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ATTITUDES TOWARDS TECHNOLOGY BASED ON STEREOTYPES, SELF-CATEGORISATION AND SENSE OF CONTROL

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Contents

Abstract

This research examines social psychological explanations for the under-representation of women in careers in computing. Following a review of the literature, a paper questionnaire collected open response data from 524 participants from two age groups representing pre- and post- adolescence. Results regarding what constituted a typical computer user indicated a shift from same gender representations at ages 10-11 to a young male stereotype by the vast majority of 16-18 year-olds. Proportionally less computer use by adolescent girls than boys was reported alongside girls having fewer positive emotions with age.

An online survey provided quantitative data from a further 672 participants and introduced additional age-groups of 13-14 year-olds, undergraduates and adults. It confirmed the transition from same gender to a stereotyped male representation of a typical computer user during adolescence and indicated this occurred around 13-14 years of age. Principal Component Analyses (PCA) of 24 pairs of Locus of Control measures for work/education and computing contexts suggested men had a higher sense of personal control in a computing context than general whereas for women this was the reverse. PCA of a 20-item semantic differential scale to represent emotional responses provided evidence of three factors: positive/negative emotions; engagement and emotionality which offered some gender differences and relationships with other variables.

A third study, of 179 undergraduates, related data from the online questionnaire to any effect on actual performance or self-rating on a computing task. Results showed that framing the task as evaluative and holding same-gender mental representations affected both performance and self-evaluation. This gave support to Stereotype Threat Theory (Steele & Aronson, 1995) in a computing context plus suggested factors that may prompt the opposite: Stereotype Lift (Walton & Cohen, 2003).

Finally, the results of all three studies are discussed in terms of cognitive, affective, behavioural and perceived control components of an overall attitude towards computers.

Chapter One

Thesis Overview, Structure of the Thesis and Introduction

1.1. Thesis Overview

The research reported in this thesis aimed to combine several perspectives and established theories within Social Psychology from social inhibition and facilitation (Allport, 1924, cited in Hewstone, 2008) to cognitive dissonance (Festinger, 1954, cited in Hewstone, 2008) and social comparison (Festinger, 1957, cited in Hewstone, 2008) to advance our understanding of gender identification during adolescence with regards to attitudes towards technology and computers. More specifically, it set out to examine the inhibiting social factors that exist to prevent girls from pursuing careers in technology based on how they use computers relative to others, how they reconcile their computing performance with others and how they satisfy them selves as to their own performance relative to other women and more generally.

The approach taken was to collect computer attitudes as best as possible through attempting to examine each of the three factors of an attitude in turn. These comprised the cognitive, affective and behavioural components of an attitude or in the context of computer attitudes: what mental representations there were of computers, their users and their worth; what emotions were felt during their use and how much a person actually used them. In line with a popular measure of computer attitudes (Kay, 1993), perceived control of a computer was also felt worthy of interest.

Having looked at computer attitudes overall the next objective was to see how attitudes impinged upon performance which could become a self-fulfilling prophecy. The work by Aronson and Steele (1995) that proposed having a social identity with a negative feature relating to a task in hand prompted anxiety and underperformance appeared highly pertinent so the decision was made to adapt their work from a racial/IQ context to a gender/computing one. Much work had also been conducted around the field of women disengaging from mathematics based on a negative stereotype (Aronson et al, 1999, Spencer, Steele & Quinn, 1999, Oswald & Harvey, 2001, Nosek, Banaji & Greenwald, 2002, Pronin, Steele & Ross, 2004) which gave support to this approach.

Once results were in hand the final stage of the thesis was to assess them in terms of alternative theories including the interesting converse to Stereotype Threat Theory, that of Stereotype Lift (Walton & Cohen, 2003). Ending with a discussion that referred back to the more general theories of social psychology would position the work on developments of social cognition in adolescence and component parts of attitudes more broadly in the field of social psychology rather than just the more specific arena of computer attitudes. Furthermore, methodologies developed to examine the concern of a strong, and relatively socially permissible, stereotype of a computer user may then be seen as usable or adaptable in other contexts. A return to the original concerns of Stereotype Threat theorists such as ethnicity and school performance are good examples of how better understanding and methodological improvements and alternatives may be applied.

1.2. Structure of the Thesis

The research for this thesis is reported in four chapters. It commences with a discussion of the literature surrounding the research which forms Chapter Two followed by three empirical studies which form the next three chapters. The final chapter, Chapter Six, discusses the research and its outcomes. Data collection regarding computer attitudes was to be directed along the three pathways of cognition, affect and behaviour as described in the Thesis Overview (Section 1.1).

An initial review of the literature was conducted to hone the areas of study and to establish appropriate methodologies for use. Following that, it was clear that the initial data collection needed to establish the prevalence and type of stereotypes of computer users termed as ‘nerds’, ‘geeks’ or similar that existed within adolescence and their point of onset.

Thus in the first study, a social cognitive approach was used to record the development and occurrence of stereotypes of computer users during adolescence and baseline data on behaviour was derived from recorded computer use. The affective component of attitude was examined by a single closed question and an open response statement. Sense of personal control over technology in relation to general sense of personal control was crudely measured to investigate any gender differences related to self-efficacy during computer use. As an untested method, it was also felt of interest to pilot looking at social or other affordances through preference for various computer settings from pre- to post-adolescence. This should indicate an implicit measure of functionality versus enjoyment from computing. The aims of the first study were met by means of a paper questionnaire combining quantitative questions and a pseudo-qualitative approach of a free-drawing exercise followed by coding on recurrent features. This initial paper questionnaire study is reported in Chapter Three.

Once the baseline data on stereotypes, emotion and use was in place the research adopted an entirely quantitative method using an online questionnaire that collected data across an expanded age-range Thus, more exact proportions of types of representation of computer users were collected and were able to be related to a better definition of lifespan development. Emotion felt during computer use was also reduced from an open response through means of a 20-item scale to a quantitative measure so various components of it could more readily be investigated in relation to other variables. It was felt producing and validating a scale here would be particularly useful in future examination of the affective component of computer use because it is not always within conscious awareness. Additional scales were also developed at this point of the research process to better investigate perceived control - not only in the specific domain of computing but also more generally. This aspect of sense of mastery over a computer needed to be explored as performance in a specific domain may have generalisation and vice versa. Chapter Four reports this online questionnaire study.

A further student sample was used for the final area of investigation that forms Chapter Five. This group underwent a computer performance task in a laboratory setting to reflect any self-categorisation and stereotype threat influences a same-gender or not representation of a typical computer user may have on actual use. Self-reported evaluations of self and others were related alongside the performance data to data from students completing the online questionnaire subsequent to attendance at the experiment.

By seeking out relationships at this point, as throughout the research, data were related to cognitive and affective components of attitude in order to establish links between these and behaviour which may then form together to shape identity in terms of the self as a 'computer user' and all the consequences that would follow.

Chapter Six concludes the thesis with a discussion of the empirical findings in the context of the published literature and suggested future research. It also relates the finding to more general themes within social psychology and attempts to broaden the debate on how theories such as Stereotype Threat fit in this context.

1.3. Introduction

The broad justification for the detailed research contained in this thesis lies in the requirement for a successful modern national economy to have a workforce that is not only literate and numerate but also sufficiently computer literate to keep apace with technological development worldwide. The computer industry and Internet transcend national boundaries to act as powerful forces in the dissemination and organisation of information. Those who can access information are often well rewarded by use of the tradable commodities of knowledge and communication. However there are inequalities in use and access within even the most developed societies and thus it is important to identify patterns of computer use and attitudes that could lead to sectors of the population being unhappy at the least, and the use of avoidance behaviour at the worst, when they encounter computers. As part of a 'developed' nation and on a more individual level, using a computer in the UK is now an integral part of nearly all occupations and a major form of personal communication with others, both for social purposes and with more official agencies and organisations such as banks and Government. Indeed in the most extreme of circumstances, and with the passage of time, refusal to engage with computers may lead to someone becoming disenfranchised and the governance of a nation being inefficient through avoidable duplication of communication media. It is the reluctance of full engagement to best personal advantage with computers that this thesis examined. It started specific to dissociation from careers around computing in adolescence but ended with a discussion of more general patterns behind this. Focussed quantitative data enabled identification, extent and comparison of relationships between variables towards establishing why general dissatisfaction with computers leading to disengagement occurs. In summary, this thesis started with identifying inhibiting social factors that lead to cost at the micro/individual level and put this towards understanding the macro/national level which affects all members of a society.

Chapter Two

Literature Review and Discussion of Previous Research

2.1 Aims of the Literature Review

This first phase of the research process was to identify and integrate the most relevant material from the extant range of available literature on the topic of gender differences in attitudes towards technology. The concept of representing attitudes towards computers in the tri-partite aspects of cognitive, emotional and behavioural components also required investigation in the context of previous research.

In terms of the direction the research of this thesis was to subsequently take it was also conducted to provide better clarity and focus as to the main variables for investigation using later quantitative research methods. Alongside the identification of variables and towards the development of hypotheses, a final purpose was to highlight the difficulties that much of the research has thrown-up around methodology. Thus previous methods of investigation in this area needed examination and particularly the need to address the debate as to the validity of recording explicit attitudes against implicit.

2.2 Background information on levels of women engaging with computing

As preparation for transcribing paper practices such an elections, Inland Revenue returns, vehicle licensing and such like to electronic equivalents, the dissemination of essential advice and such like, the UK Government has commissioned opinion polls to identify the best means of providing interaction and communication for all. The results of these polls indicate a gender difference in attitude towards new technology with women significantly less likely (46% of women compared to 58% of men) to consider new technology as improving communication with Government (Women's Unit, 1998). They were also less willing than men to use a touch screen (17% vs. 24%), interactive TV (13% vs.21%) or a personal computer (30% vs. 40%) to communicate with Government (Women's Unit, 1998). Brosnan and Davidson (1994) have suggested that fear of computers is more common in females and that this would contribute to a gender difference in attitudes. Another likely explanation is that this is a reflection of a more general antipathy towards computers consistent with the under-employment of women in the computer industry itself. In the USA a mere 18% of the IT workforce were women with this proportion falling to only 7% for top executive positions (Goyal, 1996). Furthermore, within the UK, female admissions to university computer courses in 1995 comprised just 18% overall despite initiatives to attract more women applicants as a means to satisfy national skill shortages (Durndell, Cameron, Knox, Stocks & Haag, 1997). Ironically, although there are fewer women attracted to careers in computing, it has been reported that sex discrimination and stereotyping within the computer industry is less than in others (Laberis & Paul, 1983, as cited by Goyal, 1996) through the relative youth of the subject and success as an absolute measure of proven, gender neutral and gender undetermined technical skills.

There are parallels in the attitudes towards technology with those towards science and mathematics more generally. To try to establish how domain-specific this attitude may be Smith, Morgan and White (2005) conducted a series of studies that indicated that identifiably different identification with computing and mathematics could be established and these linked specifically with attitudes towards any likely future career in these areas.

2.3 Women's attitudes towards computing

The pattern of under-representation seems to be persistent despite studies indicating few girls describe computing as 'boring' (Smith, 2005). Toshiba report an ever-decreasing proportion of female IT workers since the 1960's with the level being down to only 21% in 2005. Remarks from women leaders in IT such as "We care about this morally, but also on a practical level," (Maggie Berry from Women in Technology) do not always counteract the other types of remarks from women working at the highest level in the IT industry such as Toshiba's head of information systems, Sandra Smith, who has claimed that "There's too much testosterone in my department,". The Government initiative of C4G, computer clubs in schools specifically for girls, has also not been universally regarded as successful in increasing girls' interest in computing careers. Melody Hermon of Computer Club for Girls recorded her view that "girls are usually much less interested in how the machines work, than in what they can achieve", thus indicating the actual contents of the box in terms of software and hardware was of little interest and that girls rather than adapt or tailor software would use it in standardised forms to seek out and then accept what it could offer.

This impression of males modifying and customizing technology more than their female counterparts is supported by research on Internet use (Joiner, Gavin, Duffield et al. ,2005). This indicates that men identify more strongly than women with the Internet and beyond a cognitive difference in terms of their self-description also behave differently by not only using the Internet more but also being more likely to have their own webpage.

This indicates that there may be something inherent in computer use that averts women so they do not identify with it or alternatively that there are strong social factors or early experiences that prevent women from embracing computer technologies. It also suggests that there are factors such as ‘interest’ and ‘boredom’ that can be examined to identify how representative this is of a negative attitude towards computers based on a recorded emotion during use or socially derived norms of appropriate emotions to be reported.

One problem that recurs in the literature is the difficulty of measuring computer attitudes and how useful any scale is in actually predicting likely use or confidence. A recent discussion of this (Garland & Noyes, 2008) compared four computer attitude scales and concluded that although most were reliable and relevant, despite their age and the rapid changes that have occurred of the place that computers have in society, none of them truly address the ethos of using a computer. Attitude is generally derived from hours of use, computer experience and computer confidence which may only represent part of the reality as computers are inescapable in the modern world.

Indeed the more recent approach to computer attitude scales is exemplified by Wang, Chen and Shi (2007) who consider that the computer rather than simply operating on the more distant, traditional constructs of a separate entity to the self and acting as a useful tool instead has three more components of a more humanistic nature: sense of harm; sense of benefit and sense of dependence. In effect these authors suggest attitudes towards computers now more closely replicate that of our evaluation of the affordances another person may offer to us – are they good/bad for us and what will they ask of us? At the level of integration to everyday life and time spent with computers that most people now have this may be seen as a natural development of the closer relationships most people develop in terms of increased interaction with their computers.

2.4 The development of gender roles and their effect on computer use and computer confidence

Previous research (Archer, 1984) has shown that parents endorse gender roles with toys and constraints on behaviour seen as appropriate for the sex of the child with more rigid male roles supported than female. Although girls as ‘tomboys’ are better accepted than boys as ‘sissies’ if computers are seen as boys’ toys it helps explain the reported patterns of use which indicate that parents buy more computers for sons than daughters (Durndell & Thomson, 1997). This effect works alongside the imbalance in commercial software available that favours boys’ tastes rather than girls’. Thus, there is a greater use of computers by boys for social purposes from actual game-play to discussion and sharing of game software with peers. Indeed, the generally perceived impression of males as ‘loners’ who do not interact socially through absorption with computers is very strongly challenged by research on Internet use which indicates that men’s and women’s use is undifferentiated as far as use of the Internet for communication is concerned (Joiner, Gavin, Duffield et al. ,2005).

Beyond the peer pressure and social pressures of conforming to a particular social identity based on the objects one owns and aspires towards, cognitive developmental theory proposes knowledge of a child's own sex makes liked others of the same-sex act as role models. Archer (1984) argues that girls tend to identify with their mothers whereas, by lesser contact with a father, boys tend to use their peers as role models. Thus, computer ownership by boys is amplified as they attempt to mimic friends with computers. Compounding this, once one member of a social group of boys has a computer, the pressure is on for other parents to endorse that until it becomes the norm. However, in contrast, girls using their mothers as role models reinforce the pattern of relatively low computer interest and higher interest in self-definition through personal appearance, comfort objects or items that define relationships.

Although not specifically relating to computing, Lewis, Ross and Mikowsky (1999) state that parental endorsement and home opportunity for experience can be powerful allies in not only increasing skill but also confidence and a sense of control at a chosen task or within a certain context. Cognitive skills, defined as the 'ability to acquire and apply knowledge', set adolescence behaviour patterns that then affect adult attitudes and outcomes. Alongside this, from the age of 14 sense of control in life increases for those who remain in education with, unsurprisingly, the level of parental education helping to foster this. The effect is not so apparent for those who do not pursue formal education so fully. Thus, settings that promote early experiences of learning, whether by educated parents or committed others help develop pre-teen cognitive skills that stand alone as the most significant determinant of a later high personal sense of control. Indeed, this theoretical framework of important others shaping a sense of personal control is endorsed by the work of Skinner, Zimmer-Gembeck and Connell (1998) whose longitudinal study across adolescence indicates the clear self-fulfilling prophecy of children judging their ability by encouragement from others to persevere. This is particularly important with pre-adolescent children since they lack the cognitive capacity to distinguish endeavour producing success from actual ability and will assume the more successful are the more hard-working rather than the more able.

Lewis, Ross and Mikowsky (1999) refer to a general sense of personal control but it is not too large a step to argue that seeing oneself and being encouraged to see oneself as a competent and confident user of computers could produce a concept of computer mastery that becomes integrated into self-identity. Solvberg (2002) examined this very point by evaluating self-appraisal of computer expertise and found gender differences in sense of control in a group not explicitly exposed to computers and computer training against those without specific endorsement of computers as pertaining to the self. Those without this cognitive pattern of computer appraisal see computers as beyond their personal remit or direct slavish control. Hence the adolescent years are key not only in the development of attitudes generally, but also more specifically in attitudes towards computing either through the generalisation of a high sense of personal control or through specific encouragement in that area.

Conversely, it can be argued that with the advent of computers as part of the National Curriculum and their presence in every primary school in the UK, attitudes towards computers should be becoming less differentiated between males and females. Durndell and Thomson (1997) recorded computer use, knowledge of computers and reasons for not studying computing from 1986 to 1996 and found that this was indeed the case although the differences were only diminishing very gradually. Use in school during lesson time had become similar for boys and girls but the use of computers inside school during free time and outside school remained much higher for boys than girls. Measures have been taken in USA to ban access to computers during recess to make computer use time more equable between girls and boys (Huber & Schofield, 1998, p114). This was felt to be particularly important since the imbalance reinforced stereotyping. Additionally those with more confidence or experience gain more access through the passivity of a less able partner and this in turn serves only to widen the ability and confidence gap further (Huber & Schofield, 1998, p128). Worse still, educational software was also found to contain biases in favour of higher appeal to boys (Huff & Cooper, 1987) thereby further alienating girls in the school environment.

Many of the social factors behind the difference in boys' and girls' preference for computer use is summarised by Chivers (1987, p21) who puts forwards a suggested list of primary factors behind a less positive attitude towards computers for girls than boys. These are parental attitudes, peer group pressures, teachers' and software developers' sexist practices, the lack of suitable role models, over-assertion of equipment by boys and a lack of confidence in girls to try new things. Huber and Schofield (1998, p121) examined the last of these factors, unwillingness of girls to attempt new or difficult tasks, in isolation and found that parents and teachers encourage boys more than girls to re-attempt difficult tasks in order to master and control them. Expectations are often higher and praise reserved for success rather than mere attempt.

Once a task has become associated with gender girls are unwilling to be seen as 'clever' at a "boys' thing" in case it alienates them from their peer group or makes them less desirable to boys (Chivers, 1987, p25). In running counter to their sex role they risk being seen as a lesser member of an in-group to girls or as lesser representative (less feminine) to an out-group of boys. Although this quite often leads to a rejection of all things masculine by girls it is not as marked as the effect for boys who markedly reject all things feminine (Eisenberg-Berg, Murray & Hite, 1982).

This would indicate that if a girl acted against the stereotype and became a high-level computer user she could have difficulty reconciling her gender identity. Upitis (1998) examined this very point by categorising a group of school-age users into ‘computer personalities’. She found that a girl ‘hacker’ despite equal skill and behaviour was not labeled as such by her peers and refused to think of herself in that context. Boys, on the other hand, were happy to label themselves and their fellows as 'hackers' with full computer mastery. Some even gained kudos from the status.

One technique that can be used by girls (or any others) to maintain their identification with their stereotype is to underplay or refuse to acknowledge their abilities. This has been termed ‘sandbagging’ (Gibson & Sachau, 2000) and primarily acts as strategy to protect self-esteem and preserve gender identity. It does not seem to impair performance and in some cases relieves the pressure against expectation to do well. It can act as a defence mechanism should failure occur and appear as modesty on success that can promote liking. It is a phenomenon well known in the competitive arena to explain why the under-dog sometimes produces an unexpectedly brilliant performance against an opponent lulled into a false state of security.

‘Sandbagging’ is distinct from ‘self-handicapping’ in that the individual’s performance is not affected by the strategy. The ‘sandbagger’ demonstrates or describes low ability despite confidence to succeed and is prepared to attribute success and failure to themselves. Then should an important task be set a motivated ‘sandbagger’ will demonstrate their true potential. A ‘self-handicapper’, however, claims hurdles to success prior to the task because they are unsure of their ability to succeed. Then, if failure should occur it is not blamed on ability but attributed to external causes. If success should occur, ability is seen as enhanced to overcome the difficulties but still dependent on external causes. Performance is generally lowered as confidence is reduced through the salience of reasons for failure irrespective of their real or imaginary nature. Ultimately, self-handicapping can even lead to avoidance behaviour.

It can be seen in the context of computing that girls may operate either a sandbagging or self-handicapping strategy and appear to hold negative attitudes towards computers in order to preserve gender identity that dictates self-presentation as a poor computer user. If girls are confident and competent users then they may sandbag to preserve their female friendships and remain feminine. If they are unsure of their ability they may self-handicap and for example say they cannot be expected to know about computers since they have little experience. With computing experience defined as a forerunner to computing ability and a preference not to be seen as a computer nerd or doing male things this becomes a self-fulfilling prophecy as they are unwilling to gain experience. It can be suggested that boys and perceived feminine activities such as cooking or ironing could be similarly ‘self-handicapped"’.

As some compensation, the value of various uses of computers has been seen to be different based on gender such that some applications such as word-processing are seen as without any male association whereas gaming and programming are (Oosterwegel, Littleton, & Light, 2004). Thus, the secretarial role translated via technology to the computer is not prone to a masculine attribution and may act as at least one feminine form of use in creating the overall attitude towards computers.

2.5 Computers as objects and gender differences in the affordances they offer

The actual preference for objects is something that has been studied primarily around the interest in ‘treasured possessions’. This refers to the well observed phenomenon of a favourite teddy bear, blanket or similar that acts as a parental substitute to young children in the primary caregiver’s absence. Thus, an object acts as an emotional support in times of attachment need. There seems little difference in terms of gender for very young children in this but the development from early infanthood through childhood and adolescence is an area of study that indicates beyond the social influences of ‘appropriate’ toys based on gender there are real differences between males and females in the purpose behind their ‘treasured possessions’ (Kamptner, 1995, Dyl & Warner, 1996).

One such piece of research that tracks gender preferences from a pre- to post-adolescence period is by Dyl and Warner (1996) who interviewed participants from 6 years of age through to 16 years of age with regards to their most treasured items. The children aged six years still acted egocentrically and referred to possessions acting as transitional objects that served as a safe base to replace an absent care-giver and from which they could explore their environment yet still be able to return securely to that item. They also saw treasured items as initial mechanisms to practice social interactions such as teddy bear picnics and tea-set parties. However, there was also a move from the youngest children towards regarding objects as items about which they could make personal decisions which would affect an outcome related to that item. This was based upon repeated comments of control over an item and possession in its truest sense of an extension of the self into a managed and mastered object. Items also served a cognitive purpose in that they represented personal experience and history and were used as markers for events or relationships. Boys at age six endorsed the desirability of an item based on what it could offer them in terms of enjoyment or more effectively what they could do with it that would allow them to feel good about themselves. Across the full age range this effect was sustained by the male participants with 18 year-olds also referring to treasured sports equipment as something that made them feel better about themselves when they used it.

