that they use to help them to address this sort of issue and it may be useful to begin to develop these either though watching others, or using a list of help finding strategies. This should be adapted to suit individuals.

Often people turn first to the internet in the hopes that someone else has already addressed this issue or produced some on-line guidance. Alternatively, or additionally often people see if there are any manuals that could be accessed. This may not be an appropriate strategy for young children, so alternatives include creating a class help book, a FAQ board or providing an instruction manual.

Another strategy is trying things out and playing with the application. This can seem a bit daunting if the outcome is not clear so sometimes having an expert nearby can be reassuring. Remember that everyone who is using this application had to learn how to do it in the beginning – it might be tricky at first, but it will get easier with practice. Children who are confident might be prepared to be class experts to support others, or pair children up as study buddies to support each other.

Sometimes, if the task and application is complex, it might be appropriate to have an extra session dedicated to getting to grips with the application before starting to solve the problems

Here is a list of the strategies that most people use to help them find answers. Everyone has their own order of attack though so choose the order that seems most appropriate for your class.

Strategy List

- Look for on screen help
- Ask a friend/colleague
- Look it up on the internet
- Read the manual
- Ask to go on a training course/ individual tuition
- Just have a go at things and see what happens

Why should I

This type of computer anxiety can be caused when being asked to complete a task when either it is unclear how to complete the task within the current context, or it is unclear why the task has to be tackled in a particular way. Some people do not need to have the big picture and are happy to complete their task in isolation, but for others it can be very helpful to see where the task fits into the larger story. Often when new applications are introduced the learning curve can be challenging especially as it seems the task ends up taking longer than it used to while the new process is being learnt. This can be one of the causes of this type of anxiety where for example, new learning for little or no perceived benefit is coupled with deadlines for task completion.

This type of anxiety can be avoided by having requests prefaced with clear purpose and rationale, or mitigated by being given this same information. It may also be helpful for children to be supported to help the development of strategies that address the issues which are the cause of the anxiety. At this level too, sometimes the underlying rationale cannot be explained away due to working conditions or similar, in which case an adult can support the development of anxiety management techniques. It is also important to address any operational anxiety around the task or the use of the application involved in completing the task. The main message here is to promote the culture of asking for information that would help the children to feel more comfortable in completing the task.

I don't want to

Sometimes it is hard for people to approach any interactions with technology in a positive way for any number of reasons, some of which may not seem rational to others. Like other phobias, such as fear of spiders, there can be a range of reactions and if this is at a severe level professional help should be sort. The good news is that this phobia, like others, can be treated with desensitization techniques. If the reaction is less severe working with a coach to develop anxiety management strategies can be helpful. It may also be the case that someone presenting with this type of anxiety may also need to be supported in both the operational and sociological areas as it is likely that avoidance will have formed a strong part of any coping mechanisms

The important thing to remember is that it is normal for people to feel anxious sometimes when working with technology, but if this anxiety is impacting on performance then it needs to be addressed. Individuals need to be supported to find the best way of helping them to address any computer anxiety that they might feel and this document should be the beginning of a conversation about this.