It is suggested at age 18 some possessions still perhaps act to some extent as a security measure and as a mechanism for self-verification. Girls however declined in this representation of treasured possessions as instrumental to self-verification in the same way and instead preferred contemplative items increasingly with age. Items became more treasured as they endorsed relationships such as jewellery received as a gift from friends or family. Both of these patterns sit in line with Erikson’s (1963, as cited in Erikson & Erikson, 1997) theories of identity formation in adolescence but again from different perspectives with males using items for an independent self and females using objects for an interdependent self.

Once earning potential of ones own was enjoyed, males and females seemed to establish their independence in different ways. Items that are actively instrumental towards independence seemed more prevalent in males than females as bicycles and other means of transport such as cars were mentioned as enjoyable items to own and a means to establish and maintain social networks. Females tended to establish identity through buying items that display independence rather than act it out dynamically such as clothing, jewellery or items for their rooms that set them apart from their parents. They also seem to develop peer conformity and 'fitting-in' through buying items that related to their friendship groups. Relationships were further fostered through mutual sharing and gift-giving rather than actively owning transport to enable contact.

One further aspect of the study of cherished possessions is that in general there is more change over adolescence for males than females as they move from comforters to instruments of independence (Kamptner, 1995). This is in line with the social expectations of males becoming fully independent during adolescence whereas to some extent it is still socially permissible for females to retain a degree of dependency. Thus, status derived from ownership of a rare item and value aside, the importance of identity by virtue of the objects owned may be greater for males than females. It may also explain male pride and hurt should something happen to their car against the theft of an item of inherited jewellery which would cut more deeply at a woman's sense of identity.

Computers as instruments of enjoyment that create escape and distraction through game-play and role-assumption (Cole & Griffiths, 2007) may well act as attractive features for males but a further appeal will be to act as an instrumental means of social contact whether it be through message boards such as the online community of Gaia (http://www.gaiaonline.com/) with a supposed 17 million members (Retrieved 1st April 2009 from http://rankings.big-boards.com/?sort=members) or online gaming such as World of Warfare (http://www.wow-europe.com/en/index.xml) which reports it has 11.5

million online players involved as avatars in various virtual worlds (Retrieved 1st April 2009 from http://eu.blizzard.com/en/press/081223.html). Skill acquisition through computer use may also be seen as a career option since computers are framed, as with many other male possessions, as tools. Based on developing an interdependent identity, the communication aspects of computers and the Internet will clearly appeal to females as well but it is less likely they will be seen as tools to further a career since in general adolescent females do not think as generally in such instrumental terms (Upitis, 1998). Few would suggest that computers offer much comfort in a tactile sense or replication of a care-giver but the storage of life experiences and sharing of such through interfaces such as Facebook (http://www.facebook.com/) and MySpace (http://www.myspace.com/) would undoubtedly appeal to both sexes albeit for possibly different reasons such as bonding and intimacy amongst female friendship groups and peer approval and status amongst males. Indeed access to a computer at the very least and better still ones own may become an imperative to adolescents in the same way as mobile phones determine social lives and identities independent of parents.

Group cohesion is dependent on maximising communication within any group so peer-pressure to maintain friendship groups through adopting common means of communication, whether texting on a mobile phone, the same online chat provider or whatever will be important to adolescents wanting to remain included. Furthermore, using new forms of technology will serve to distinguish an adolescent's socialisation from the patterns familiar to their parents so serving several purposes: separation and exclusivity from an older generation increasing group identity; adherence to group norms increasing acceptance and better kudos from ones peers as the latest, best means of communication indicating support for group values. Thus, the aspects of computers for communication or games and any gender differences therein may serve to support any difference in mechanisms to support friendships in adolescence (Willoughby, 2008).

More specific to this thesis, technology products reflect the ideas of innovation and modernity and thus ownership of the latest product indicates a self that is identified with initiative, progress and worth (Grewal, Mehta & Kardes, 2000). This may be more important to men than women since they are expected to be dynamic and action-orientated. Furthermore, rarity through recent invention increases value and status which is also considered to be more of relevance to men than women. Women who define their selves through possessions reflecting life experiences or personal appearance are also less likely to see this possibility in the most recent technology product. Manufacturers even go to great lengths to overcome female resistance towards technology by customising phones not by enhanced technical features but by appearance such as being pink in colour, obviously feminine or available with fashion designers' co-ordinated extras.

2.6 How computing as a masculine activity relates to performance

Once defined as a masculine activity a complementary theory to self-handicapping, stereotype threat, predicts women will 'dis-identify' with that area (Spencer, Steele & Quinn, 1999). This preserves self-esteem by avoiding stereotyped failure and maintains self-identification as female. In other circumstances without any cognitive strategy to the contrary, actual performance is reduced as the onus of proving a stereotype wrong increases anxiety. In effect, whilst boys master computing because they expect to, many girls may miss out because they think it inappropriate, underplay any mastery they have acquired or underperform because they consider themselves atypical.

Indeed this becomes a self-fulfilling form of self-definition based on previous experience and socially derived information which shapes identification with a domain and this then becomes incorporated into the self-schema which affects motivation and expectations of success in that domain (Smith, White & Morgan, 2005). Hence if women in general do not identify with computing they will be less motivated to engage with computing or be motivated to do so, reinforcing self-schema of low identification with technology. This clearly establishes a link between cognitions based on self-schema and behavior based on high versus low motivation and seeking out versus avoiding opportunities with technology.

One study that addressed the problem of motivation and explicitly attempted to keep it as a constant was conducted by Davies, Spencer, Quinn and Gerhandstein (2002). It included maths majors in the second year of their course that considered themselves both ‘good at math’ and agreed that ‘it is important that I am good at math’. Thus motivation was high and the task, a maths test, was personally relevant. Participants were either exposed to two TV advertisements that portrayed women in trivial roles of drooling over a new chocolate cake mix or displaying extreme excitement for a skin care product or to two non-stereotypical TV advertisements that showed a woman talking intelligently about healthcare or impressing a man with her knowledge of cars. In the first part of their study, between watching the TV advertisements and tasking the maths test, a lexical decision task indicated that both men and women participants had female stereotypical information primed if they had seen the stereotypical TV advertisements but not if they had seen the counter-stereotypical ones. Women, exposed to the negative stereotype performed worse on the maths task than those who had seen the alternative counter-stereotype commercials. Men who had seen the negative female stereotype advertisements performed better than otherwise and this occasional side effect, to be discussed later, has been referred to as ‘stereotype lift’ (Walton & Cohen, 2002). The second part of the study by Davies et al (2002) removed this checking procedure on stereotype activation and replaced it with a free choice of maths or verbal exercises that participants could attempt as a time-filler. It was found women subjected to the stereotypical advertisements preferred to perform verbal task time-fillers rather than mathematical ones, unlike their male counterparts or those who had seen only neutral TV advertisements. Thus women seemed to avoid exposure to a task that could support the negative stereotype and furthermore when they were asked to perform the final part of the experiment, the obligatory maths test, they again underperformed. The final part to the study by Davies et al (2002) attempted to assess the longer term aspirations of women based on exposure to these different types of TV advertisements in terms of career and asked for completion of a vocational survey - the responses to which were factored to load on either a quantitative (masculine) domain that included careers such as engineering, computing, mathematics etc. or a verbal (feminine) domain that included careers such as communications, literary fields, journalist etc. A third domain of health care was not analysed in relation to invocation of the stereotypical model. Women exposed to the stereotypical advertisements, as predicted, tended to reject quantitative careers and instead increased their preference for the verbal type careers that did not run as counter to the female stereotype and provoke the possibility of negative appraisal on an atypically feminine ability.

Despite the theories described above, research as yet has not determined any definitive group of social factors that relate specifically to gender differences in cognitive patterns of computer assessment. Social theories involving sense of personal control, sandbagging, self-handicapping and stereotype threat have not been tested in the computer context or been applied for comparison in a single study. Furthermore since adolescence is such a critical period in career choice, the development of a self-identity and social cognition in general, particular attention needs to be focussed upon any changes that take place then. Examination of lifetime variation in attitudes is also vital since social processing affects behaviour throughout. Additionally, multiple stereotype threats such as age and gender may act as compounded disadvantages to older women whose cohort would also historically have been more exposed to rigid sex-roles and discriminatory practice.

2.7 Limitations of a social psychology approach to research on gender differences in computing

The following sections present alternative arguments to the social psychology approach of gender roles, social development and influences determining attitudes towards computers. They consider intrinsic individual differences in brain physiology and differences in aptitude due to natural selection and evolutionary success for sex-based skill specialisation. The nature/nurture debate with regards to gender differences in computing is therefore whether there are innate features based on biological sex that dictate men, for example, may have naturally superior skills at computing than women or whether social factors and experience form an attitude and sense of identification. For example, it appears a robust effect that men innately possess superior visuospatial skills to women that leads to greater ease with mathematical tasks through the ability to process abstract 3-D information. (Masters & Sanders, 1993). Gender differences in the numbers who enter careers in engineering or science are also suggested to be related to this innate difference although even with what appears to be innate differences it is suggested that human variation means some girls with high visuospatial skills outperform many of the boys (Casey, Nuttall & Pezaris, 1997). Investigation of these areas are beyond the scope of this thesis but they are included to illustrate the limits of the research contained herein and to reflect that these are growth areas of research either based (ironically) on new technology opening up more methods available to study brain physiology or a current focus on evolutionary psychology.

2.7.1 Brain physiology as an explanation to why women do not engage with computers

In terms of the nature argument and that there is something intrinsic to the female brain one of the areas that is most convincing as to why women feel less comfortable with highly systematic processes such as computer programming and impersonal interaction is the research by Baron-Cohen on autism and different brain types (Baron-Cohen, 2003, Baron-Cohen & Wheelwright, 2004). It indicates that there are biological factors beyond mere heredity such as pre-natal testosterone levels in the amniotic fluid that move towards a higher proportion of males having ‘systemizing’ or an ‘extreme male brain’ in the case of autism that is linked to approaching life through a collection of systems that need logical resolution. For example, the positioning of a perception in terms of categorization and implanting in a structured knowledge base is a more natural tendency to some (generally males) than others. The alternative is a physiologically based preference to interpret reality through interpersonal relationships and adjustments based on a more developed ‘theory of mind’ that structures reality in a more haphazard way. This type of ‘empathizing’ brain is held more often by females and thus would go some way to explain the differences in self definition that exist between males and females in terms of independent or relational selves (Eagly & Steffen, 1984, Cross & Madson, 1997, Kashima, Yamaguchi, Kim, Sang-Chin, Gelford & Yuki, 1995, Aries, Olver, Blount, Christaldi, Fredman & Lee, 1998, Guimond, Chatard, Martinot, Crisp & Rederdorff, 2006).

In terms of interaction with a highly logical and systematic system such as a computer there are therefore obvious reasons why some people not only find it easier through having a more closely matched mental framework but also through a more compatible style of communication. Hence some tend to seek out the computer experience rather than avoid it and this is clearly nothing to do with social factors.

There are methodological problems associated with following this type of research across the age range proposed by this thesis. To look at career choices requires examination of pre- and post-adolescence attitudes. To adapt and apply the empathizing and systemizing scales generated by Baron-Cohen to children as young as 10 could be impractical and produce unreliable results. So much as there may be considerable merit behind examining systemizing types against empathizers in this research, gender as a categorization may be inaccurate but it is at least less prone to cultural and societal manufacture than degree of personal empathy.

2.7.2 Gender roles and preference for computers through evolutionary advantage of skill specialisation by males

To indicate the likely depth of this difference, it has been suggested (Alexander & Hines, 2002) that toy choices made by humans such that boys prefer cars and balls and girls prefer dolls is linked to an endocrine disorder in early childhood where levels of androgens were a better indicator of toy preference than biological sex. Whether there was some evolutionary advantage in this such that females are selected on their ability to prefer and care for certain shapes, colours and movement is less well defined although there is some indication that perceptual preferences around colour and movement do exist (Alexander, 2003). In particular, innate preferences for items that elicit motion are of more interest to males based on evolutionary arguments. Thus, an initial preference for males to develop skill in movement tracking through toy choice ties in with developing the superior spatial skills required to position hunting groups and map a hunting terrain or prey environment. A bias towards specialised visual systems tracking movement leading to expertise and skill specialisation can be seen to be compounded by usefulness to the social group and hence social norms allocating this role to a differentiated sub-group based on some feature such as biological sex or innate interest. Group norms of a hunter-gatherer tribe or any similar society would then compound this effect.

The pre-occupation of males with sports that involve visual systems to track objects may also reasonably be traced to this effect. The need to co-ordinate eye, body and ball is certainly something that many more males find appealing than females whether it is through football, rugby, cricket or whatever. It can also be argued that certain computer games are mere transcriptions of such play with hunting or 'first person shooter' types (Wolfenstein, Doom, Medal of Honour etc.) pursuit types (Gran Turismo, Colin McCrae Rally, Grand Theft Auto etc.) or sports types (FIFA Football, Tiger Woods, Tony Hawkes etc.) of computer games. The expansion on to the Nintendo Wii platform takes this to an even more developed and involved level with full body co-ordination and response replicated through the suite of Nintendo Wii Sports software.

Hence, it seems the interest in movement for males starts young and becomes normalised through accepted practice routes. In terms of this thesis the biological predispositions of males and females based on bias towards different kinds of visual processing are beyond its scope. What is clear is that with a more evolved society these skill specialisations in superior visual tracking would be less rewarded than previously. It is therefore not a matter of how innate these tendencies are but whether they are recognised and encouraged to be of worth. Also whether there is retention of a traditional principle that spatial skills in males are of more worth than they are in females through the accepted gender roles that each are expected to be able to perform. How gender norms operate such that girls and boys feel able to develop these skills is really the essence since perceptual processes, as with many other skills, can be improved with practice through motivation and application. In terms of computers, evolutionary factors may well explain the types of computer games that girls and boys choose to play but it does not go very far with regards to following a career in computing that may have rewards such as good pay, independence through self-employment and working from home options that many other careers do not.

2.8 Summary of the literature towards developing areas of study within this thesis

The areas that have emerged form the literature are that firstly personal use and access need to be ascertained to set all other data in context. Thus individual differences in computer use affect the attitudes that people hold about computers and vice versa. Attitudes are not easily assessed through direct means because of socially desirable answers and difficulties in accessing inner belief systems and subconscious representations of appropriate roles based on gender or any other such criterion. Furthermore, looking across adolescence provides particular difficulties in having equivalent forms for all ages that allows cognitive development over this period not to become a factor in interpretation of language or any task. Thus, methodology is critical in extracting useful data such as by means of the 'draw a computer user' task (Brosnan, 1999) or clear-cut choices and preferences without participants second-guessing the purpose of the inquiry.

Fruitful area for investigations to build a cohesive picture of computer attitudes and antecedents to avoidance as a career therefore are most likely to be based around mental representations of what being a computer expert is, whether one wants to see oneself and assume others perceive oneself as such, literally whether one wants to 'buy into' that and the affordances of what a computer brings plus how personal suitability through sense of control and self-efficacy fit. Finally, how do attitudes derived from stereotypical representations affect actual performance so that features of a stereotype undermine success and so disengage individuals from participation through a social identity defended by dissociation and avoidance, based on the theory of Stereotype Threat (Spencer, Steele & Quinn, 1999) that has seen to operate in other domains and with other social groups?

Chapter Three

Paper Questionnaire Study

3.1 Introduction

The study reported in this chapter laid the foundation for the remaining research by collecting data on computer use and mapping the extent of computer user stereotypes. It covered five areas and was split into five associated parts: computer use; computer control; affective components of computer use; gender identification with computers through liking for various computer appearances; and stereotypes of computer users.

The first part of the study set participants' use of computers such as place and degree of use within the context of previous research and provided baseline data for different sexes and ages to be used elsewhere in the study.

The second part of the study sought to collect basic data on sense of control during computer use that could either be a reflection of generalised sense of control or an outcome of parental encouragement to be a 'computer user'. Attribution of control to internal or external loci for the computing task is of interest to help explain attitudes (Solvberg, 2002) and perhaps show evidence of sandbagging (internal loci) or self-handicapping (external loci) approaches to computing.

The third part of this first study was examination of more general emotions felt whilst using a computer. Brosnan (1999), in a study described more fully in the method section of this chapter, found girls aged 5-11 years drew fewer 'happy' computer users than did contemporary boys suggesting an overall less positive affect towards computers for girls. This initial study intended to examine the emotion felt by an adolescent sample more directly by use of a free response to a question on emotion (categorised as positive or negative affect) and attitude (positive or negative) towards learning computing for a specific objective such as a job.

The fourth and fifth parts of this study examined intrinsic patterns of thought and implicit attitudes towards computers and computer users using indirect methods of assessment. This is because it has been suggested (e.g. Nosek, Banaji & Greenwald, 2002) that asking explicit questions about attitudes and social stereotypes can produce results that appear to react against them. The effect is attributed to participants' assumptions that giving a politically correct response with all social groups' differences minimised is the most socially desirable. Although indirect methods may still have the effect present, it is reduced and in some cases, particularly with children whose level of social sophistication is less, it may even be eliminated.

So, the last and largest two parts of this first study dealt with attitudes towards computers and examined the association of gender with computing using less direct methodologies than self report to a question on a questionnaire. It is presented as two parts as it comprised two separate methods. The indirect approach used in the first method required participants to view photographs of several different computer settings to assess their visual appeal (like versus dislike) and so identify any factors that increase or reduce this. A rejection of all things masculine by girls and vice versa (Eisenberg-Berg, Murray & Hite, 1982) should be evident if computer appearance is associated with gender. Individuals often assign a gender to inanimate objects (Nass, Moon & Green, 1997) which could indicate that visual appearance may either influence perceived gender of the computer itself or assign gender to an appropriate user. Since women and girls in particular are put off by situations in which they are not expected to succeed (Lightbody & Durndell, 1996), creating an image in which evidence of a female presence exists could trigger attributions of comfort and success and hence produce a more positive attitude towards a setting. Furthermore, there is evidence that men and women arrange computer equipment differently for use (Cooper & Stone, 1996) and so have preferences in its appearance. Visual presentations within software have also been found to affect boy and girl pupils differently (Cooper & Stone, 1996). The response to different computer settings therefore has the potential to provide data that would reflect intrinsic attitudes towards computer appearance such as desire for personalisation and gender association of users.

The fifth and final part of the study also used an indirect method and extended previous research on the measurement of computer attitudes through an art based “draw-a-computer-user” technique. Brosnan (1999) asked 5-11 year-olds to draw a picture of someone they considered used a computer and found boys and to a lesser extent girls drew computer users as male. This study reported here adapted Brosnan’s method to examine sex and age differences from the beginning to the end of adolescence. It examined the sex, age, appearance and familiarity of the typical user drawn in relation to the sex and age category of the individual. It also examined, as Brosnan did, the mood of the figure drawn to infer affect towards computing.

In addition to the data yielded by the individual parts of the study, the different measures will be combined to give an overall view of computer attitudes. Thus, recorded computer use will be correlated with the other data for an individual such as education and interests, sense of control during computer use and attitudes to computers and their users. Thus, the research will fill a gap in the literature by relating computer use to the prevalence of social stereotypes of computer users.

In summary, the overall aim of this first study was to combine results from different methodologies into a cohesive picture of attitudes, both internally felt and overtly expressed, towards computers. It aimed to apply more general theories of social cognition to the computing context and extend our knowledge of male and female computer attitudes and behaviours towards computers.

3.2 Hypotheses

The hypotheses for this study reflect the five parts of the study described:

3.2.1 Use and interests

3.2.1.1 ***H1***: There will be more reported computer use for male participants than female participants (based on Dundell & Thomson, 1997)

3.2.1.2 ***H2***: Computer use will be related to gender roles through association with favoured subjects for study at school (based on Archer, 1984)

3.2.2 Sense of control

3.2.2.1 ***H3:*** There will be a relationship between level of use (computer experience) and sense of control during computer use (based on Solvberg, 2002)

3.2.2.2 ***H4:*** Sense of control will differ for male and female participants (based on Ross & Wright, 1998)

3.2.2.3 ***H5:*** As general sense of personal control is affected by educational background, so sense of control in a computing context will also be related to educational attainment (based on Ross and Mirowsky, 2002)

3.2.3 Affect during computer use

3.2.3.1 ***H6:*** There will be more positive affect expressed by male participants whilst using a computer than by female participants (based on Brosnan, 1999)

3.2.4 Computer Appearance

3.2.4.1 ***H7:*** There will be differences in preferences of computer appearance for male participants and female participants (based on Cooper & Stone, 1996)

3.2.5 Stereotypes of Computer Users

3.2.5.1 ***H8:*** A typical computer user will differ for male participants and female participants (based on Brosnan, 1999)

3.2.5.2 ***H9:*** The process of social cognition development during adolescence will affect the types of computer users drawn for the different age groups (based on Hoover and Fishbein, 1999)

3.3 Method

3.3.1 Participants

The participants were from two age groups, 10-11 year-olds and 16-18 year-olds, who attended state schools in Northamptonshire and Warwickshire that responded positively to a request for participation in this study.

For the youngest age group, data from eight schools were used and for the teenage age group data from six schools were used. A total of 335 Year 6 (aged 10 to 11 years, mean age =10.58, SD=0.49) and 189 Year 12 (aged 16 to 18 years, mean age=16.88, SD=0.46) participants were recruited. The ratio of male and female participants in both age groups was almost equal with 169 boys and 166 girls aged 10-11 years participating and 89 adolescent men and 100 adolescent women aged 16-18 years participating.

To ensure ecological validity several analyses were conducted to compare sample characteristics of the schools chosen with national data. These analyses are included as Appendix A-1.

3.3.2 Design and Materials

Two questionnaires of similar design were used and are included as Appendix A-2. The main difference in design apart from occasional simplification of the language for the youngest age group was the inclusion of an additional central section in the questionnaire for the teenage age group. This required explicit attitudinal responses to questions on computers and the Internet and sat between an initial sense of control question and a later locus of control attribution. Data from this additional section exclusive to the teenage age group are not included in this thesis.

The study involved changes during adolescence so the design was a 2x2 between-groups design with age and gender of participants as independent variables. The questionnaires reflected the five research areas and were split into five sections accordingly (the section on direct attitudinal questions for the 16-18 year-old age group being discounted).

3.3.3 Procedure

Discussion with the schools that agreed to take part indicated that the preferred method was for the schools to receive the questionnaires in hand and for the children to complete them at their teachers' convenience in a single sitting along the lines of a class exercise. Permission was granted from the head teacher of each school so teachers acted 'in loco parentis' to allow permission for their pupils to take part. The questionnaires were felt to be sufficiently similar to regular school work that the children would not be put under any duress by completing them. The experiment had received formal approval from the School of Psychology, University of Leicester's Ethics Committee. Instructions were included that asked for the questionnaires to be completed without conferring and as spontaneously as possible. Participants who did not wish to take part were freely able to withdraw from the study. Space on the questionnaire was also included for any comments. All questionnaires were entirely anonymous.

3.4 Details of method and results for each area of study

For purposes of clarity within this Chapter, there are five sub-sections of combined Method and Results sections that relate to each of the five areas of study. The Discussion combines all these elements.

3.4.1 Section 1: Education, Interests and Recorded Computer Use

Section 1 Method

The first section of each questionnaire recorded interests and computer use. To reflect educational background each school that provided data was ascribed a rating based on published data about its performance in national assessments. This was particularly relevant for the youngest age group who had no personal data available concerning educational attainment. All questionnaires initially recorded sex, age and either favourite subject (for 10-11 year olds) or subjects of ‘A’, ‘AS’ or GNVQ exams currently being studied (for 16-18 year olds). The teenage age group next indicated level of personal educational achievement in the form of number of GCSE passes obtained. Computer access in the last month was recorded for all age groups based on use of family, own, school or friend’s computer. Level of computer use was determined by one of two means. Participants either made a choice of three levels of use based on average number of hours’ use per week (youngest and oldest age groups) or gave a free recording of number of hours (16-18 year-old age group). This latter figure was attributed a category for comparison with the other age groups and also used directly for comparison with other variable such as subject interests, educational attainment and sex of participant. Degree of computing expertise was assessed for the teenage age group only by self-description as novice, average or expert user.

Thus, the dependent variables were school rating, personal educational attainment (16-18 year-olds only) and a measure of gendered interests (based on favourite or exam subjects at school). Further variables are computer access (use or not in last month of family, own, school and friend's PC), computer usage (categorisation and actual hours (for 16-18 year-olds only)) and computing experience are also variables.

Section 1 Coding and analysis

The method used to generate school ratings is described in Appendix A-1. Number of GCSE passes obtained (Grade C or above) was taken directly from the participants' responses.

Details of coding for favourite school subject (10-11 year-olds) and 'A' levels being taken (16-18 year-olds) are included in Appendix A-3. The process assigned a value to represent predominantly masculine (science-based), neutral or feminine (non-science) activities to each participant in each age group. For the youngest age group, the subject choices for the pupils were categorised based upon significant gender differences in choices for 11-13 year-old boys and girls that emerged from the study by Colley, Comber and Hargreaves (1994). Any subject that was favoured predominantly by boys was categorised as 'masculine' and by girls as 'feminine'. A summary of the average rankings of each subject from this study is included within Appendix A-3. To support this method of coding, from the same study, correlates with M/F scores on a Bem Sex-Role Inventory adapted for use with children (Boldizar, 1991) indicated increased femininity with preference for Humanities and decreased femininity with preference for PE plus decreased masculinity with liking for English. However, there is little consistent evidence to link subject choice directly with M/F scores and it is an area that requires review particularly in light of much critical appraisal of the suitability of the application of BSRI for cohorts with changing social perceptions of masculinity and femininity (Holt & Ellis, 1998, Choi & Fuqua, 2003). For the group taking A level subjects, categorisation was based upon the figures published for numbers taking each subject at a National level in 2001 which are summarised in Appendix A-3. Some subjects were clearly favoured by either male or female adolescents and so were allocated as ‘masculine’ or ‘feminine’ choices. Some subjects had equal proportions of entrants and so were deemed ‘neutral’. Although not directly comparable across age groups this method provided a systematic reflection of traditional gender-appropriateness of activity and interests that can be applied across the age range. Non-parametric and correlational analyses were conducted on these data to investigate sex and age differences.

Computer access was measured directly from yes/no responses to a participant’s use in the previous month of a family, their own, a school (or course) or a friend’s computer. Results for participants’ computer usage categories were either drawn directly from the data or, for 16-18 year-olds, generated from the open response to average number of hours of computer use per week. Non-parametric analyses were conducted of these data to investigate sex and age differences.

Correlations were conducted between the actual number of hours reported by the teenage age group and type of ‘A’ level being taken (ICT or equivalent computing course versus not taking ICT or any computing course). The inclusion of separate analysis for those taking ICT as a subject was to attempt to quantify any course requirement that increased use as opposed to general use in supporting A level study or computer use for non-study purposes such as entertainment etc. Furthermore any gender differences between adolescent ICT students would be of particular interest since it could indicate use beyond purposeful study that reflected depth or interest and engagement. Independent groups t-tests were also conducted for number of hours of computer use to examine sex differences for computing and non-computing AS/A2 level students.

Computer experience was examined for sex differences and correlated with the results from hours of computer use.

Section 1 Results: Education

Appendix A-1 contains details of the derivation of each school rating. For both age groups, higher ratings indicate better school test or examination performance. For the 10-11 year-olds’ schools the school ratings were from 196 to 288 with an average value of 237, (*SD* = 34). For the 16-18 year-olds’ schools the school ratings were from 238 to 869 with a mean value of 639 (*SD* = 246). A Pearson’s correlation between the calculated rating for 16-18 year olds’ schools and number of GCSE’s obtained by participants was highly significant ($r(186) = 0.52$, $p < 0.001$).

The range of number of GCSE passes obtained was from 0 to 12. The mean value for each school varied from 6.57 to 9.91 passes with an overall value for the sample of

8.76 passes (*SD* = 2.37). The average number of GCSE's obtained for girls was 9.30 (*SD* = 1.98) compared to 8.2 (*SD* = 2.65) for boys. This was a significant difference, t (184) = -3.15, $p < 0.01$, indicating girls in the sample had higher academic attainment than did boys and that this could be a factor elsewhere in the analysis. The average number of AS/A2 levels that were being taken was 3.64 (*SD* = 0.74). There was no significant difference for boys and girls in this ($t(184) = -1.21$, $p > 0.05$).

Section 1 Results: Interests

There were no significant differences between the 10-11 year-old girls and boys in free choice of favourite subject as Design Technology (DT), Mathematics, Science or Information and Computer Technology (ICT). However, there were significant differences between the 10-11 year-old girls and boys in free choice of favourite subject as English, Art or Physical Education (PE).

Considering the evidence from Colley, Comber and Hargreaves (1994) in relation to masculinity/femininity scores, for the younger age group, there were only very few (2 girls reported History and 2 girls and 2 boys reported Geography) who favoured any Humanities subjects so no conclusions were possible regarding increased femininity or association with gender for these subjects. In terms of decreased masculinity for liking of English, this was supported by a gender difference (χ^2 (1) = 3.79; $p = 0.05$) of more girls (15.2%) than boys (7.9%) expressing it as their favourite subject. There was a highly significant difference (χ^2 (1) = 7.12; $p < 0.01$) in choice of Art as favourite subject with more girls (27.3%) choosing it than boys (13.9%) but no significant difference in the choices for Design and Technology (12.1% of boys and 14.5% of girls). These particular results are difficult to compare with the previous research since subjects of ‘Art & Design’ and ‘Craft, Design and Technology’ were used by Colley et al. (1994) However, it can be noted that the separation of ‘Art’ from ‘Design’ appears to have made it a relatively more popular subject with girls than boys in terms of free first choice compared to the previous ranking of it in conjunction with ‘design’.

The expression of PE as favourite subject had a highly significant association (χ^2 (1) = 13.00; $p < 0.01$) with gender since significantly more boys (23.6%) described it as their favourite subject than girls (7.9%). This reflects the decreased femininity described by Colley et al. (1994) but for the purposes of this study the responses were coded as neutral rather than science/non-science since it clearly was science-neutral but also in the older age-group relatively few took it as a subject of academic study so comparison would be difficult if included as a science (nominally masculine) subject for the 10-11 year-olds.

Thus, rather than stick to the high-low femininity/masculinity subjects from Colley et al, it was decided that to aid comparison with the older groups and for clarity of coding the classification of science/non-science subjects throughout would be used. For the 10-11 year-old girls’ and boys’ choices, those that stated science, DT, ICT or mathematics were coded as science subjects; those that stated PE, History, Geography, Form Period or more than one subject that comprised science and non-science subjects were coded as neutral subjects and those that stated English, Music, French or Art were coded as non-science subjects.

Table 3.1 shows favourite subject for 10-11 year-olds and AS/A2 level choices for 16-18 year-olds coded as science/non-science activities.

Table 3.1.
Percentages of each Age Group who Nominated their Favourite Subject or Chose to Study Science Subjects Compared to Non-Science Subjects.

	10-11 year olds			16-18 year olds		
Subject choice	male	female	both	male	female	both
Science subjects	52	44	48	31	10	20
Neutral	25	12	19	15	11	13
Non-science subjects	22	44	33	54	79	68
Chi-squared science vs. non-science	19.52**	0.01	9.33**	4.77*	52.55**	47.41**

* *significant at p < 0.05 level*

** *significant at p < 0.01 level*

† Continuity correction used for χ^2

Combining the age-groups, boys and adolescent men preferred science subjects whereas girls and adolescent women preferred non-science subjects (χ^2 (2) = 20.50 †; p < 0.01; φ = 0.22). The younger age group followed more traditional gender interests with boys significantly preferring science subjects above all else whilst girls were split equally between science and non-science subjects (χ^2 (2) = 9.77 †; p = 0.001; φ = 0.20). For the older age group, the majority of both adolescent men and women preferred non-science based subjects. However there was still a significant gender difference with more adolescent men preferring science compared to adolescent women (χ^2 (2) = 12.80 †; p < 0.001; φ = 0.30).

The switch from science to non-science subjects during adolescence was significant not only overall (χ^2 (2) = 52.60 †; p < 0.001; φ = 0.36) but also for adolescent men (χ^2 (2) = 18.44 †; p < 0.001; φ = 0.32) and, most markedly of all, for adolescent women (χ^2 (2) = 34.66 †; p < 0.001; φ = 0.40).

There was a significant correlation between preference for science based subjects and school rating such that those who had a higher rated school preferred science subjects more than lower rated schools. This was true overall ($r(330) = 0.23$, $p < 0.01$), for boys alone ($r(165) = 0.20$, $p < 0.01$) and girls alone (r(165) = 0.33, $p < 0.01$).

Of the 188 participants 16-18 year-olds in the sample it was found that 33 (17.5%) were taking Computing or ICT as an AS/A2 level. This comprised 27 (30.3%) men and 6 (6%) women which was a highly significant gender difference ($\chi^2(1) = 25.47$, $p < 0.001$).

Section 1 Results: Computer Access

Table 3.2 shows the percentages of participants who had accessed a computer in the last month. Chi-squared analyses were conducted of the different types of access (family, own, school and friend's computer) and are included as Appendix A-4. These indicated that there were no significant associations between sex of participant and use of a computer in school or at home. There were no significant associations between age group of participant and use of a computer in school or at home.

Table 3.2.
Percentages of each Age Group who indicated each Place of Use of a Computer in the Last Month.

	10-11 year olds			16-18 year olds		
Computer Access	male	female	both	male	female	both
Computer at school	82	81	81	84	80	82
Computer in the home	81	78	80	75	84	80
Own Computer	51	37	44	39	16	27
Friend's Computer	51	48	49	37	27	32

Boys and adolescent men reported more use of their own computer than girls and adolescent women with significant associations between use of ones own computer and sex of participant not only overall (χ^2 (1) = 16.76; $p < 0.001$) but also for the 10-11 year-olds (χ^2 (1) = 5.95; $p = 0.015$) and 16-18 year-olds (χ^2 (1) = 13.00; $p < 0.001$) separately. There were also significant associations between age group of participant and use of their own computer both overall (χ^2 (1) = 14.88; $p < 0.001$) and for girls and adolescent women (χ^2 (1) = 13.73; $p < 0.001$) with older participants having more use of their own computer than younger ones. The trend was evident for boys and adolescent men but did not reach significance.

There were no significant associations between sex of participant and use of a friend's computer but use of a friend's computer declined with age such that there were significant associations between age group of participant and use of a friend's computer both overall (χ^2 (1) = 15.35, $p < 0.001$) and for boys and adolescent men (χ^2 (1) = 4.66, $p = 0.031$) and girls and adolescent women (χ^2 (1) = 11.04, $p = 0.001$) separately.

Further analysis of these results examined the impact, if any, of taking ICT as an AS/A2 level. There was no difference between the group taking ICT and those not in terms of access at school, on a family or friend's computer but there was a significant association for use of ones own computer. The effect was not significant for adolescent men alone (52% of male ICT students had their own computer compared to 34% of others) or adolescent women alone (one of the six female ICT students had her own computer compared to 15% of others) but only for the combined sample (χ^2 (1) = 9.38, $p < 0.01$). Although the number of adolescent women ICT students was small, it was worthy of note that none of the six used a friend's computer whereas in the rest of the female sample 27 from 94 (29%) did.

Section 1 Results: Computer Use

For the 16-18 years age group the free response of number of hours of computer use per week was processed into equivalent categorical data to that of the younger age group. This was not only to provide direct comparison across the entire sample but also to reduce the effects of AS/A2 levels' biases which are reported later. Table 3.3 shows the categories of time spent by participants using a computer per week.

Chi-squared analyses to examine sex and age differences indicated that overall, boys and adolescent men spent significantly more time using a computer than girls and adolescent women (χ^2 (2) = 9.67; $p < 0.01$; $\varphi = 0.14$).

Table 3.3.
Percentages of each Age Group for Stated Levels of Computer Use in hours per week.

	10-11 year olds			16-18 year olds		
Computer Use	male	female	both	male	female	both
Less than one hour	29	35	32	2	5	4
One to five hours	54	56	55	18	41	30
Over five hours	17	9	13	80	54	66

This effect was not significant but approached it for the younger age group (χ^2 (2) = 5.38; $p = 0.07$, $\varphi = 0.18$) with a trend towards 10-11 year-old boys spending more time using a computer than the counterpart girls. The majority of this age group (54% of boys and 56% of girls) spent from one to five hours per week using a computer. Most of the rest of the 10-11 year-olds used a computer for less than one hour per week although there was a portion of boys (17%) and a smaller portion of girls (9%) that used a computer for more than five hours per week.

For the 16-18 year-old age group there was a highly significant association between sex of participant and level of computer use (χ^2 (2) = 14.05; $p = 0.001$, $\varphi = 0.28$). The vast majority of adolescent men (80%) used a computer for five hours or more a week against only a small majority (54%) of adolescent women. Very few of this age group reported their use of a computer to be less than one hour per week.

There was a significant increase in the amount of computer use recorded not only overall (χ^2 (2) = 160.30; $p < 0.001$; $\varphi = 0.56$) but also for boys (χ^2 (2) = 95.54; $p < 0.001$; $\varphi = 0.62$) and girls (χ^2 (2) = 72.76; $p < 0.001$; $\varphi = 0.53$) separately from the 10-11 year-old age group to the 16-18 year-old age group.

Overall, there was a significant correlation ($r(328) = -0.18$, $p < 0.01$) between favourite subject and usage with those choosing a science-based subject indicating higher use through 19.5% using a computer for over 5 hours a week and 26.4% for less than an hour a week. This compared to those who chose non-science subjects who had 7.4% in the topmost category of use and 41.7% in the lowest. This relationship was significant for male participants alone ($r(164) = -0.22$, $p < 0.01$) but not female participants ($r(164) = -0.11$, $p > 0.05$).

For the older age group, subject choice was used to partition the data and examine responses of those taking AS/A2 levels in Computing and ICT in further detail. It was assumed that their usage would be particularly interesting and could affect the overall data. These data are summarised in Table 3.4 and show that the average computer use of

ICT students (21.18 hours/week, *SD* = 14.65) was significantly different ($t(32) = 5.19$, $p < 0.001$, equal variances not assumed) to that of non-ICT students (6.58 hours/week, *SD* = 4.96).

One ICT student's report of hours of use was missing and another was included in the categorical data as over 5 hours but excluded from the analysis concerning number of reported hours since at 80 hours/week it was deemed unreliable. Even without his response there remained a significant gender difference ($t(18) = 3.98$, $p = 0.015$, equal variances not assumed) with the average computer usage of female ICT students (8.26 hours/week) far lower than that of their counterpart male students (24.22 hours/week). Indeed, female computing student usage was comparable to that of the male non-computing students (8.50 hours/week) and was only a non-significant difference of 2.77 hours per week more than that of the female non-computing students (5.49 hours/week). Male ICT students did however differ from male non-ICT students ($t(27) = 5.36$, $p < 0.001$, equal variances not assumed) with, on average, 15.72 more hours of computer use per week. Further to the differences found for those taking computing subjects there were also significant differences between male and female participants for the number of hours of computer use reported both overall (13.10 and 5.68 hours/week respectively) ($t(105) = 5.442$, $p < 0.001$, equal variances not assumed) and for the non-computing students ($t(104) = 3.301$, $p = 0.001$, equal variances not assumed). Although the effects are highly significant, there was unfortunately by nature of the very imbalance in subject choice that this study hopes to investigate, only six female students of ICT compared to twenty-six males available. Therefore some caution must be applied in drawing too general conclusions from the data on reported computer use from female computing students.

Related to this point, the male ICT student that reported 80 hours of use was discounted from the analyses on the grounds of reliability and this may have been unfair and it is possible that a very keen user will have this usage.

Section 1 Results: Computer Experience

Table 3.5 shows the self-categorised types of users in terms of computer experience from expert to novice.

Overall, significantly more (χ^2 (2) = 14.77; p = 0.001) adolescent men (38%) saw themselves as experts than adolescent women (14%) although this effect was primarily driven by the higher number of men compared to women that were taking computing as an AS/A2 level subject. Men studying computing particularly saw themselves as experts (70%) but unfortunately again due to the small number of women participants that were taking computing as an AS/A2 level subject the trend that fewer (50%) female counterparts saw themselves as experts is not reliable. There were strong associations between computing experience and taking a computing AS/A2 level not only overall (χ^2 (2) = 36.649; $p < 0.001$) but also for men alone (χ^2 (2) = 17.54; $p < 0.001$). The effect for women was still significant (χ^2 (2) = 7.12: $p < 0.05$) but somewhat less convincingly.

A Pearson's correlation showed that self-categorisation of type of user was related to number of hours spent using a computer (r(182) = -0.41, $p < 0.001$) with those that spent most time on a computer seeing themselves as more expert than others. This correlation was significant for men (r(85) = -0.44, $p < 0.001$) and for women (r(97) = -0.22, $p < 0.05$). It was only significant for those men who were not taking ICT or Computing as an AS/A2 level subject (r(59) = -0.36, $p < 0.001$).

Table 3.4.
Comparison of 16-18 year-old Students Taking an ICT Course or not for Levels of Computer Use and Overall Numbers Present in each Category.

	Taking ICT			Not taking ICT			Combined		
Computer Usage	male	female	both	male	female	both	male	female	both
	Mean Values of Open Question Responses for Number of hours per week								
Number of hours use	24.22	8.26	21.2	8.50	5.49	6.58	13.01	5.68	9.08
(Standard Deviation)	(14.47)	(5.42)	(14.65)	(6.57)	(4.33)	(4.96)	(11.6)	(4.51)	(9.30)
	Percentages within each Category of Level of Use								
Less than one hour	0	0	0	3	6	5	2	5	3
One to five hours	4	33	3	24	42	35	18	41	30
Over five hours	96	67	90	73	53	61	80	54	66
No. of Participants	25	6	31	59	91	150	84	97	181

Table 3.5.

Comparison of 16-18 year-old Students Taking an ICT Course or not for Self-defined Levels of Computer User. Percentages in each Category and Correlation Coefficients of Type of User with Stated number of hours per week of Computer Use.

	Taking ICT			Not taking ICT			Combined		
Computer Skill	male	female	both	male	female	both	male	female	both
Expert	70	50	67	24	12	17	38	14	25
OK with most things	30	50	33	68	78	74	56	76	67
Novice	0	0	0	8	10	10	6	10	8
Spearman's correlation coefficient with hours of use	-0.23	-0.42	-.34	-0.36**	-0.17	-0.33**	-0.44**	-0.22*	-0.46**
Number of Participants	26	6	32	59	91	150	85	97	182

* *indicates significant correlation at $p < 0.05$ confidence level*

** *indicates significant correlation at $p < 0.01$ confidence level*

3.4.2 Section 2: Sense of Control in Computer Use

Section 2 Method

The second section of the questionnaires examined sense of control in relation to computing. This was achieved by recording responses to the question “What is the thing you most like about computers?” The choice of responses was “I can tell them to do things” (internal LOC); “I can do what they tell me to do for help or information” (external LOC) or “I can ask them for help or information” (shared LOC). Thus, a simple locus of control attribution for computer use was collected for each age group – control with self, shared or with computer. This formed the first dependent variable for sense of control. The teenage age group was assessed for further measures of locus of control (attribution of percentage of access time user and computer respectively, are ‘in control’) to form two further dependent variables.

Section 2 Coding and analysis

Locus of control was measured using a three-way categorisation of: with user; shared or with computer. This was analysed using Chi-squared to search for sex and age differences. Sense of control for the older age group was in the form of percentages of the time that the participant felt they or the computer was ‘in control’. There were 11 options from 0 to 100% at 10% intervals. Data was analysed using independent-groups t-tests to examine each sex and age group combination.

Section 2 Results: Simple categorisation of Locus of Control

Chi-squared analyses are included in Appendix A-4 and proportions for each locus of control category shown in Table 3.6.

Table 3.6.
Percentages of each Age Group for Simple Measure of Locus of Control.

	10-11 year olds			16-18 year olds		
Locus of Control	male	female	both	male	female	both
With user	20	12	16	77	60	69
Shared	65	80	73	16	24	20
With Computer	14	7	11	7	16	11

The results for the10-11 and 16-18 year-old age groups combined indicated that more male than female participants endorsed an internal locus of control (with user rather than with computer) (χ^2 (2) = 7.40; $p < 0.05$; $\varphi = 0.12$). This was also true for the 10-11 year-olds (χ^2 (2) = 9.62; $p < 0.01$; $\varphi = 0.17$) and 16-18 year-olds (χ^2 (2) = 7.00; $p < 0.05$; $\varphi = 0.20$) separately.

In terms of age effects, the locus of control became more associated with an internal state for older participants compared to younger ones (χ^2 (2) = 151.11; $p < 0.001$; $\varphi = 0.54$). This was not only true for the whole sample but also for males (χ^2 (2) = 79.08; $p < 0.001$; $\varphi = 0.56$) and females separately (χ^2 (2) = 80.98; $p < 0.001$; $\varphi = 0.56$).

Correlations of locus of control with educational attainment, interests, computer use and computing experience for available data from 10-11 year-olds and 16-18 year-olds are shown in Table 3.7 and Table 3.8 respectively.

Table 3.7.
Correlations of Locus of control with other Variables for 10-11 year-olds.

	Spearman's correlation coefficient for 10-11 year olds		
Variable for correlation	male	female	both
School rating	-0.02	-0.18 **	-0.12 **
Science/non-science interests	0.00	-0.04	0.02
Category of Computer Use	-0.02	0.16 *	0.05
Number of Participants	166	161	323

** indicates significant at p < 0.05 level*

*** indicates significant at p < 0.01 level*

Table 3.8.
Correlations of Locus of control with other Variables for 16-18 year-olds.

	Pearson's correlation coefficient for 16-18 year olds		
Variable for correlation	male	female	both
School rating	0.09	-0.21 *	-0.08
No of GCSE passes	-0.06	-0.03	0.00
Science/non-science interests	-0.03	0.02	0.05
Taking ICT AS/A2 level	0.01	-0.01	0.07
Category of Computer Use	-0.09	-0.01	-0.09
Computer Use (hours)	-0.12	-0.03	-0.14 *
Computer Experience	0.26 **	0.28 **	0.30 **
% computer is in control	0.05	0.15	0.16
% user is in control	-0.15 *	-0.35 **	-0.32 **
Number of Participants	85	91	178

** indicates significant at p < 0.05 level*

*** indicates significant at p < 0.01 level*

Only two variables (school rating and level of computer use) were found to significantly correlate with locus of control for the 10-11 year-old age group.

Three variables had significant correlations with locus of control for the 16-18 year-old age group. The first of these was the variable of self-described computer experience which was significantly related to locus of control not only for the group overall but also for males and females separately. The second variable that was correlated with locus of control was number of hours of computer use (not category of use) but this was only for the sexes combined. The third variable was for females only and was between locus of control and females' school ratings. There was no significant correlation between locus of control and personal educational attainment (number of GCSE's) or any link overall with school ratings.

Section 2 Results: Locus of Control in terms of % user and % computer is in control

Across the whole of the 16-18 year-old age group, the simple measure of Locus of Control was related to both other sense of control measures of % of time user is in control ($r(183) = -0.32$ $p < 0.001$) and % of time that a computer is in control ($r(183) = 0.16$, $p < 0.05$). % of time a user was in control was related for male participants ($r(87) = -0.22$ $p < 0.05$) and female participants separately ($r(91) = -0.35$ $p = 0.001$) whereas % of time a computer was in control was not significantly related to the simple locus of control measure for adolescent men and adolescent women separately.

The mean values for % time that the user or the computer is in control overall were 69% and 29% respectively. There was a significant gender difference in the values given for % of the time that the user is in control ($t(178) = 5.394$, $p < 0.001$, equal variances not assumed) with adolescent men considering the user was in charge 78% of the time and adolescent women, 61%. There was also a significant difference between 16-18 year-old men (24%) and women (32%) in values given for % of the time the computer in control (t (181) = -2.85, p = 0.005, equal variances assumed).

Correlations of sense of control were conducted for the same variables as previously used for the simple measure of Locus of Control. Tables of the correlations for % of the time user is in control and % of the time computer is in control are shown as Table 3.9 and Table 3.10 respectively.

Table 3.9.
Correlations of % of time User is in Control with other Variables for 16-18 year-olds.

	Spearman's correlation coefficients and significance		
Variable for correlation with % time user is in control	male	female	combined
School rating	-0.01	0.01	0.00
Number of GCSE's	-0.13	0.02	-0.12
Ratio of science to non-science AS/A2 levels	-0.06	-0.03	-0.15
Taking ICT AS/A2 level	-0.02	0.17	-0.09
Category of computer use	0.10	0.14	0.21 **
Computer use (hours/week)	0.18	0.14	0.30 **
Self-defined computer experience	-0.22 *	-0.29 **	-0.32 **
Number of Participants	85	91	178

** indicates significant at p < 0.05 level*

*** indicates significant at p < 0.01 level*

For all 16-18 year-olds, the only significant correlations found for % time user is in control were with choice of science AS/A2 levels, category of computer use, number of hours of computer use and self-defined computer experience. For male participants alone the only one of these that was significant was computer experience. For females alone, not only was computer experience significantly correlated with % time user is in control but also category of use in terms of less than one hour, one to five hours and over five hours use.

Table 3.10.
Correlations of % of time Computer is in Control with other Variables for 16-18 year-olds.

	Spearman's correlation coefficients and significance		
Variable for correlation with % time computer is in control	male	female	combined
School rating	0.02	0.02	0.03
Number of GCSE's	0.16	0.07	0.15 *
Ratio of science to non-science AS/A2 levels	0.03	0.20 *	0.15 *
Taking ICT AS/A2 level	-0.02	-0.03	0.05
Category of computer use	-0.13	0.11	-0.05
Computer use (hours/week)	-0.14	0.12	-0.10
Self-defined computer experience	0.13	0.20 *	0.21 **
% computer is in control	-0.67 **	-0.47 **	-0.58 **
Number of Participants	83	94	177

** indicates significant at p < 0.05 level*

*** indicates significant at p < 0.01 level*

The only significant correlations found for % time computer is in control were with number of GCSE passes, choice of science AS/A2 levels, number of hours of computer use and self-defined computer expertise. Unsurprisingly, % of time that the computer is in control correlated significantly with % of time that user is in control. Self-defined computer use and choice of science AS/A2 levels were the only variables that had a significant correlation for female participants alone. There were no significant correlations for male participants alone.

3.4.3 Section 3: Emotion during and Engagement with Computer Use

Section 3 Method

The 16-18 year-old age group only was given an additional free response question on emotion during computer use. The emotions expressed were later categorised as positive, neutral or negative affect to form a single variable. This method was not used for the youngest age group since it was felt 'emotion during use was' too difficult a concept for them to respond to without teacher input.

In order to assess engagement with computing and desired level of proficiency, a single question asked 16-18 year-olds how long a participant would be willing to study computing in order to get a job. Five options were available as response: not at all, one week, one month, six months and over a year.

Section 3 Coding and analysis

The 16-18 year old age group completed the sentence 'The main emotion I feel when I am using a computer is …'. This produced a large variety of responses the majority of which were coded as either positive or negative affect (Watson & Tellegen, 1985). A third category of neutral affect relating to a low arousal state was included since the explicit responses ‘neutral’ and ‘nothing’ occurred and to take into consideration some of the criticisms (Russell & Barrett, 1999) of simple positive or negative categorisation of emotion. The results were coded by entering all responses directly into an SPSS data set which was sorted to identify and list data. Based on this, participants’ emotions were categorised using SPSS syntax commands to assign a value of direction of affect. Details of the coding SPSS Syntax commands are in Appendix A-5.

Responses from the length of time willing to study computing question were used directly as categorical data. Non-parametric analyses were conducted to investigate sex differences in affect during computer use and affect towards learning computing.

Section 3 Results: Emotions recorded as an open response

There were a total of 164 responses from participants expressing the emotion they felt whilst using a computer. These comprised 55 identifiably distinct emotions that were assigned to either a positive, neutral or negative affect category (Watson and Tellegen, 1985). Appendix A-5 includes full details of the different emotions expressed by participants, their frequency of occurrence and subsequent categorisation.

Table 3.11 shows the proportion of male and female participants who expressed different categories of emotions during use of a computer alongside Chi-squared analysis of these proportions. There was a significant gender difference in the type of emotion expressed (χ^2 (2) = 12.76; $p < 0.01$; $\varphi = 0.28$) with most adolescent women reporting negative emotions and most adolescent men reporting positive emotions.

Table 3.11.
Distribution (% of participants) of Stated Affect Coded as Positive, Negative or Neutral during Computer Use for 16-18 year-olds.

	male	female	combined
Negative affect	22	42	33
Neutral	33	38	36
Positive Affect	45	20	31
Chi-squared values	5.71	7.03 *	0.47
p-value	0.06	0.03	0.79

** indicates significant at $p < 0.05$ level*

In order to identify the relationship between other variables and emotions felt once coded as negative, positive or neutral, a correlational analysis was conducted. Table 3.12 is a summary of the results from this.

For 16-18 year-olds emotion was related to number of hours of use, self-defined expertise, locus of control, sense of control for both user and computer and AS/A2 level subjects scientific or ICT choices. Contributing to these overall effects there were interesting patterns of correlation apparent for male and female participants separately.

Adolescent men’s emotions during computer use were most strongly related to % of the time that the computer is in control followed by number of hours use. The only other significant relationships for this group were with % of time the user is in and taking ICT AS/A2 level or not.

Females’ emotions during computer use were related to self-defined computer experience and locus of control only.

Table 3.12.
Correlation of Coded Affect for 16-18 year-olds with other Variables.

Variable for correlation with affect	Spearman's correlation coefficients and significance male	female	combined
Sex of participant	-	-	-0.15 *
School rating	-0.02	-0.01	-0.02
Number of GCSE's	0.03	-0.04	-0.07
Number of hours/week using a computer	0.20	0.14	0.20 *
Self-defined computer experience	-0.22	-0.18	-0.23 **
Locus of Control	-0.15	-0.28 **	-0.24 **
% of time that computer is in control	-0.28 *	-0.13	-0.23 **
% of time that user is in control	0.30 **	0.20	0.27 **
Ratio of science to non-science AS/A2 levels	0.21	0.08	-0.19 **
Taking ICT AS/A2 level	0.31 **	-0.02	0.24 **
Number of Participants	73	84	157

** indicates significant at $p < 0.05$ level*

*** indicates significant at $p < 0.01$ level*

Table 3.13 shows the emotions of the twenty-five and six female participants who were taking ICT or computing as an AS/A2 level subject. These are of particular interest since they reflect the extremes of high computer use and expertise and shed light on any differences that make computing a career choice for some and not others.

Table 3.13.
Emotions Recorded for ICT Students during Computer Use.

ICT Students	Emotions recorded
25 Males	Disheartening, boredom, frustration, aggression, apathy, mixed, nothing, none much, focus, relaxed (4), satisfaction (4), relief, excitement, calmness, enlightenment, power, happy, pure ecstasy, comfort
6 Females	Frustration, annoyed, stress, interest, comfortable, enjoy/helpful

Table 3.14 shows the distribution of coded emotions for computing students and others. From previously, 16-18 year-old men and women differed in mainly reporting positive and negative emotions respectively, however, this effect was not maintained at a significant level for the groups of ICT (χ^2 (2) = 5.21; p = 0.07; φ = 0.41) and non-ICT (χ^2 (2) = 5.53; p = 0.06; φ = 0.20) students separately.

Table 3.14.
Emotions (% of participants) Coded for ICT and Non-ICT Students during Computer Use.

	Taking ICT AS/A2 levels		Not Taking ICT AS/A2 levels	
	male	female	male	female
Negative affect	12	50	28	41
Neutral	24	0	37	41
Positive affect	64	50	35	18
Chi-squared values	11.12 **	-	0.82	8.70 *

** indicates significant at p < 0.05 level*

*** indicates significant at p < 0.01 level*

Further analysis showed that for 16-18 year-olds, taking ICT as an AS/A2 level subject was related to type of emotion expressed (χ^2 (2) = 15.70; $p < 0.001$; φ = 0.31). The trend existed but was not significant for male participants alone (χ^2 (2) = 5.78; p = 0.06; φ = 0.28) or female participants alone (χ^2 (2) = 5.39; p = 0.07; φ = 0.25).

Section 3 Results: Affect towards computing in terms of willingness to study

The proportions of 16-18 year-olds willing to study computing in order to get a job are shown in Table 3.15. Chi-squared analyses of these indicated that adolescent men were more willing than adolescent women to spend longer studying computing (χ^2(4) = 17.30, $p < 0.01$; φ = 0.31).

Since this study was focusing on factors that prevented involvement with computers the data were split and examined in terms of those that were and those that were not already studying computing through taking ICT AS/A2 levels. For those taking ICT AS/A2 levels, there was no significant association of sex of participant with willingness to study (χ^2(4) = 0.56, $p > 0.05$; φ = 0.13). However non-ICT students did exhibit an association between sex of participant and length of time willing to study computing (χ^2(4) = 11.99, $p < 0.05$; φ = 0.29) with male participants prepared to study longer than female participants.

There was a significant correlation (r(179) = -0.35, $p < 0.001$) between taking ICT AS/A2 level and willingness to study computing. This was true for both adolescent men (r(83) = -0.33, $p < 0.001$) and adolescent women (r(96) = -0.26, $p < 0.05$) separately. By averaging the scale of length of time willing to study computing the two groups had the following average ranks: ICT students M=4.09, SD =0.91 and non-ICT students M=3.05, SD =1.21. This was a significant difference t(177) = 4.97, $p < 0.001$ with unsurprisingly, those already taking the subject willing to study it for longer than those that were not with a mean response of six months further study for those taking ICT and one month further study for those that were not.

Further correlational analysis of willingness towards studying computing indicated that number of hours use was significantly related overall ($r(173) = 0.31$, $p < 0.001$) and for male participants ($r(72) = 0.32$, $p < 0.01$) alone but not female participants. Hence, those engaged in more use were also more willing to spend longer studying computing. However, those already studying computing may have been a confounding factor in this so analyses of ICT students and non-ICT students were conducted separately. This revealed that neither group had a significant relationship between use and length of time willing to study computing but the non-ICT students ($r(141) = 0.16$, $p = 0.06$) supported the trend far better than the ICT students ($r(32) = 0.21$, $p > 0.05$) most likely as a result of a larger sample size.

Type of emotion expressed during use was significantly related to length of time willing to study computing overall ($r(162) = 0.25$, $p = 0.001$) with the more positive the emotion the more willing to study computing. The trend was apparent for both genders but the effect was not significant for adolescent men alone ($r(74) = 0.19$, $p = 0.10$) or for adolescent women alone ($r(88) = 0.20$, $p = 0.07$) alone.

Table 3.15.
Time 16-18 year-olds are Prepared to Study Computing to Get a Job through % of Participants in each Category of Period of Study.

	Taking ICT			Not taking ICT			Combined		
Length of study	male	female	both	male	female	both	male	female	both
Not at all	0	-	0	9	8	8	6	7	7
One week	3	-	3	25	23	24	18	22	20
One month	26	33	27	21	42	34	23	42	33
Six months	26	33	27	23	21	22	24	22	23
One year	44	33	42	21	6	12	29	7	17

3.4.4 Section4: Computer Appearance

Section 4 Method

The fourth section of each questionnaire reflected computer appearance. A task to assess computer appearance and gender associations by expressing a choice of preference for different computer settings was presented to all age groups. The choice of computer setting task used four colour photographs of the same computer (included as Figure 1 in A-2) that represented a nominally masculine (computer setting D), feminine (computer setting A) or neutral (computer settings B and C) context for a computer. Participants were asked to nominate their first, second, third and fourth choices in terms of which computer they would ‘most like to use’.

This gave computer appearance three dependent measures of favourite and least favourite choice of computer setting and overall rating for a particular setting.

Section 4 Coding and analysis

Computer setting preference was examined in two ways. The first was to look at first and last preferences to see patterns of like and dislike. These were taken directly from the data and a non-parametric analysis conducted to investigate any sex or age effects both overall and for each sex and age group combination. The second approach was to form a rating for each computer setting based on its preference with 1 allocated to first preference, 2 to second preference and so on. This then provided an average ranking for each setting indicative of its overall popularity.

Section 4 Results

Computer settings' rankings were analysed using Chi-squared analyses which indicated there were patterns of choice evident other than equal preference for the four computer settings. This was true across the whole sample, for each age group, for both sexes and for all independent groups based on age and sex of participants. The Chi-squared results are described more fully under the following relevant sections for most and least preferred settings. Table 3.16 summarises the main choices that occurred indicating patterns of choice other than equality.

Chi-squared analyses of the data indicated that there were significant differences in first choice of computer to use based on both gender and age group. Male and female participants were not only associated with particular settings overall (χ^2 (3) = 67.58; $p <$ 0.001; φ = 0.38) but also as 10-11 year-olds (χ^2 (3) = 41.45; $p < 0.001$; φ = 0.37) and 16-18 year-olds (χ^2 (3) = 31.43; $p < 0.001$; φ = 0.42) separately. Computer settings were also significantly associated with particular age groups overall (χ^2 (3) = 59.18; $p < 0.001$; φ = 0.35). This was true for male (χ^2 (3) = 37.33; $p < 0.001$; φ = 0.40) and female (χ^2 (3) = 28.05; $p < 0.001$; φ = 0.34) participants separately.

Overall boys placed computer setting D as clear first choice (59%) followed by computer settings B and then C. They strongly rejected computer setting A as first choice (3% of all responses). Girls placed computer setting C as first choice (33%) overall although for the younger age group computer setting D was more popular. Girls' choices generally were more evenly distributed with again computer setting A having fewest first choices (17%).

Table 3.16.
Most and Least Preferred Options for each Sex and Age Group Combination including Percentages of Choices Made of the Relevant Computer Setting A, B, C or D.

	Main Causes for Discrepancies	
Participants	Most preferred setting	Least preferred setting
All	D chosen (42%)	C not chosen (6%)
	A not chosen (10%)	
10-11 year-olds	D chosen (56%)	B chosen (39%)
	A not chosen (9%)	C not chosen (7%)
16-18 year-olds	C chosen (37%)	D chosen (48%)
	A not chosen (12%)	C not chosen (4%)
Male participants	D chosen (59%)	A chosen (47%)
	A not chosen (3%)	C not chosen (7%)
Female participants	C chosen (33%)	D chosen (44%)
	A not chosen (17%)	C not chosen (4%)
10-11 year-old males	D chosen (73%)	A chosen (44%)
		C not chosen (7%)
10-11 year-old females	D chosen (38%)	B chosen (41%)
		C not chosen (6%)
16-18 year-old males	A not chosen (2%)	A chosen (54%)
		B,C not chosen (11%, 6%)
16-18 year-old females	C chosen (45%)	D chosen (63%)
	D not chosen (8%)	C not chosen (2%)

The large majority (73%) of 10-11 year-old boys and most (38%) 10-11 year-old girls chose computer setting D as their first choice. 16-18 year-old males only just retained computer setting D as their first preference (35%) over computer setting B (34%) with computer setting C following closely behind (29%). Meanwhile, 16-18 year-old girls had strongly rejected computer setting D (only 8% of choices) in favour of computer setting C (45%) followed by computer settings B (26%) and A (21%). Thus from the younger to the older age group the popularity of computer setting D decreased whilst the more neutral, work-like settings of B and C increased. This effect was particularly marked for female teenagers, who rather than halving the number of choices for computer setting D like the boys, reduced it to a fifth of that seen pre-adolescence.

Section 4 Results: Least Preferred Computer Setting

Table 3.18 shows the distribution of computer settings as choice of computer that participants would least like to use.

Chi-squared analyses of the data indicated that there were significant differences in last choice of computer to use based on both gender and age group. Male and female participants were not only associated with particular settings overall (χ^2 (3) = 63.67; p < 0.001; φ = 0.37) but also as 10-11 year-olds (χ^2 (3) = 28.15; p < 0.001; φ = 0.31) and 16-18 year-olds (χ^2 (3) = 41.27; p = 0.001; φ = 0.48) separately. Computer settings were also significantly associated with particular age groups overall (χ^2 (3) = 40.49; p < 0.001; φ = 0.29). This was true for males (χ^2 (3) = 24.21; p < 0.001; φ = 0.32) and females (χ^2 (3) = 21.44; p < 0.001; φ = 0.30) separately.

Table 3.18.
Last Choice Computer Settings of each Sex and Age Group Combination in % of Participants' Choices.

	10-11 year olds			16-18 year olds			combined		
Computer Setting	male	female	both	male	female	both	male	female	both
A	44	20	32	54	12	31	47	17	32
B	37	41	39	11	23	17	28	34	31
C	7	6	7	6	2	4	7	4	6
D	12	33	22	30	63	48	18	45	32

Overall boys placed computer setting A as clear last choice with 49% of responses whereas girls placed D as clear last choice with 48% of responses.

The proportion of boys that placed A as last choice increased from 44% for the 10-11 year-age group to 54% for the 16-18 year-old age group. Computer setting D also increased in dislike from the younger to the older age group as the proportion of boys placing it last increased from 12% to 30%. The increase in dislike for A and D appeared to benefit Computer Setting B which started with 37% of 10-11 year-olds placing it last and ended with only 11% of 16-18 year-olds doing so. Alternatively, it could be said that B became more popular and this caused the changes to A and D's ratings.

The proportion of girls that placed D as last choice increased greatly from 33% for 10-11 year-olds to 63% for the 16-18 year-olds. This was explainable by setting B and to a lesser extent A becoming less disliked. The dislike expressed by 16-18 year-old girls for computer setting D was the strongest seen throughout

Remarkably, C was rarely placed as last choice with only 5% of the sample overall choosing to do so. This did not alter appreciably from one sex or age group to another. It is worth noting, however, that 16-18 year-old girls had an extraordinarily low proportion of 2% placing it as last choice.

Section 4 Results: Overall Computer Setting Ratings

In addition to looking at the most and least preferred settings overall ratings for the four settings were calculated. The values, shown in Table 3.19, represent liking by low values and dislike by higher ones

.

Table 3.19.
Mean Ratings of Computer Settings for each Sex and Age Group Combination.

	10-11 year olds			16-18 year olds			combined		
Computer Setting	male	female	both	male	female	both	male	female	both
A	3.2	2.6	2.9	3.4	2.5	2.9	3.3	2.6	2.9
B	2.9	2.8	2.9	2.1	2.4	2.3	2.6	2.7	2.6
C	2.4	2.1	2.2	2.1	1.7	1.9	2.3	2.0	2.1
D	1.6	2.4	2.0	2.4	3.3	2.9	1.9	2.8	2.3

There was no significant difference between age groups for computer setting A but overall female participants preferred it significantly more than did male participants (t (469) = 8.29, $p < 0.001$, equal variances not assumed). Neither girls nor boys changed their ratings with age and both 10-11 year-olds ($t(290) = 5.46$, $p < 0.001$, equal variances not assumed) and 16-18 year-olds ($t(176) = 6.57$, $p < 0.001$, equal variances not assumed) maintained the sex difference in preference. The boys gave computer setting A the lowest rating throughout and based on the overall rating, A was either the joint (with B) or exclusive least popular choice.

There were no sex differences in the rating of computer setting B either overall or for the separate age groups. Computer setting B, however, was liked more by the older age group than the younger one ($t(475) = 5.27$, $p < 0.001$, equal variances assumed). Male ($t(230) = 4.99$, $p < 0.001$) and to a lesser extent female participants ($t(243) = 2.67$, $p = 0.008$, equal variances assumed) both increased their liking of B with age. The younger age group placed B as joint (with A) least favourite whilst the older age group rated it second highest choice.

Computer setting C also increased its popularity with age ($t(474) = 4.68$, $p < 0.001$, equal variances assumed). Male ($t(231) = 2.74$, $p = 0.007$, equal variances assumed) and female ($t(241) = 3.73$, $p < 0.001$, equal variances assumed) participants both placed it as a higher preference in the older age group than the younger one. It was clearly the setting with the best rating for the older age group (1.9), having moved from second position for the younger one (2.2). 16-18 year-old girls particularly rated it above all others. Female participants preferred C more than their male counterparts not only overall ($t(474) = 4.12$, $p < 0.001$, equal variances assumed) but also for the 10-11 year-old ($t(296) = 2.79$, $p = 0.006$, equal variances assumed) and 16-18 year-old ($t(176) = 2.97$, $p = 0.003$, equal variances assumed) age groups separately.

Computer setting D seemed to have the most variable ratings with age ($t(476) = -7.96$, $p < 0.001$, equal variances not assumed). It was the most popular choice overall for the 10-11 year-olds (2.0) and joint least popular for the 16-18 year-olds (2.9). Both male ($t(147) = -5.33$, $p < 0.001$, equal variances not assumed) and particularly female ($t(241) =

-5.96, $p < 0.001$, equal variances not assumed) participants increased their dislike with age. Computer setting D also had a large overall sex difference in liking ($t(475) = -7.90$, $p < 0.001$, equal variances not assumed). 10-11 year-old boys made it by far their most preferred setting and 10-11 year-old girls also rated it sufficiently for it to be their second choice but the difference between them remained significant ($t(281) = -6.10$, $p < 0.001$, equal variances not assumed). 16-18 year-old boys demoted it to third place by increasing preference for the two neutral settings and 16-18 year-old girls rejected it severely as their clear last choice thereby maintaining the sex difference ($t(159) = -5.34$, $p < 0.001$, equal variances not assumed).

3.4.5 Section5: Computer Users

Section 5 Method

The fifth, final section of the questionnaire examined computing stereotypes by asking participants to draw a ‘computer user’ and record the name of the figure drawn. The extraction of an intrinsic view of ‘computer users’ using the ‘draw-a-computer-user’ task for the two youngest age groups had three primary variables of sex, age and type of user drawn. These were manipulated to produce the secondary variables of stereotypes, older role models and friends or self.

Section 5 Coding and analysis

Both age groups were simply asked without any prompting to ‘draw a computer user’ and then complete the line ‘the name of the computer user I have just drawn is …’. The draw-a-computer-user task was coded for four primary variables summarised below based on those of Brosnan (1999), using both the drawing and name supplied by the participant.

Sex of user: Drawings that were expressly neutral (for example a stick person with the name 'anyone') or were ambiguous (an alien) were also coded to provide a third category in addition to the male and female categories.

Age of User*:* This was coded as contemporary (peer, e.g. friend/self/imaginary), older (adult, e.g. parent/teacher/imaginary) or ambiguous (non-human or unclear, e.g. alien, computer, several figures)

Type of User*:* This was coded as personally known (acquaintance, e.g. friend/self/parent/teacher), imaginary (stereotype, e.g. computer geek/alien/bank manager) or ambiguous (unclear, e.g. name supplied indistinguishable as acquaintance or not).

Mood of user: This was coded by examination of any mouth or facial characteristics such as up-turned/down-turned smile, frowning or tears to be positive or negative mood. Any drawings that did not have discernable characteristics were coded as indeterminate.

Two independent coders were used for this part of the task and the codes they assigned were compared to give initial inter-rater reliability scores of $r = 0.73$ for sex of user, $r = 0.82$ for age of user, $r = 0.80$ for type of user and $r = 0.36$ for mood of user. The coders then met to identify any ambiguities which were re-assessed, again independently, to form the final set of coded data which had the following correlations with each of the coders' decisions for sex, age, type and mood of users respectively: coder 1: $r = 0.97$; $r = 0.91$; $r = 0.88$; $r= 0.65$ and coder 2: $r = 0.78$; $r = 0.88$; $r = 0.86$; $r= 0.64$.

Secondary categories were formed from these data by transforming the primary categories into male, female and ambiguous stereotypes (sex of user, peer, not personally known), male or female friends (sex of user, peer, acquaintance) and male or female role models (sex of user, adult, acquaintance). The results were analysed using Chi-squared analysis to identify age and sex differences.

Section 5 Results

Appendix A-6 includes a summary chart of the responses to the ‘draw-a-computer-user’ task. Of the 335 10-11 year-old participants, 301 (90%) provided drawings that could be used to determine characteristics of a typical computer user. Among those there were some (from a single school) where it appeared the children had been prompted to draw a computer rather than a computer user and so these were omitted from analysis. The older age group provided 160 drawings out of a possible 189 (84.7%). These did not show a particular pattern of omission but from the solicited feedback comments at the end of the questionnaire it appeared that some of the teenagers were reluctant to perform what they considered a childish task. Indeed some showed what could be considered true alienation by drawing a picture of an alien with in one case the description ‘you – an alien’.

Table 3.20 shows the proportions of participants who drew figures that are coded for sex, age, type and mood of computer user.

Section 5 Results: Sex of user drawn

For sex of the user drawn there was an association with age group overall ($\chi^2(2) = 5.16$, $p < 0.05$; $\varphi = 0.18$). This was not sustained at a significant level for male participants alone since they tended to draw males throughout ($\chi^2(2) = 2.99$, $p > 0.05$; $\varphi = 0.11$). However, female participants did have an association of age with sex of user drawn ($\chi^2(2) = 7.94$, $p < 0.05$; $\varphi = 0.19$) such that more of the younger age group drew females than the older age group and fewer of the younger age group drew males than the older age group.

There was a highly significant association of gender with sex of user drawn overall ($\chi^2(2) = 101.83$, $p < 0.001$; $\varphi = 0.47$). This existed for the 10-11 year-olds ($\chi^2(2)=79.19$, $p < 0.001$; $\varphi = 0.51$) and the 16-18 year-olds ($\chi^2(2) = 27.63$, $p < 0.001$; $\varphi = 0.42$) separately. Female participants tended to draw more females generally than their male counterparts who, as stated previously, drew males throughout. 38% of 10-11 year-old females compared to 5% of males producing a female computer user and 30% of 16-18 year-old females compared to 5% of males drew a female computer user.

Those that were deemed of indeterminate sex referred to such cases as a user sitting facing a computer screen but with their back portrayed and a name such as ‘a child’, a robot with a fictitious name or, as more often for the older age group, aliens or groups of users with descriptions such as ‘anyone’ or unsexed characters such as ‘Bob(ette)’ or ‘Joe/Jane Bloggs’.

Table 3.20.
Proportions of each Coded Property of the Results of the 'draw-a-computer-user' Task.

	10-11 year olds			16-18 year olds			combined		
Figure drawn	male	female	both	female	male	both	female	male	both
				Sex of User					
Male	76	31	54	86	46	65	79	37	58
Female	6	48	27	5	30	18	6	41	24
Indeterminate	18	21	19	9	24	17	15	22	18
				Age of user					
Contemporary	46	48	47	78	68	73	56	55	56
Older	25	15	21	8	8	8	20	13	16
Indeterminate	29	36	33	14	24	19	24	32	28
				Type of user					
Personally known	50	46	48	32	21	26	44	37	40
Not Personally known	24	20	22	63	74	69	39	40	38
Indeterminate	26	34	30	5	5	5	19	23	22

Table 3.20. (continued).
Proportions of each Coded Property of the Results of the 'draw-a-computer-user' Task.

	10-11 year olds			16-18 year olds			combined		
Figure drawn	male	female	both	female	male	both	female	male	both
	Mood of user								
Unhappy	57	72	64	51	68	60	14	5	9
Happy	14	3	9	15	7	11	55	70	63
Indeterminate	29	25	27	35	25	30	31	25	28

Section 5 Result: Age of user drawn

For age of user there was no association with sex of participant either overall or for either of the age groups individually.

There were significant associations between age of user drawn and age group for the participants overall ($\chi^2(2) = 28.81$, $p < 0.001$; $\varphi = 0.25$), for male participants alone ($\chi^2(2) = 21.78$, $p < 0.001$; $\varphi = 0.31$) and female participants alone ($\chi^2(2) = 8.69$, $p < 0.05$; $\varphi = 0.19$). The younger age group tended to draw a higher proportion of older computer users (21% of drawings) than the older age group (8% of drawings) who generally drew contemporary teenage figures (73% of drawings).

There was a near significant association between gender and age of user drawn overall ($\chi^2(2) = 5.78$, $p = 0.06$; $\varphi = 0.11$) with more male participants drawing older computer users (generally male) than their female counterparts. This trend was visible within the younger age group ($\chi^2(2) = 5.08$, $p = 0.08$; $\varphi = 0.13$) but not within the 16-18 year-old age group ($\chi^2(2) = 2.33$, $p > 0.05$; $\varphi = 0.12$).

Section 5 Results: Type of user drawn

For type of user there was no association with gender either overall or for either of the age groups individually.

There were highly significant associations between type of user drawn and age group for the participants overall ($\chi^2(2) = 133.71$, $p < 0.001$; $\varphi = 0.54$), for male participants alone ($\chi^2(2) = 52.51$, $p < 0.001$; $\varphi = 0.48$) and female participants alone ($\chi^2(2) = 82.85$, $p < 0.001$; $\varphi = 0.60$). The younger age group tended to draw people they knew personally (48% of drawings) rather than imaginary figures (22% of drawings) whereas the older age group drew people unrelated to themselves (69% of drawings) such as stereotypes rather those personally acquainted (22% of drawings).

Section 5 Results: Mood of user drawn

There was no association of mood of user drawn with age of participant either overall, for male participants alone or female participants alone.

There was a significant association between gender of drawer and mood of user drawn overall (χ^2 (2) = 16.34, $p < 0.001$; $\varphi = 0.19$). This applied to 10-11 year-olds alone (χ^2 (2) = 12.27, $p < 0.01$; $\varphi = 0.20$) where more girls (72%) drew computer users with smiles than did boys (57%). The trend was also apparent for the older girls, more of whom (68%) drew happy computer users than did their male counterparts (51%) but this was not significant (χ^2 (2) = 5.31, $p = 0.07$; $\varphi = 0.18$).

For the 16-18 year-old age group correlational analysis examined any relationships between emotion expressed whilst using a computer, willingness to study computing and mood of user drawn. The correlations with affect during computer use were very low not only for the sexes combined ($r(143) = -0.04$, $p > 0.05$) but also for male participants ($r(66) = 0.07$, $p > 0.05$) and female participants ($r(77) = -.17$, $p > 0.05$) alone. The correlations with willingness to study computer were also very low not only overall ($r(156) = 0.03$, $p > 0.05$) but also for male participants ($r(73) = 0.14$, $p > 0.05$) and female participants ($r(83) = -.11$, $p > 0.05$) alone.

Section 5 Results: Names of Computer Users Included

As part of the ‘draw-a-computer-user’ task participants were asked to add the name of the computer user they had just drawn. This helped identification in many cases but there were also recurrences of certain names, relationships and occupations that are worth noting. Appendix A-6 includes a distribution amongst age group and sex of participants of some of the more interesting responses and the categorisation process of responses in terms of an organisation chart. The names did not originate from a single source but came from different schools and even towns indicating participants did not collude in the generation of such names. The list below gives those names, relationships and occupations that occurred three or more times.

Bob (20 times), Dave (7 times), Malcolm (6 times), Fred (5 times), Dexter (3 times)
Me (11 times), my dad (7 times), my mum (6 times), my brother (3 times), a child (6 times), a business man (5), professor (3)

A picture of one such Bob is included as Figure 3.1.

Figure 3.1. Example of a drawing of a computer user called ‘Bob’ generated in the open task of ‘draw-a-computer-user’.

Section 5 Results: Categorisation of drawings into friends, role models and stereotypes

Table 3.21 shows the proportions of each type of figure that occurred based on tendency to draw friends of a particular gender, certain role models or stereotypes.

Despite the data including participants who drew themselves as users, the association between gender of drawer and gender of friend as a ‘computer user’ was robust. It was apparent not only overall (χ^2 (1) = 88.28; $p < 0.001$; φ = 0. 76) but also for the 10-11 year-old (χ^2 (1) = 70.43; $p < 0.001$; φ = 0. 78) and 16-18 year old (χ^2 (1) = 17.67; $p < 0.001$; φ = 0. 68) groups separately. There was no association between age group and gender of friend drawn (χ^2 (2) = 1.04, $p > 0.05$; φ = -0. 08) with both age groups following the pattern if they chose to draw a friend of drawing same-gender peers. In general the older age group drew fewer friends (54%) as computer users than the younger one (24%). There were no friends drawn or coded as of androgynous or indeterminate gender so all analyses comprised figures drawn and coded as either male or female.

There was no significant association between gender of older role model drawn and gender or age of participant. Very few older participants (2%) drew an older role model so analysis was limited mainly to the younger group of whom 13% drew an older role model. Both boys and girls tended to draw more males (dads and male teachers) than females (mums) but because of the small number of participants involved this was not significant.

Table 3.21.
Allocated Categories of Peers, Role Models and Stereotypes in Proportions of the Results of the 'draw-a-computer-user' Task.

	10-11 year olds			16-18 year olds			combined		
Type of drawing	male	female	both	male	female	both	male	female	both
Known male peer	51	11	32	30	7	18	43	9	33
Known female peer	2	46	22	1	11	8	3	32	16
Any known peer	53	56	54	31	18	24	46	41	49
Known older male (role model)	12	7	10	3	3	3	15	5	6
Known older female (role model)	3	4	3	0	0	0	3	3	2
Any known elder	15	11	13	3	3	3	18	8	8
Male stereotype	31	16	24	55	42	48	40	28	28
Female stereotype	2	13	7	4	18	12	3	16	10
Androgynous stereotype	0	1	0	7	16	12	3	8	5
Any stereotype	33	31	32	65	76	72	46	50	43

There was a significant association between gender of drawer and sex of stereotype drawn not only overall (χ^2 (1) = 20.58; $p < 0.001$; φ = 0. 37) but also for the younger (χ^2 (1) = 14.39; $p < 0.001$; φ = 0. 47) and older (χ^2 (1) = 7.64; $p < 0.01$; φ = 0. 30) age groups separately.

There were several stereotypes drawn and subsequently coded as androgynous or indeterminate gender, so two different analyses of data were conducted. The first of these methods used sexed data coded as either male or female figures. The second method expanded these data to include responses categorised as neutral (androgynous/indeterminate) in a two-way comparison of male versus not-male figures. Table 3.22 illustrates the proportions of such figures from all figures categorised as stereotypes.

For figures that were coded as male or female, 10-11 year-old girls tended to draw roughly equal proportions of male and female stereotypes (χ^2 (1) = 0.31; $p > 0.05$) moving towards drawing male stereotypes for the 16-18 year-old age group (χ^2 (1) = 7.04; $p < 0.01$) whereas male participants drew male stereotypes of computer users both for the younger age group (χ^2 (1) = 29.43; $p < 0.001$) and the older age group (χ^2 (1) = 30.86; $p < 0.001$).

By including the figures of indeterminate gender and conducting two-way Chi-squared analyses between male and not-male categories of users drawn as stereotypes there was a slightly increased association with gender of sex of stereotype drawn overall (χ^2 (1) = 23.46; $p < 0.001$; φ = 0. 37). The effect of gender was also marginally increased for the younger (χ^2 (1) = 15.52; $p < 0.001$; φ = 0. 48) and older (χ^2 (1) = 9.17; $p < 0.01$; φ = 0. 30) age groups separately. Drawing androgynous figures or of indeterminate sex was not much in evidence for the 10-11 year-old age group so girls remained equally likely to draw figures of any sex and boys very likely to draw male figures. For the 16-18 year-old age group, male participants continued to draw male figures rather than anything else whereas female participants by including a neutral category, were as likely to draw a male figure as not. Therefore, it can be suggested that it was the inclusion of indeterminate (often politically correct responses indicating ‘anyone’ etc.) which removed the difference in gender of figures drawn by the16-18 year old group for female participants that had been seen previously for the sexed drawings. Table 3.22 summarises the chi-squared analyses that made this comparison.

Table 3.22.
Proportions of Gender of Figures Drawn and Comparison of either male/female or male/not-male Categorisations of Stereotypes of Computer Users Drawn in Terms of Chi-squared Results of Degree of Association with Gender.

	10-11 year olds						16-18 year olds					
	males			females			males			females		
	% of each gender of figures drawn											
	m	f	n	m	f	n	m	f	n	m	f	n
	31	2	0	16	13	1	52	4	8	40	18	20
	Statistics based on either of the binary categorisations											
	χ^2 (1)		*p*	χ^2 (1)		*p*	χ^2 (1)		*p*	χ^2 (1)		*p*
Male vs. female	29.43		< 0.001	0.31		> 0.05	30.86		< 0.001	7.04		< 0.01
Male vs. not-male	29.43		< 0.001	0.13		> 0.05	20.45		< 0.001	0.62		> 0.05

Key: m = *male figure drawn;* f = *female figure drawn;* n = *androgynous or indeterminate sex figure drawn*

3.5 Chapter Discussion

Rather than include a full discussion of the points raised by this study here, consideration of its results in terms of the study's hypotheses and a critique of the method will be made. Discussion of the limitations of this initial study will explain the basis for the approach taken for the next study, the method of which is described in the next chapter. Other matters and broader issues will be included under the general discussion at the end of this thesis.

3.5.1 Use and interests

3.5.1.1 H1: There will be differences in reported computer use for male and female participants

In terms of computer use this study showed that there was little to no difference in access to computers for male participants and female participants in school or at home. More of the younger age group had their own computers than of the teenage group but it is possible that they interpreted the question as alluding to a household computer. Therefore the apparent decrease in personal ownership for 10-11 year-olds to 16-18 year olds may be unreliable. Any subsequent research would require confirmation of what 'own' meant. However, the differences between male participants and female participants and the data for the 16-18 year-olds can be considered a much more reliable effect. More 16-18 year-old male participants had their own computers than their female counterparts, which indicated either parental endorsement or considerable action on their own part to earn the money to purchase one. In either case, it can be assumed that the outcome of more adolescent men having their own computer must reflect an increased desire to own one.

Usage was only crudely examined in this study as interest in and values of different computer applications were not examined. There are well-recorded differences in the attitudes of males and females to different aspects of computer use such as gaming and word-processing (Oosterwegel, Littleton & Light, 2003) and further research could examine these different aspects in relation to some of the other variables used here.

3.5.1.2 H2: There will be a relationship between computer use and general interests

The most striking aspect of participants' education was that there were only six female ICT or Computing AS/A2 level students from a sample of one hundred. Hence, the research topic of this study, the low participation of women in computing was fully warranted particularly since the sample was drawn from a variety of schools and locations.

Not only was ICT unpopular with women but there was also a significant difference in the proportions of male and female participants that took science AS/A2 levels. Those male and female participants who did favour science subjects were in the minority but this was more marked for adolescent women than men with only 10% of female participants taking more science subjects than non-science. This compares with 31% of males doing so. The pattern for the younger age group was based on interest rather than career choice but showed a much more even approach to science and non-science subjects and far less difference between boys and girls. In the case of the younger age group 44% of girls chose science or maths as their favourite subject compared to 56% of boys.

The extent of the decline in interest in science and ICT from the younger age group to the older age group with non-science subjects preferred by both male and female participants was unexpected. This is an area for further examination and if the current findings are replicated, is of greater concern than the under-representation of women in technology since it may indicate a more general antipathy to careers in this area. Alternatively, it may be a lowered willingness by males to be associated with traditional male roles and a broadening of their outlook in terms of career options.

In summary, academic interests still predominantly followed gender lines although this seemed to be a trend that was less marked in pre-adolescents and increased during adolescence as more men retained an interest in science based subjects than women.

There was little difference between boys and girls in the 10-11 year-old age group in terms of usage. However, the older group showed a large difference in number of hours spent using a computer by male and female participants. Bearing in mind that many more males were studying computing at AS/A2 level it could also be argued that their need was greater for academic purposes. Indeed, the results indicated that there was an association between taking ICT for examination purposes and having one's own computer but since the study did not inquire when the computer was purchased it is difficult to conclude which came first – academic need or academic choice based on interest.

The clear difference between level of use for the ICT and non-ICT students could be interpreted as indicating that higher usage is simply related to course demands, but the finding that female ICT students reported far less than their male counterparts indicates that usage was not merely based on course requirements. Also, the usage of most non-ICT males was higher than the female ICT students indicating that a factor or factors beyond necessity drew males and not females towards computing. In general, data of usage from ICT students may have benefited from a more qualitative approach and greater depth of inquiry based on the few female participants available and the possible extremes of computer use by some such as the data from the participant reporting 80 hours of use.

3.5.2 Sense of control

H3: There will be a relationship between level of use (computer experience) and sense of control during computer use.

As the simple measure of Locus of Control (LOC) was related to both other sense of control measures it seemed to be valid and appropriate as a reasonable first measure for the younger age group and for useful comparisons between the two age groups. However, the slight asymmetry for this measure's correlation with % of time user is in control and % of time computer is in control was not expected. It seemed that the measures were not interchangeable but tapped into different perspectives on control with % time user is in control closer to the simple LOC question than % time computer is in control.

There was a relationship between amount of time spent using a computer and LOC for 10-11 year-olds overall and girls alone. This suggests that as girls' level of use increased, so control passed from the user to the computer. 10-11 year-old girls therefore tended to think that computers became more instrumental in their interactions as their use increased. In effect, as use increased, so did the sense of passivity. This was contrary to the prediction and may have been a problem of the younger girls understanding of the question. Alternative phrasing of the question would determine if this was a reliable effect.

For the 16-18 year-olds, as self-perceived level of expertise increased, control became more internalised not only overall but for males and females separately. Increased use for 16-18 year-olds in terms of number of hours also made the locus of control more internal. This was true for males and unlike for the younger group, also for females and thus supported the hypothesis.

For the 16-18 year-old males and females who recorded % of time user is in control, this was related to higher levels of usage and self-assigned level of computer expertise. These variables were, in turn, inter-related.

3.5.2 Sense of control (continued)

H4: Sense of control will differ for male and female participants

All three measures of LOC indicated that males considered their LOC to be more internal than did females. For the simple measure this was true for both age groups alongside sense of personal control increasing with age for both sexes.

Whether this is specific to computers and computing or more general needs to be qualified as does the level of any difference between general sense of personal control to the unique context of computing.

H5: As general sense of personal control is affected by educational background, so sense of control in a computing context will also be related to educational attainment.

Overall the 16-18 year-old girls in the sample had better GCSE results than the boys and so had higher levels of personal educational attainment. Although this reflected national statistics, it meant that comparisons within the data could be confounded by high-low attainment differences instead of the male-female differences of interest. Since GCSE results were used alongside school rating, and the number of AS/A2 levels being taken was not significantly different for male and female participants, the possibility of this occurring was considered acceptable. Furthermore, the use of school rating was particularly designed to apply to both age groups so comparison could be made before and towards the end of adolescence. It is possible that school ethos through expectation of success may be more, or as important as personal education scores. In this case, a more sophisticated measure of personal locus of control could examine expectation of academic success at an individual rather than at a school or educational establishment level.

For the 10-11 year-old age group, although the correlation between locus of control and school rating was significant for girls and overall, it was not significant for boys. The correlation suggested that as school rating increased so locus of control was reduced and hence became more internal. In effect, the better performing schools tended to have pupils overall who considered themselves more instrumental in using a computer than pupils in lower performing schools. This was particularly true for girls.

For the 16-18 year-olds in terms of subject choices, 16-18 year-olds were more likely to control was with the user if they took mainly science or ICT AS/A2 levels. For 16-18 year-old females only, as school performance increased so LOC (as measured through % of time user is in control) became more internal and girls felt more instrumental in using a computer.

Considering the third measure of LOC, 16-18 year-olds were more likely to consider the computer in control if they had more GCSE's, took mainly-non-science AS/A2 levels, spent fewer hours using a computer and thought of themselves more as a novice than expert.

Overall, related to educational attainment, it appeared that the better the school performed, the more internalised was control and this affected female students more than males. The direction and extent of this was variable in terms of personal measures of attainment so this measure and any relationships with LOC needed further investigation.

The measure of number of GCSE's was fairly crude as it did not represent any difference between the students with bare passes and those that achieved the best possible grades. Since the relevant phenomenon such as stereotype threat (Steele & Aronson, 1995) in particular seems to affect capable students more as they have the capacity to perform but are undermined by a threat to self-identity, this was a shortcoming in the measure used. It may also explain the lack of a clear-cut relationship between individual educational attainment and stereotyping.

3.5.3 Sense Affect during computer use

H6: There will be more positive affect expressed by males whilst using a computer than by females

The categorisation of expressed emotions by the 16-18 year-olds indicated female participants associated computing with negative affect and male participants associated it with positive affect. The degree of this association was not quantified and would be a worthwhile topic for further investigation.

The correlational analysis shows that, for 16-18 year-olds, type of emotion/emotional valence was related to number of hours of use, self-defined expertise, locus of control, sense of control for both user and computer and AS/A2 level subjects scientific or ICT choices. Contributing to these overall effects there were interesting patterns of correlation apparent for male and female adolescents separately.

Of particular interest, was the finding that for male participants, more positive emotions during computer use were related to higher use, taking ICT AS/A2 levels, a higher sense of user control and a lower sense of computer control. For female participants, more positive emotions during computer use were related to self-defined computer experience and locus of control only. Thus, 16-18 year-old women who saw themselves as more expert than novice and considered control of a computer lay with the self rather than externally expressed more positive emotions concerning computer use.

With respect to willingness to study computing by 16-18 year-olds overall, it was found that time prepared to take a course on improving ICT skills was related to affect and use. Female participants reported more positive affect during computer use as related to willingness to study and male participants reported number of hours use as similarly related. ICT students were willing to study for longer than others. Male participants overall, and male non-ICT students in particular, were willing to study for longer than their female counterparts. This result suggests that even adolescent men not currently studying ICT would be more prepared to engage with computers for longer than would adolescent women.

3.5.4 Computer Appearance

H7: There will be differences in preferences of computer appearance for males and female

This hypothesis was certainly supported by the data in that the two 'gendered' photographs of computers had very different and more extreme responses from the participants compared to the two other settings. The 'masculine' computer with controllers and other game-playing equipment was much preferred by the younger age-group with little difference between the girls and boys. The older age-group, by contrast, had the male participants retain this as their favourite computer albeit with a reduced proportion, while, for the female participants overall, it was their least liked computer. Both older males and females preferred a neutral setting overall, ranking the one with a pot of pens and paper next to the computer slightly higher than the completely unadorned computer.

Across all the age groups, male participants rejected the 'feminised' computer to a far greater extent than the females rejected the 'masculine' one, tying in with previous research that boys are less tolerant of atypical gender than are females in case it turns them into ‘sissies’ (Brannon, 2008, p50).

It would be of interest to expand the sample to encompass a number of adults and a mid-point in adolescence to track the changes in preference more comprehensively.

3.5.5 Stereotypes of Computer Users

H8: A typical computer user will differ for male and female participants

For the 10-11 year-old children this hypothesis was shown to be supported with the predominant response being same-sex users who were most often personally know to the participants and therefore acted as role models. Results for the 16-18 year-olds did not support the hypothesis as this age group tended to draw stereotypical images of male computer users irrespective of the drawer being male or female.

H9: The process of social cognition development during adolescence will affect the types of computer users drawn for the different age groups

The cross-over from 10-11 year-old children’s typical drawings in terms of sex, age and whether personally known to the stereotypes produced by the adolescent group was remarkable and illustrated the broadening of social experience that happens during adolescence. What is unclear is at what point this occurs. Therefore, is it a result of cognitive development or changing schools and social environment? Also, at what point in the interim period does it occur? Thus, data from 13-14 year-olds between the two age groups studied, would help chart the transition and indicate how robust it this.

This is a key finding as far as the research is concerned since it established that there are evidential changes in the way children and adolescents represent a typical computer user. The children of 10-11 years use people of whom they have direct personal experience as computer users such as their friends and members of their family as models of a computer user. They also tend to draw same gender figures. However the 16-18 year-old adolescents have moved away from this and endorse a strong stereotypical image of a young male with glasses, poor skin and bad sense of dress, generally called Bob or something similar. This is particularly critical for the female participants as they move from a same gender figure to someone of the opposing gender, thereby implicitly dissociating them from the possibility that the typical computer user is representative of them.

This could be the result of a wider social experience that 16-18 year-olds are exposed to within typically larger schools and many, more diverse encounters with people of whom they have little acquaintance. Alternatively it could be the transition from smaller primary schools and the ethos they contain to the larger, less intimate environment of the secondary school. In either case the move towards operating as a socially independent individual in a more distant and less predictable setting as opposed to the relatively tranquil experience of being a child operating as a reflection of family and friends appears to be instrumental in this altered social perspective.

3.6 Summary of areas for further study

As initial research to qualify the areas of further investigation towards this thesis, the paper questionnaire study was successful in that it supported the hypotheses on differences in male and female approaches to computers and began to define the most important areas. The open question on affect and free drawing of a computer user were particularly helpful in this. It did not quantify the degree of many of the differences but the following necessary refinements were identified and were critical in the design of the next stage of research:

1. More age-groups across adolescence and data from adults are required
2. Educational attainment information needs to be better measured at a more individual level
3. Different applications within computing need investigation rather than just a global attitude measurement
4. Locus of Control in a wider context than specifically for computing is needed for comparison purposes
5. Level of affect towards using a computer needs quantifying
6. The prevalence and features of stereotypes need quantifying more accurately
7. Measurements of actual performance on a computing task are required to assess the impact of stereotypes and attitudes towards computers in terms of a practical outcome
8. Relationships between variables should be examined for predictive purpose

The next phase of the research was set to address these areas for further investigation through a more focussed questionnaire omitting the previously unused section on explicit attitudes towards computers. It would update the mode of delivering the questionnaire to an online version as it was felt this would be more appropriate for the topic. An online questionnaire would also act as a ready means for participants at various schools to simultaneously contribute data in a controlled environment and a more uniform manner such as during an ICT class.

There would be better detail designed into the questionnaire to expand data upon the topics of emotion felt during computer use and sense of personal control in a general and computer-specific context. The introduction of multiple response data for the scales would improve their reliability plus give indication of any subscales that were of importance in relation to aspects of emotion or control experienced.

The development of scales for emotion and locus of control in a computing domain would be in line with the components of affect and perceived control, as represented by Kay (1993) in the Computer Attitude Measure (CAM) scale, and as with his scale sit alongside measures of use (behaviour) and representations (cognitions) for cross-comparison.

Reducing the previous open questions of free response to drawing a computer user would eliminate any coding ambiguities and provide quantitative data to establish more accurate proportions of types of representation. It would also allow inclusion in models that would examine the impact of holding a stereotype or not on other variables.

Chapter Four

Online Questionnaire Study.

4.1 Introduction

To develop the results from Chapter Three, further research was required to determine how robust was the main finding that a transition occurred between the ages of 11 and 16 from personally known representations of a computer user to stereotypical ones. It also needed a further age group between those points to better define at what age the change mostly took place. Introducing quantitative measures of some of the variables associated with representations so coding ambiguities of qualitative data would be removed and the variables reduced to three simpler factors of gender, age and stereotypical or not would also enable better examination of relationships with other variables. These other variables were to include a more complex affect scale that could be factored into primary components towards looking at features that loaded positively and negatively on emotion during computer use plus investigate if subsidiary groups of emotion were also felt. The simple measure of Locus of Control was to be developed further to see if it, too, had factors within it and to see if locus of control scale in a computing context was related to LOC in an alternative domain such as at school/work/university. Inclusion of adult and undergraduate data would also expand the age range to see how lifespan development of the social representation of computer users and all other variables would perform. Again, the emphasis was as with Kay (1993) on an attitude towards computers based on a cognitive component (computer user representation in this instance), an affective component (recorded emotion during computer use), a behavioural component (use) and perceived control (LOC measures).

Towards this end, the research described in this chapter used an online survey that was distributed to 10-11 year-olds, 13-14 year-olds, 16-18 year olds, undergraduates and adults.

To redress some of the limitations of the initial study's qualitative approach, instead of a free response to emotion during computer use, there were options to select from a list of emotions and their opposites based on those reported in Chapter Three. Replacing the previous free-drawing of a 'typical computer user', there was a choice of six 'typical users' based upon categorised data from the paper questionnaire of Chapter Three.

To measure sense of perceived control, a more complex measure of Locus of Control in a computing context was developed alongside a comparison scale of Locus of Control in work or an educational setting. These scales were to be appraised for reliability and undergo factor analysis to identify features that loaded towards any particular aspect of control.

The new measures of emotion during computer use, Locus of Control in a work/education or computer context and more precise prevalence of certain mental representations of a 'typical' computer user were used to examine relationships with computer use, other control and attitude measures. The preference for computer setting test was repeated in the same form as previously so that it could be related to the new data.

4.2 Method and Results

The general method used is presented in a single combined section, but the details of the measures in each area are presented with the results in relation each area covered. Some of the supporting statistical analyses conducted are referenced in the text but included in Appendices B-1 to B-9.

4.2.1 Participants

The sample for the study comprised 672 participants split into five age groups: 183 (91 boys, 92 girls) 10-11 year-olds; 75 (43 boys, 32 girls) 13-14 year-olds; 108 (50 boys, 58 girls) 16-18 year-olds; 219 (34 men, 185 women) undergraduates and 87 (34 men, 53 women) adults. The mean ages for each of the four youngest age groups were: 10.34 years (*SD* = 0.48); 13.35 years (*SD* = 0.91); 16.95 (*SD* = 0.95) and 19.34 (*SD* = 1.15). The adults reported their ages using an age-range from a menu of choices and by assuming the median value for each of those, the adult age-group had a mean age of 39.22 (SD = 11.34) years. There were no significant differences in age based on gender for any of the age groups.

The youngest participants were drawn from three primary schools in Northamptonshire (class sizes of 58, 30 and 39) and one in Leicester (56 pupils) that agreed to allow their pupils to provide data. 13-14 year-old participants were also recruited via the school they attended (a rural mixed comprehensive in Northamptonshire) asking them to complete the questionnaire in class. The 16-18 year-old group were drawn roughly equally from the sixth form of the school that provided the

13-14 year-olds and volunteers at a general Open Day for sixth formers held at University of Leicester. Undergraduates completed the online questionnaire as part of a course requirement for experimental participation. The adult sample was an opportunity sample and was drawn from classes in higher education run by the University of Leicester, personal acquaintance of the researcher or through request slips distributed to parents of sixth formers attending the Open Day.

4.2.2 Design and Materials

The questionnaires reflected the same five research areas as Chapter Three and are split into five sections. The main variables under consideration were educational attainment, science vs. non-science subject choices, level and type of computer use, sense of personal control whilst using a computer related to a more general sense of personal control, emotion during computer use, preference for computer appearance and the prevalence of stereotypes of computer users. The design examined the dependent variables in terms of the independent variables of age and gender, and also included a correlation analysis of the variables with each other leading to a linear regression model of attitude towards computing as represented by the emotions reported during computer use.

All questionnaires were presented via a webpage requiring closed responses made from either buttons or drop-down menus. Age appropriate questionnaires are included in Appendix B-1 and were accessed from a menu on the University of Leicester School of Psychology website managed by the researcher with the following URL: http://www.le.ac.uk/pc/eavm1 . Each age group had its own version to reflect the educational level that best suited the group. The youngest age group (10-11 year-olds) had a much shorter version of the questionnaire than the other four, as questions for the more developed affect and LOC scales (described within the relevant Method and Results sections later) were omitted.

Participants made their responses and at the end of the questionnaire clicked on the ‘submit’ button to email the form to the researcher’s email account where data was transformed via Excel into a SPSS dataset.

4.2.3 Procedure

For the youngest two age groups, permission was obtained from the participating schools and arrangements made for the researcher to attend a computer room session at which groups of pupils completed the online questionnaires, without conferring, at individual consoles. The consoles had been prepared for pupils by the researcher logging on to the Internet and accessing the appropriate URL address to present the questionnaire on screen. The 16-18 year-old school pupils, undergraduates and adults were asked to complete the questionnaires in their own time and at their own convenience. The URL was supplied on a slip of paper with details of how to include the identification details. The 16-18 year-olds recruited at the Open Day completed the online questionnaire in groups in a computer laboratory at the university, again at individual consoles and without conferring. The URL was given using a data projection screen at the front of the classroom along with a short demonstration on how to start completing the form.

The questionnaire required an identification code comprising a letter and a numerical part. The letter identifier represented the source of the data and was allocated to the participant by the researcher whilst the participant was able to freely choose the numerical value. Undergraduates followed a different procedure with regards to the identifier as this was passed to the participant in its entirety so participation could be traced to assign course credit. The only means of tracing data therefore was either by a cross-reference table held by the researcher for undergraduates or by the participant retaining identification details and being able to supply the approximate time and date of submission to link the data to the email containing it.

All participants had the right to reclaim their data by emailing the researcher whose contact details were provided at the end of the online form. The data required active anonymous submission of the data. The research was approved by the University of Leicester Ethical Approval system and no negative feedback or withdrawals occurred.

4.2.4 Coding, analysis and results

Section1: Education, Interests and Recorded Use of Computers and their Applications

The first section of each questionnaire recorded data on level of education attained, subject preferences at school or type of employment, and category of computer use based on points of access and number of hours per week. Educational attainment applied to the 16-18 year old, undergraduate and adult participants only and was reflected by number of GCSE's, UCAS points and category of highest qualification respectively. The 13-14 year-old participants gave the number of GCSE's they were taking as a reflection of likely attainment. The number of GCSE's obtained by the 16-18 year-olds was included alongside the 'A' levels they were taking. Appendix B-2 includes these data for the four oldest age groups and t-tests or Chi-squared analyses as appropriate indicated that there were no differences between male and female participants in levels of either actual or projected educational attainment. The average number of GCSE's the 13-14 year-olds were taking was 9, with 8 passes at grade 'C' or higher being held on average by the 16-18 year-olds. The undergraduate sample had 10 such passes on average. Most of the adult sample (60%) had a degree or higher as their highest qualification. To control for level of education across the sample and for later analyses across the sample based on above or average educational performance, categorisation of participants into average and above qualifications or below is included at the end of Appendix B-2. There were no gender differences (Mann-Whitney: $z = -0.26$, $p > 0.05$) or preference for science/non-science subjects (Mann-Whitney: $z = -0.05$, $p > 0.05$) in the composition of these groups.

All age-groups still at school had participants drawn from as wide a sample as possible by asking their teachers to select as broad a representation as was possible with no particular areas of study favoured. For the 16-18 year-old age group, some participants were recruited at a general Open Day at the University of Leicester, again with no areas of study favoured. Interests were measured through favourite subject at school for those aged 10-11 and through GCSE choices for 13-14 year olds. For the 16-18 year-old and undergraduate age groups, it was based upon A-level subject choices. The adult age group was not categorised based on their employment but a list of occupations and their frequency of occurrence based on gender is included in Appendix B-3. It illustrates that there were no significant differences in gender between occupations other than a trend for teachers or those in medical/health care to be women and those working in ICT or the Public Services to be men. The coding for science/non-science interests for the younger four age groups followed that used in Chapter Three. The proportions of science/non-science subjects based upon the coding are included within Appendix B-3.

There was a significant gender difference in the subjects favoured by the 10-11 and 16-18 year-old age groups but not the 13-14 year-old group or undergraduates. The 13-14 year-olds most likely had their responses tailored by the National Curriculum GCSE requirements rather than anything else so the results cannot be considered a reasonable reflection of interests. Since the undergraduate sample was drawn primarily from psychology students there may have been some bias in the responses for this age group based on ‘A’ level choices, so again the data cannot be considered generally representative of people of this age range.

For the 10-11 year-old pupils, girls favoured non-science subjects more than the boys who favoured science subjects more than the girls. Including PE as a neutral subject (consistent with Chapter Three and in line with Colley et al.,1994) meant that as 35% of boys said this was their favourite subject the results were somewhat skewed towards boys liking neutral subjects. The modal response of the girls was that 35% of girls considered Art as their favourite subject. In terms of computing, 13% of boys compared to 2% of girls returned it as their favourite subject.

Considering ‘A’ level choices, the 16-18 year-old participants had a significant gender difference in the choice of science, neutral and non-science subjects being taken. 84% of male participants favoured science subjects against 38% of women of whom 20% favoured non-science subjects against no men in the sample.

Computer use was by selection from drop-down lists of points of access, frequency of use and average number of hours per week of use for all age groups. Appendix B-4 lists the responses to these questions for all age groups.

95% of homes had a computer with fewest in the 10-11 year-old participants' home (85%) and adults' homes (95%) against 100% of homes in the 16-18 year-olds and undergraduate age-groups. The only significant gender difference was that more 10-11 year-old girls' homes (90%) had computers than boys' (80%).

There was no gender difference in personal ownership of a computer for any age group other than the 16-18 year-olds (68% of boys, 48% of girls) and adults (94% of men, 55% of women). The proportion of personal ownership rose with age from 10-11 year-olds (35%) to undergraduates (83%), dropping back to slightly fewer adults (71%).

There were no significant gender or age differences in relation to Internet access via mobile phone.

Frequency of use increased with age with the 13-14 year-olds using computers either most days (girls) or every day (boys) rising to adults using them over twice a day (men and women). There were significant gender differences in frequency of use for the 16-18 and undergraduate participants only. 16-18 year-old boys accessed computers twice a day whereas 16-18 year-old girls tended to use them just once. Undergraduate men tended to use computers over twice a day (the maximum response available) whereas undergraduate women responded most often with twice a day.

Number of hours of use per week increased with age-group for both genders, but, with male participants consistently reporting one category higher of use across the entire age-group range than the female participants. The gender differences in use were significant for all age-groups apart from the adults. Those who spent least time on computers were the 10-11 year-old girls (1-5 hours/week), and those who spent most, were the adult men (15-40 hours/week).

In terms of educational attainment and computer use, there was a negative correlation between educational attainment and number of hours use with those having or taking more qualifications spending less time on computers than others (Mann-Whitney: $z = -2.3$, $p < 0.05$). This trend was apparent for all age groups, but only significant for the 16-18 year-olds (Mann-Whitney: $z = -2.0$, $p < 0.05$). Those with 9 GCSE passes or less produced a median value of 15-25 hours computer use a week against those with over 9 GCSE passes who recorded a median value of from 10-15 hours a week.

The various applications of computers were examined and the proportions that made use of various functions are reported in Appendix B-4. The most used aspect of computers was email which was increasingly used from 13-14 year-olds (83% of participants) to undergraduates (100%) and adults (98%). There were other clear patterns of use that were age related with playing games online reducing from 13-14 year-olds (81%) to undergraduates (19%) and adults (14.5%). Chatting online seemed to be roughly equally popular from 13-14 year-olds (56%) to 16-18 year olds (58%) and undergraduates (57%) but much less popular with adults (21%). Buying and sourcing information online also increased with age, albeit buying online rising more dramatically from 40% of 13-14 year-olds to 75% of adults than sourcing information online which was from 72% to 89% between the two age groups.

Gender differences in use were only significant for a few computer functions with male participants being more active than female participants in all instances apart from the youngest participants' use of email. Playing games online and sourcing information online by 10-11 year-olds (Mann-Whitney: $z(73) = -2.30$, $p < 0.05$ and $z(73) = -2.78$, $p < 0.05$ respectively) was more popular for boys than girls. Chatting online for the 16-18 year-olds approached a significant gender difference ($z(104) = -1.94$, $p = 0.05$) and continued to be more popular at the level of a trend for male participants than female ones within the undergraduate and adult age groups.

Opinion regarding various computer functions is reported in Appendix B-4. There was little variation throughout the sample in terms of age or gender in the usefulness of computers for presentation (neatness), calculation (databases etc.) or reliability (less fallible than humans). Communication (one-way ANOVA: $F(3,480) = 23.08$, $p < 0.001$) and convenience (one-way ANOVA: $F(3,479) = 10.71$, $p < 0.001$) were deemed equally useful by male and female participants but increased in worth with age. Positive ratings of computers for entertainment decreased with age (one-way ANOVA: $F(3,479) = 21.50$, $p < 0.001$) with 16-18 year-olds male participants rating gaming higher than their female counterparts (one-way ANOVA: $F(1,104) = 4.30$, $p < 0.05$) and undergraduate men doing likewise in comparison to undergraduate women (one-way ANOVA: $F(1,217) = 12.89$, $p < 0.001$). There were no gender differences for the 13-14 year-old and adult age groups and the only other gender difference apart from usefulness of computers for games was for programmability. 16-18 year old and undergraduates reversed their pattern of ratings in this with 16-18 year-old boys rating programmability more useful than did the girls (one-way ANOVA: $F(1,103) = 7.71$, $p < 0.01$) whereas the undergraduate women rated it more highly than did their male counterparts (one-way ANOVA: $F(1,217) = 3.67$, $p < 0.05$).

Section2: Sense of Control in Computer Use

The questionnaires contained a simple locus of control measure; two questions asking the various percentages the user and computer were in control and two further, more complex measures relating to LOC subscales derived from two sets of twenty-four questions covering personal control; capacity beliefs and strategies for control (Skinner, Zimmer-Gembeck & Connell, 1998) as described and discussed in Chapter Two of the thesis.

The simple LOC measure recorded participants' responses as to whether they felt control of the computer was with the user, shared or with the computer. Data was collected for all five age groups and indicated that there both an age-group (χ^2 (8) = 157.43, φ= 0.45, $p < 0.001$) and a gender difference (χ^2 (2) = 14.34, φ= 0.15, $p < 0.01$) in LOC. The measure was reduced from the three-way categorisation to a binary categorisation of either with the computer or not to aid later analyses. The effects of age-group (χ^2 (4) = 81.61, φ= 0.35, $p < 0.001$) and gender (χ^2 (1) = 5.23, φ= 0.09, $p < 0.05$) were maintained by doing this but unfortunately no longer differentiated between shared or with the computer responses. One cause of difference across the age groups was that the majority (70%) of 10-11 year-olds considered control was shared rather than with the user. This was the only age group that showed this and since most of the comparison analyses were to be with the other age groups it was felt the advantages in collapsing the data outweighed the disadvantages. Appendix B-5 gives details of the patterns of LOC distribution using the original categorisations and tests of significance based on the reduced categorisations. Comparison with results from Chapter Three are also included and indicate that the pattern from the data collected in this chapter is similar to that collected previously from the 10-11 and 16-18 year-old age groups.

Participants were asked to select the % of time that they considered the user and computer was in control by means of a drop-down menu with choices ranging from 0% of the time to 100% of the time in both cases. The % of time that the user was in control and the % of time the computer was in control did not produce any significant differences either in terms of age-group or gender. The results are summarised and presented in Appendix B-5. It appeared that the measures correlated well with female participants' responses to the simple LOC measure (Spearman's rho: $r(326) = -0.23$, $p < 0.01$ for % of time user in control and $r(324) = 0.19$, $p < 0.01$ for % of time computer is in control) but not with male participants (Spearman's rho: $r(152) = -0.02$, $p > 0.05$ for % of time user in control and $r(151) = 0.10$, $p > 0.05$ for % of time computer is in control).

The final data on LOC were collected from two sets of 24 questions pertaining firstly to general work/educational circumstances and secondly more specifically to using a computer. The questions for general sense of personal control for each age group were tailored to cover either school; university or work. The questions for sense of control during computer use were the same for all age groups. Participants responded to the questions by means of a drop-down menu with four Likert scale options indicating level of agreement with the statement as true of themselves or not.

Principal Component Analyses were conducted for data reduction purposes of work/education sense of control and computer sense of control questions. The first 75 participants from each of the age groups were used for this so age-bias would be minimised. All subsequent analysis beyond identification of the main factors was with the full sample. Full details of the factors and questions that loaded upon them plus scree plots of the analyses are included in Appendix B-5. Four factors were identified for each of the LOC contexts by examination of the scree plot (Cattell, 1966, as cited in Zwick & Velicer, 1998) in combination with output from a Monte-Carlo random eigenvalue extraction programme (Monte Carlo PCA for Parallel Analysis by Marley W. Watkins, Penn State University, downloaded from http://www.public.asu.edu/~mwwatkin/Watkins3.html) that generated the eigenvalue for each factor based on number of degrees of freedom that would be appropriate to use as a cut-off in Principal Component Analysis (Horn's Parallel Analysis (Horn, 1965, as cited in Zwick & Velicer, 1998)). Table 4.1 illustrates the eigenvalue from the Monte-Carlo programme plus that extracted by SPSS for the LOC subscales alongside the % of variance for which each factor accounted.

Table 4.1.
Principal Component Analysis of 24 Questions to Form LOC Scales (300 participants).

	Eigenvalues extracted			% of variance accounted by factor	
LOC Factor identified	Horn's Parallel Analysis	Work or education LOC	Computer LOC	Work or education LOC	Computer LOC
External/Internal LOC	1.55	5.75	6.21	23.95	25.87
Potential/capacity belief	1.45	2.65	2.42	11.03	10.07
Luck, others and motivation beliefs	1.39	1.71	1.62	7.12	6.76
Self-confidence	1.33	1.45	1.36	5.96	5.67
		Total variance explained		48.06	48.37

The factors extracted were considered to represent equivalent quantities in each of the domains. The first factor was overall LOC (loaded positively and negatively by various questions) with values normalised to range from 1 to 4 in line with the original questions. The higher the value, the more internalised was LOC. Of the original 24 questions, 19 questions loaded on this for the work/education context and 17 for the computing context. Reliability analyses of these scales gave Cronbach's alpha for education/work sense of personal control as 0.84 and for the computing context sense of control, Cronbach's alpha was 0.87. Three further factors that were loaded by other combinations of the 24 questions were also identified and the associated questions again listed in Appendix B–5. These other factors included potential to succeed (loaded by 11 questions for education/work LOC and 9 questions by computing LOC); the influence of luck and other people (+ve component of factor 3; loaded by 6 questions for education/work LOC and 4 questions by computing LOC); motivation (-ve component of factor 3; loaded by the equivalent two questions in both contexts); and self-confidence which was loaded by a combination of negative and positive questions (7 from work/education context and 4 from computing). SPSS syntax commands to form the sub-scales are included in Appendix B-5. Tables of Cronbach's alpha values are included in Appendix B-5 for each of the sub-scales in each of the contexts and for various age-groups. It seemed sub-scales were often not reliable enough to be useful so only the main factor of overall LOC, generated by adding the positive and negative scales together was maintained for analysis. Overall work/education LOC had Cronbach's alpha of > 0.82 for all age groups and Overall computing LOC had Cronbach's alpha of > 0.84 for all age groups.

There was a very strong correlation between work/education and computer LOC values (Pearson's correlation: $r(421) = 0.40$, $p < 0.001$) although their pattern with respect to age-group and gender was different. There was no significant main effect of age-group (two-way ANOVA: $F(3,421) = 0.15$, $p > 0.05$), gender (two-way ANOVA: $F(3,421) = 0.97$, $p > 0.05$) or interaction between them on work/education LOC (two-way ANOVA: $F(3,421) = 1.23$, $p > 0.05$). However, there was a main effect of age group (two-way ANOVA: $F(3,460) = 4.98$, $p < 0.05$) and gender (two-way ANOVA: $F(3,460)$

= 2.68, $p < 0.05$) but no significant interaction (two-way ANOVA: $F(3,460) = 0.75$, $p > 0.05$) between them on computer LOC. Figures 4.1 and 4.2 illustrate the values of both scales of overall LOC for each age-group and gender respectively. Figure 4.3 illustrates the variation of computer LOC with age-group and gender.

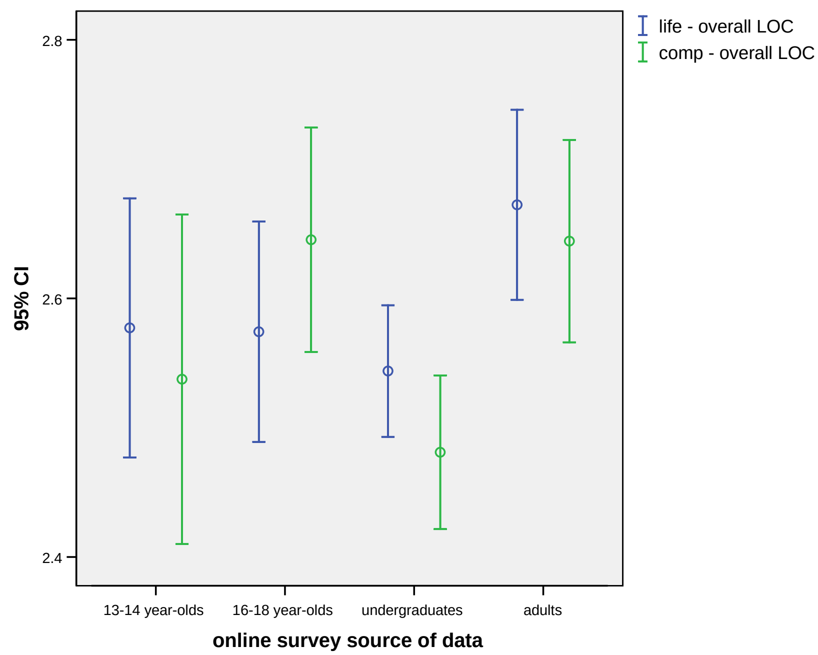

Figure 4.1: Work/education and Computer contexts primary factor of LOC (overall LOC) with respect to each age-group: 13-14 year-olds; 16-18 year-olds; undergraduates and adults.

Correlations with other variable are shown fully in Appendix B-5. The only significant correlation for work/education LOC was with percentages of time the user (Spearman's: $r(347) = 0.13$, $p < 0.05$) or computer (Spearman's: $r(344) =- 0.15$, $p < 0.01$) was in charge of a computer.

Significant correlations for computing LOC existed with the simple measure of LOC for computing (Spearman's: $r(327) = -0.29$, $p < 0.01$) and with percentages of time the user (Spearman's: $r(329) = 0.16$, $p < 0.01$) and computer (Spearman's: $r(326) = -0.12$, $p < 0.05$) was in charge of a computer.

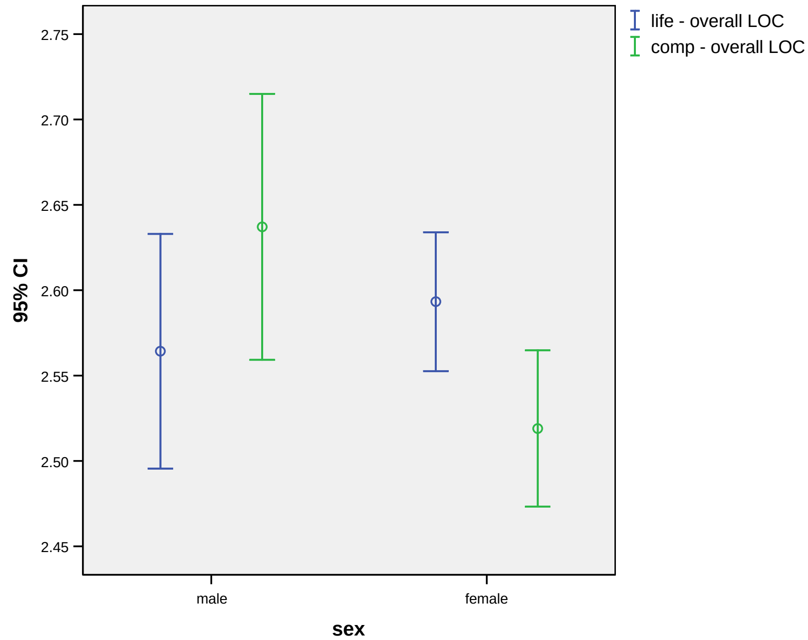

Figure 4.2: Work/education and Computer context LOC with respect to gender.

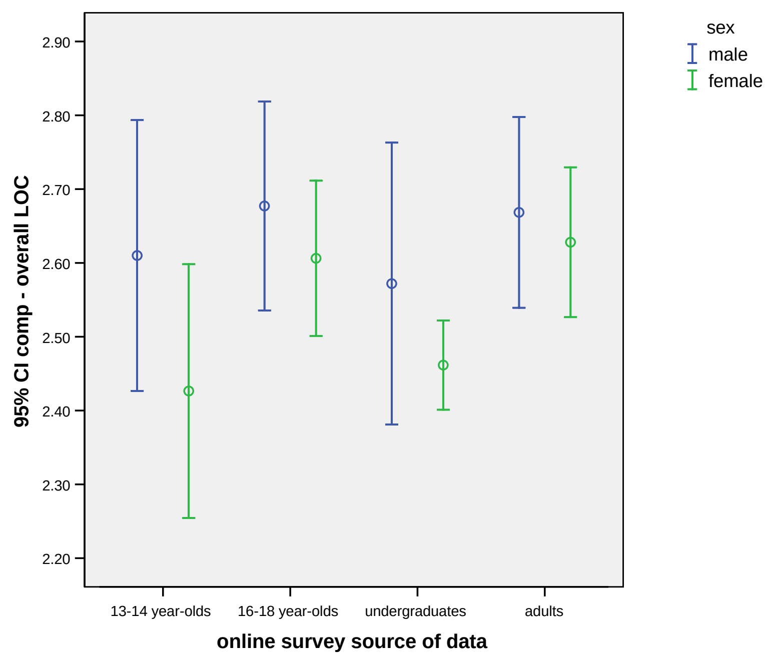

Figure 4.3: Computer context LOC with respect to age-group and gender.

There was a significant correlation between the categorisation of above or below average educational attainment and computer LOC (Spearman's rho: $r(381) = -0.12$, $p < 0.05$) but not with work/education LOC attainment (Spearman's rho: $r(404) = 0.02$, $p > 0.05$). This did not present a significant difference in the overall computer LOC subscale for any one age-group or for male and female participants separately but only across the sample as a whole ($t(379) = 2.36$, $p < 0.05$). Thus, those with better qualifications had a lower sense of personal control over computers than their contemporaries which may be related to the previous result that they tended to use computers less.

There was also a significant correlation for educational attainment with computer LOC for the 13-14 year-old age group only as defined by the number of GCSE's being taken. As discussed previously with regard to proportion of science subjects, this may not be a reliable measure as the National Curriculum may shape the entries being made to an extent rather allowing the measure to be a reflection of individual choice or attainment.

In terms of proportion of science subjects being taken, there was a significant correlation (Spearman's: $r(226) = -0.17$, $p < 0.01$) between it and computer LOC such that for the 16-18 year-old and undergraduate age groups, the higher the preference for non-science subjects, the less the sense of personal control over computing.

The final group of correlations conducted related to computer use and indicated frequency of access (Spearman's: $r(331) = 0.24$, $p < 0.01$), numbers of hours of use (Spearman's: $r(331) = 0.27$, $p < 0.01$) and ownership of ones own computer (Spearman's: $r(328) = 0.14$, $p < 0.05$) were significantly related to the sub-scale of computing LOC.

Section3: Emotion during use of a computer

The first measure of emotion during computer use was a simplification of the categorisation of emotions recorded in Chapter Three and was to indicate an opinion towards computers as either ‘good’; ‘good and bad’ or ‘bad’. There was a gender difference in response to this question ($\chi^2(1) = 14.34$, $\varphi = 0.015$, $p < 0.001$) such that overall, and in the case of the 10-11 year-old age group treated separately, male participants had a significantly more positive attitude than female participants to computers . This was a trend that was visible across all ages apart from the 16-18 year-old group. Indeed, the pattern was for 10-11 year-old boys to think more highly than did 10-11 year-old girls and to reduce this to the level that operated across the rest of the sample of roughly half thinking computers were ‘good’ and half moderating this by thinking they were ‘good and bad’. Very few thought computers were ‘bad’ .Full details of the results are reported in Appendix B-6.

The free responses as to emotion felt when using a computer were collated from the study described in Chapter Three and turned into a series of 20 semantic differential scales (Osgood, Suci & Tannenbaum, 1957). Participants were asked to click one of the six buttons between the opposing adjectives to best represent their emotion. A full list of the adjectives is included in Appendix B-6. Five of the scales produced a significant gender difference: women found computing marginally more depressing than comforting whereas men did not ($t(468) = -2.50$, $p < 0.05$); both men and women found computing relaxing rather than aggravating but more men reported so ($t(462) = 2.46$, $p < 0.05$); women were not particularly bored or excited by computing but men tended to be more excited than bored compared to women ($t(468) = 3.05$, $p < 0.01$); both genders were more at ease than stressed by computing but proportionally more men reported they were more at ease than was so for women ($t(459) = 2.63$, $p < 0.01$); and finally, women tended to describe computing as being a less animating experience than was reported by men ($t(457) = 3.09$, $p < 0.05$).

Principal Component Analysis in combination with examination of the scree plot (in Appendix B–6) and Horn's Parallel Analysis of eigenvalues (as previously used for LOC sub-scales) identified three factors for selection within the 20 semantic differential scales data. Again, the sample was reduced to 75 participants from each age group to avoid age-bias in generating these factors. Table 4.2 summarises the identification of each factor and the amount of variance each one explains.

Table 4.2.
Principal Component Analysis of 20 Questions on Emotions Experienced During Computer Use (300 participants).

Identification of factor	Horn's Parallel Analysis	Emotions scale Eigenvalue	% of variance accounted by factor
Positive/Negative emotion	1.49	7.48	37.42
Level of engagement	1.40	2.21	11.03
Level of emotionality	1.33	1.56	7.80
		Total variance explained	56.2

Cronbach's alpha values are reported in Appendix B-6 and indicate that the subscales formed to represent each of the subscales of emotion – identified as positive/negative emotions; level of engagement and degree of emotionality experienced were reliable by having values above 0.80 for all of the age groups and sub-scales apart from level of engagement (0.78) for the 13-14 year-olds which in general was slightly less reliable than the other sub-scales. SPSS syntax and the formulae to create the subscales from the 20 questions are included in Appendix B-6. The sub-scales were normalised to have values that ranged from 1 to 6 in line with the original responses for each question where 3.5 indicated a neutral position between the two semantic positions. The factor for positive and negative emotion was treated as two sub-scales to allow better comparison with Chapter Three data. T-tests of gender differences for each age group did not produce any significant results other than for engagement for the 13-14 year-old age group which, as mentioned above, from Cronbach's alpha for that scale and group may not be entirely reliable. Figures 4.4 and 4.5 illustrate the pattern of emotion sub-scales for male and female participants respectively.

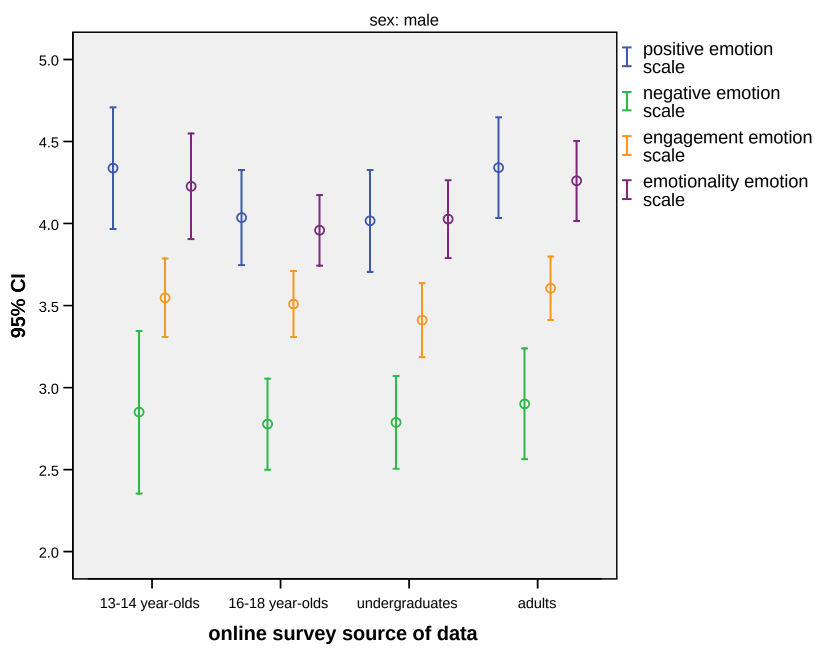

Figure 4.4: Emotion sub-scales for male participants by age-group

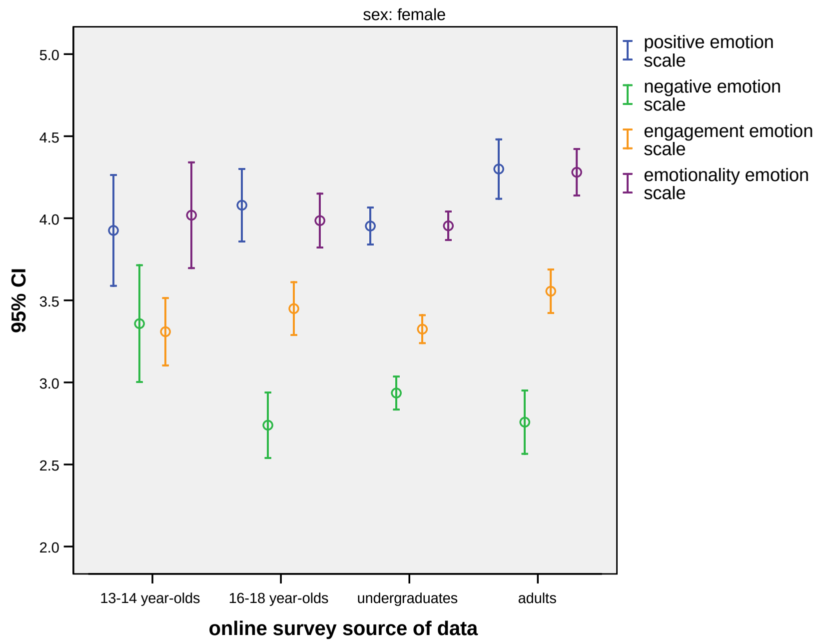

Figure 4.5: Emotion sub-scales for female participants by age-group

Appendix B-6 contains tables of correlations with other variable. These indicated that the simple measure of opinion of computers was significantly related to all the subscales in the manner that was expected such that those who considered computers straightforwardly ‘good’ recorded higher positive emotions, lower negative emotions, a higher level of engagement experienced and found they did not respond too emotionally during their use.

The simple opinion of computers was related ($\chi^2(1) = 9.86$, $\varphi = 0.15$, $p < 0.001$) to the categorised level of above average educational attainment as indicated in Table 4.3.

Table 4.3.
Proportions (%) of each Level of Educational Attainment Across the Whole Sample Who Consider Computers 'good' or 'good and bad'.

Opinion of computers	Educational attainment	
	Average or below average	Above average
'good'	60.6	45.7
'good and bad'	39.4	54.3
N	208	247

Positive emotions were related to level of educational attainment but such that more GCSE's, 'A' levels and UCAS points indicated less positive emotion. Negative emotion was unrelated to qualifications but level of emotionality experienced was significantly related to GCSE, A level and UCAS points indicating that those with more qualifications had less emotional reaction to computer use than those with lower qualifications. These effects were not supported by any significant correlation between categorisation of educational attainment and any emotion subscales despite there being significant differences in the response to the single semantic differential scales of comforting vs. depressing ($t(443) = -2.43$, $p < 0.05$); heartening vs. irritating ($t(435) = -2.28$, $p < 0.05$); calm vs. angry ($t(441) = -2.52$, $p < 0.05$) and empowered vs. humiliated ($t(434) = -2.00$, $p < 0.05$) – all of which the better qualified responded to more negatively than did the less qualified.

All emotion sub-scales were related to computer use through frequency of use, number of hours per week of use or owning ones own computer. The general pattern of relationships between positive and negative emotions seen in the results from the study in Chapter Three were maintained apart from no significant relationship existing between choice of science or non-science subjects at school and emotion felt during computer use. Appendix B-6 includes comparison data for this.

Locus of control was most closely related to the sub-scale of engagement and followed the pattern of the data from Chapter Three. Those reporting higher levels of engagement and positive emotions had the most internal LOC and those with the most negative emotions reported lower personal control. The measures of % of time the user and computer was in charge also followed this pattern. Figures 4.6 to 4.9 illustrate the relationship between the sub-scale of overall LOC and the emotion sub-scales.

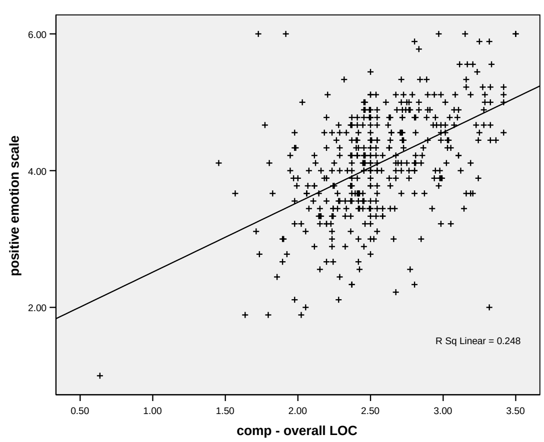

Figure 4.6: Relationship between Overall Computer LOC and Positive Emotion sub-scale

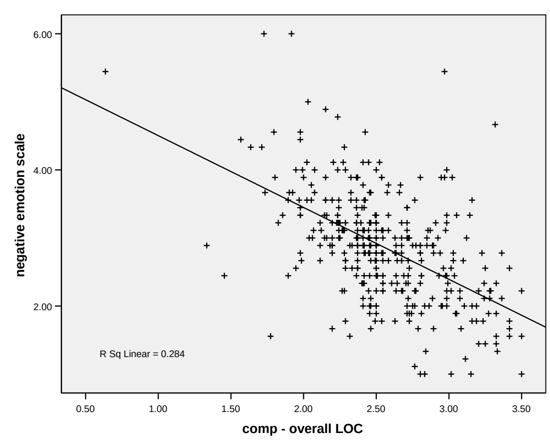

Figure 4.7: Relationship between Overall Computer LOC and Negative Emotion sub-scale

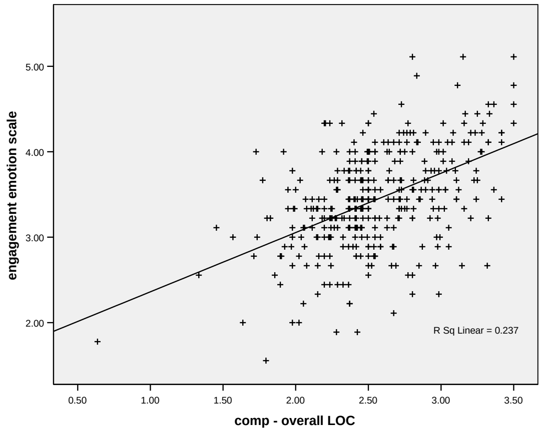

Figure 4.8: Relationship between Overall Computer LOC and Engagement Emotion sub-scale

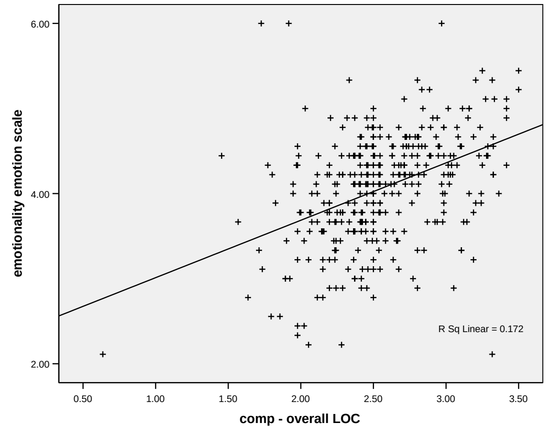

Figure 4.9: Relationship between Overall Computer LOC and Level of Emotionality Emotion sub-scale

Section4: Computer Appearance

The fourth section of each questionnaire was similar to that of the paper questionnaire in that it asked participants to express their preference as to which computer they would most prefer to use and order the remaining three in order of least preferred. The computer settings represented a feminine setting (Computer Setting A, with flowers and soft toy) and a masculine setting (Computer Setting D, with game controllers and joystick etc.) with two neutral choices either with a notebook and jar of pens (Computer Setting C) or without any other items apart from the computer alone (Computer Setting B).

Appendix B-7 includes the proportions of each age group and gender that preferred the various settings. As with Chapter Three data, apart from the 13-14 year-olds and adults there was clear evidence of a gender difference in which computer was the least preferred. Male participants generally disliked Computer Setting A most, whereas female participants generally disliked Computer Setting D most. This gender difference was consistent with the other age groups but did not achieve significance. Adult men and women equally disliked Computer Setting D.

The gender difference was also apparent for the most preferred computer setting with 10-11 year-old boys particularly liking Computer Setting D and 10-11 year-old girls split between it and Computer Setting B as their first choice. The older age groups also had Computer Setting D rated higher by male participants although among the 13-14 year-old age group Computer Setting B was the most popular, switching to Computer Setting C for the older groups. Adults had no significant gender difference in their choices with Computer Setting C as the most preferred by 53% of men and 45% of women and the large majority of the remainder opting for Computer Setting B. Appendix B-7 contains details of the statistical tests conducted and figures showing the various first and last preferences made by participants.

Mean ratings for each computer setting are shown in Figure 4.10 by age-group and gender. They were very similar responses to those made by the 10-11 year-old and 16-18 year-old participants in the study in Chapter Three, indicating the reliable nature of patterns of computer setting preferences with age and gender. Appendix B-7 includes a comparison table of the results between the two studies.

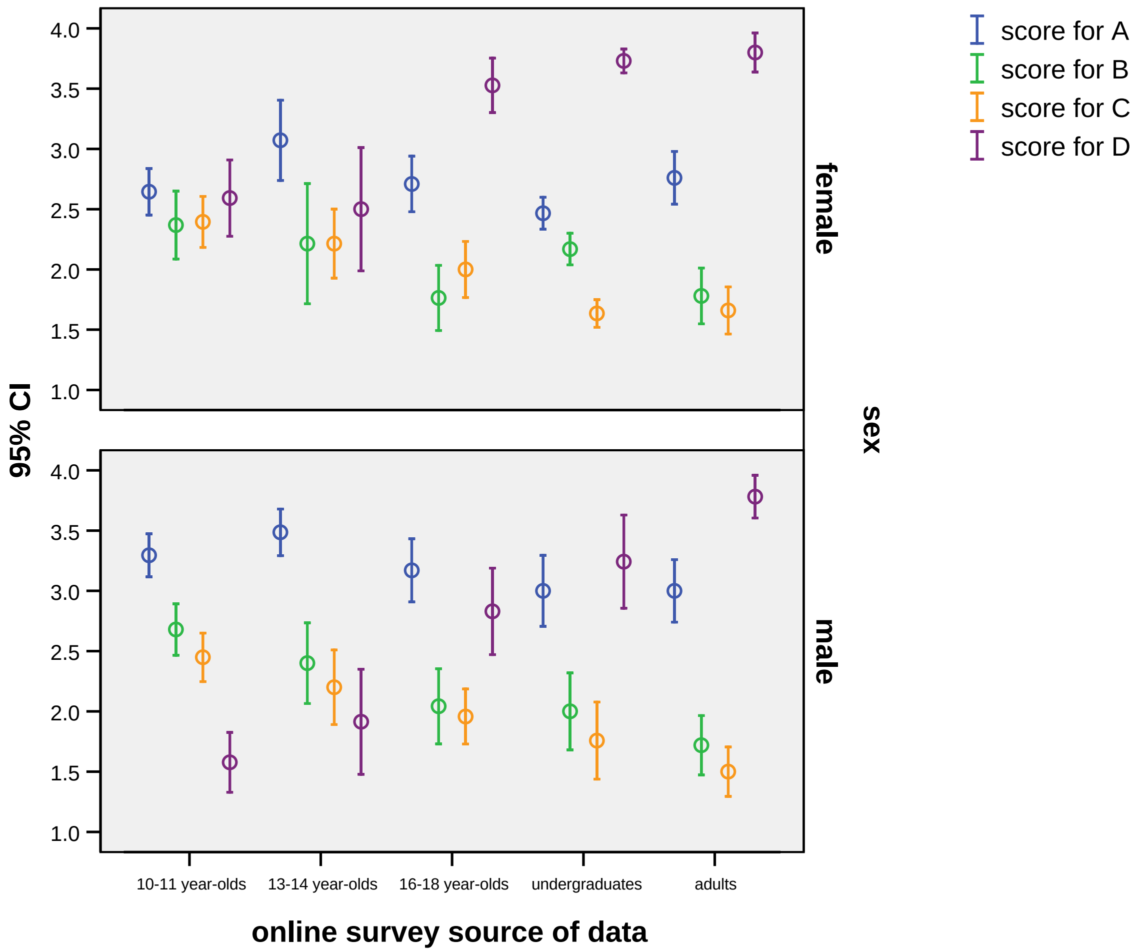

Figure 4.10: Average values of Computer Setting ratings by age-group and for male and female participants separately. A lower score indicates greater preference with 1.0 being first choice, 2.0 the second and so on until 4.0 signifies the computer setting is last choice.

Opinion of computers was strongly correlated with rating of various computer settings as illustrated by Figure 4.11. Participants who were more ambivalent about the worth of computers rejected Computer Setting D with the extra equipment and endorsed Computer Setting C with the open note book and pens visible.

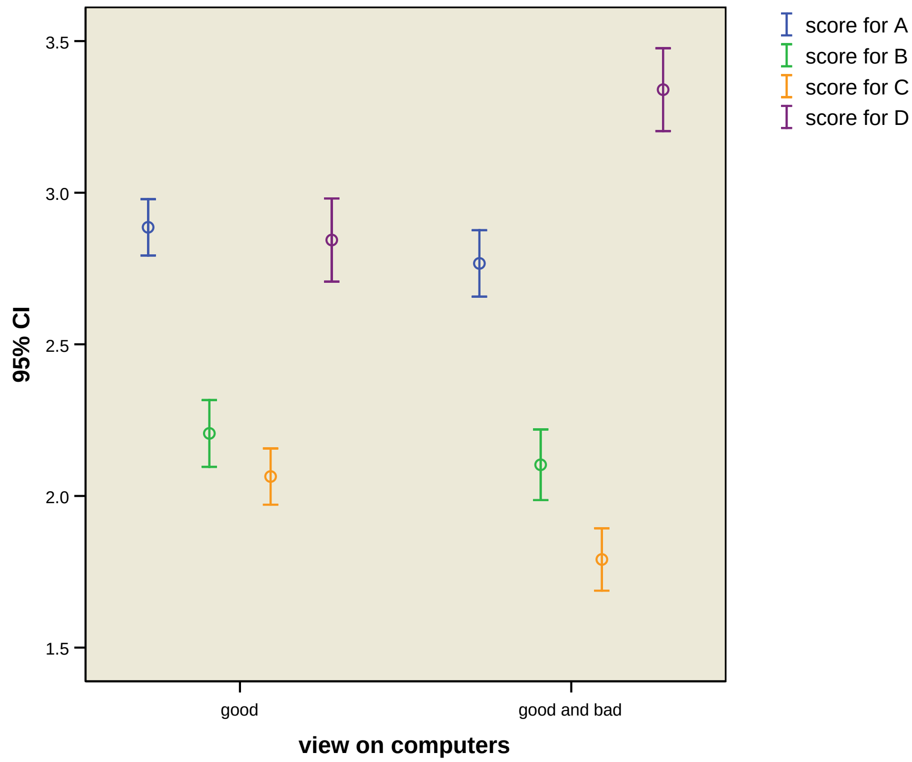

Figure 4.11: Average values of Computer Setting ratings by opinion on computers. A lower score indicates greater preference with 1.0 being first choice, 2.0 the second and so on until 4.0 signifies the computer setting is last choice.

Section5: Typical Computer Users

The fifth section of the questionnaire, given to all five age groups, examined the representation participants had of a ‘typical computer user’. By forming quantitative measures of the prevalence of male, young, stereotypical representations, relationships with other variables in the study could be made. This section of the online questionnaire required individuals to consider six figures that represented the key components identified and used for coding the free response drawings of Chapter Three. The elements of gender, age and typical features such as glasses, poor skin, bad hairstyle and dress sense were used to form the six choices. Three figures were male: young (‘Bob’:

stereotypical with glasses, poor skin, odd hairstyle and poor dress sense), young ('Nathan': no stereotypical features) and an older suited 'dad'. Three figures were female: young ('Cynthia': stereotypical with glasses, poor skin, odd hairstyle and poor dress sense), young ('Emma': no stereotypical features) and an older suited 'mum'. The names assigned reflected the responses made previously and attempted to maintain the result that although the figures that were drawn as stereotypes were young, the names often assigned to them were not commonly occurring in that age group (e.g. Bob, Cynthia, Fred, Malcolm etc.). Appendix B-8 presents the figures used and the form of the statement that required a choice from a drop-down menu of the computer users' names.

The proportions of those choosing each figure by age are presented in Appendix B-8. Young, male users were consistently chosen over either older or female ones for all age groups irrespective of the gender of the participant apart from the youngest, 10-11 year-old, age group. There was a significant difference between boys and girls in this age group as to the gender of the figure they chose with same-sex figures being more often preferred by 10-11 year-old girls than anywhere else in the sample (42%). Girls in this age group also tended to choose fewer younger figures (77% of choices) than the boys did (88%) by indicating the 'mum' and 'dad' figures were 'typical' users more often than elsewhere in the sample. Figures 4.12, 4.13 and 4.14 illustrates the patterns of responses by age group and gender for gender, age and stereotypical features or not of 'typical' computer users. Figure 4.15 indicates the level of choice for the most stereotypical computer user, 'Bob' (male, young, poor skin, glasses and dress sense).

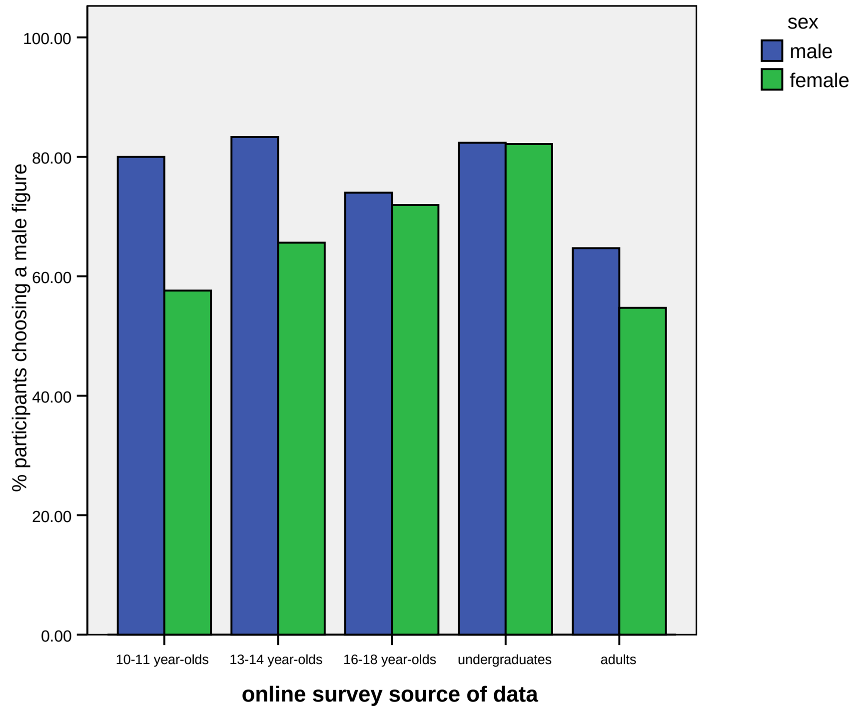

Figure 4.12: Proportions of participants based on gender and age group choosing a male figure as a typical computer user

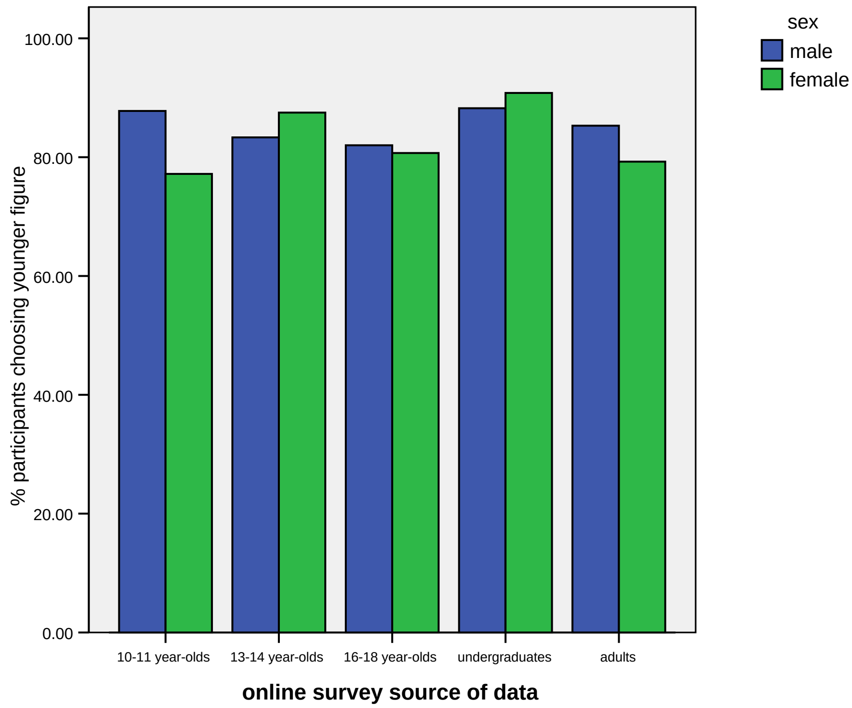

Figure 4.13: Proportions of participants based on gender and age group choosing a younger figure as a typical computer user

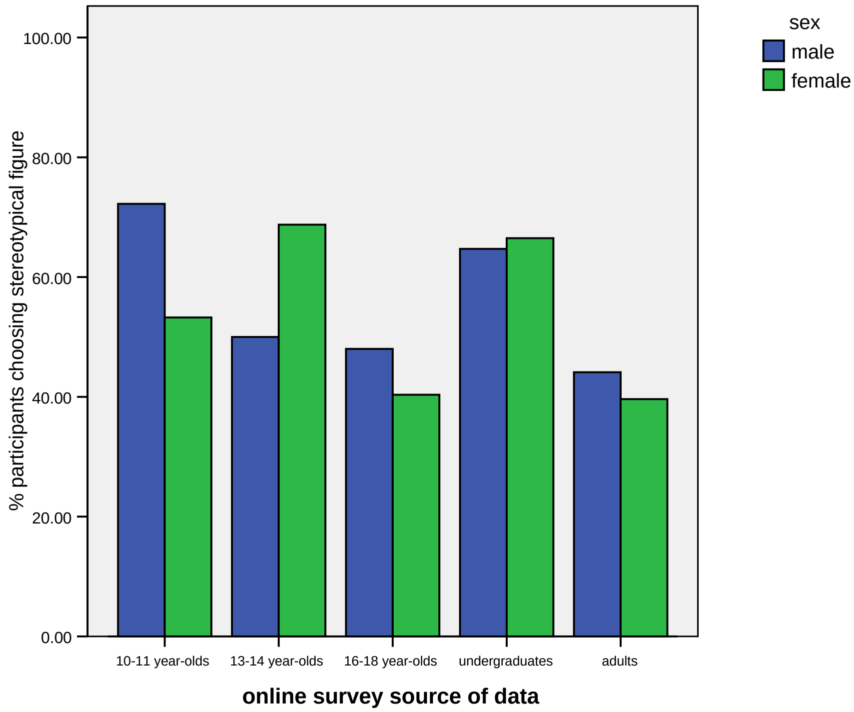

Figure 4.14: Proportions of participants based on gender and age group choosing a stereotypical figure as a typical computer user

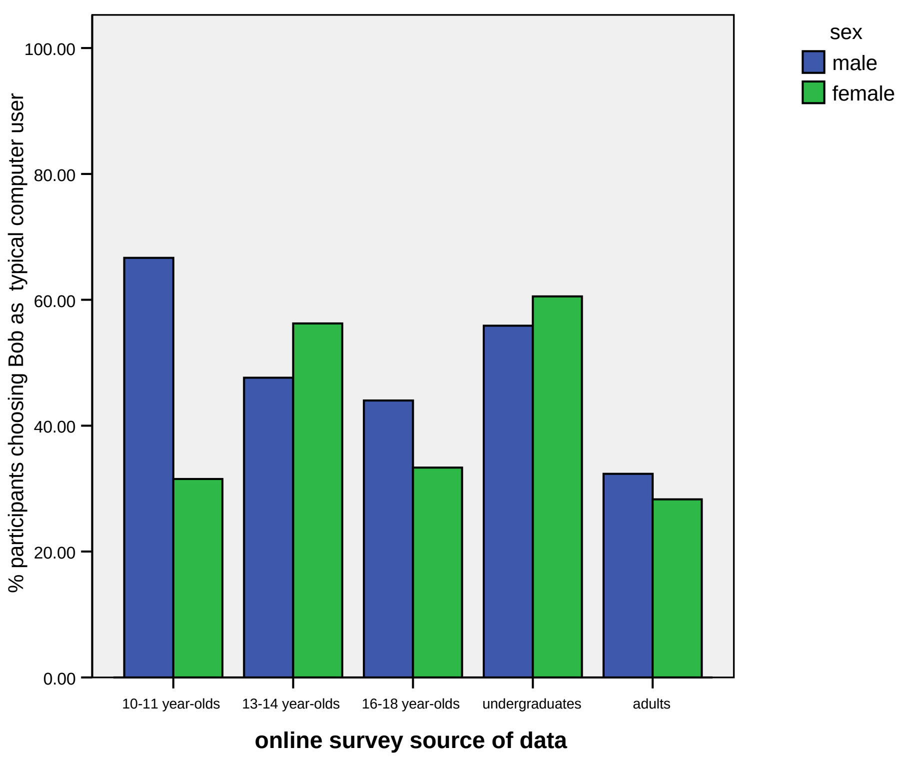

Figure 4.15: Proportions of participants based on gender and age group choosing the Bob figure as a typical computer user

To consider how the self pertained to the representation of a typical computer user, variables describing a same gender (1 coded as same gender; 2 as opposite gender) and a same age (1 coded as same age as participant; 2 as younger/older as appropriate) were derived. These were used alongside the other variables of sex of user, age of user and stereotypical representation of user for correlations with the other variables in the study. The development of gender of representation in relation to the self with age is shown in Figure 4.16.

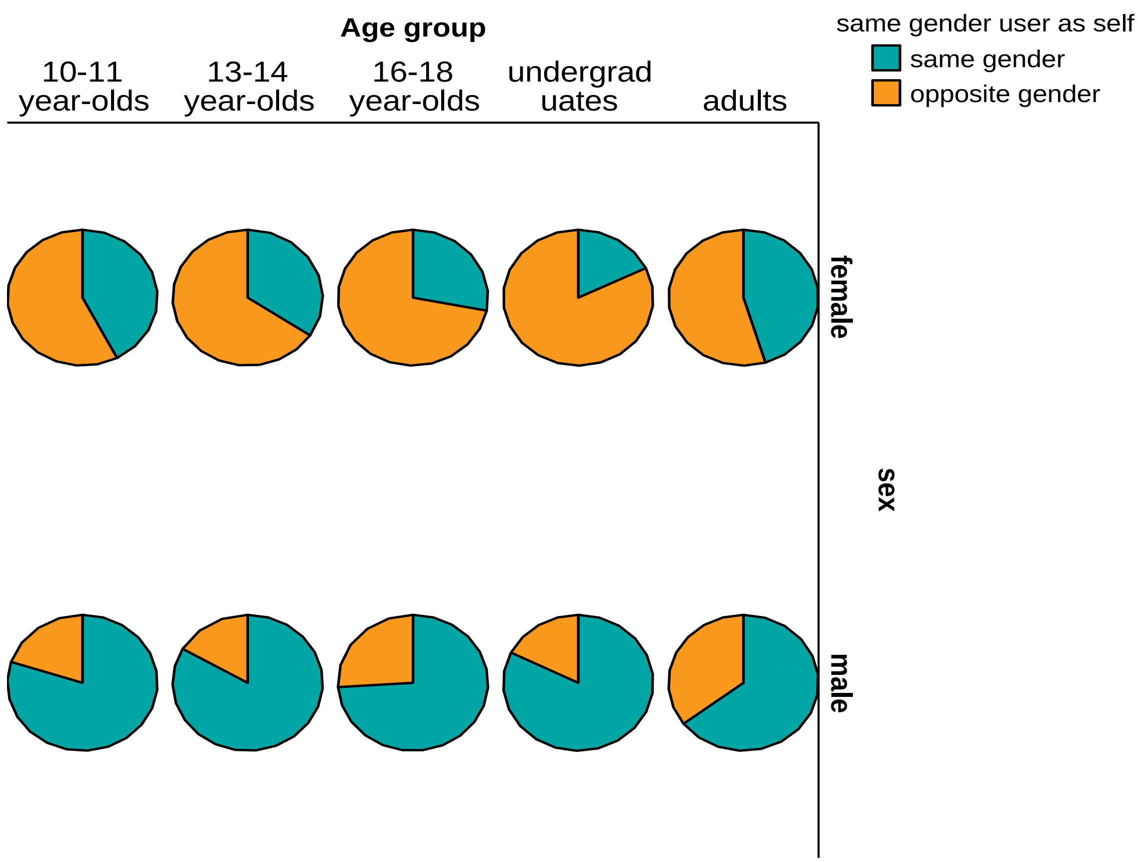

Figure 4.16: Proportions of participants based on gender and age group choosing a same gender figure as a typical computer user

Results of the correlation analyses are included in Appendix B-8. They indicate that age of user was not related to other variables. This is most likely due to the very high level of agreement across the sample (over 80% for every age group irrespective of gender) that computer users were young with the only group showing any deviation from this being 10-11 year-old girls and even then, 78% of them considered it to be the case. However, by considering age of participant as being the same or other to the self, some patterns emerged that indicated identification by age was related to level of education. It seemed there was less likelihood of choosing a stereotypical representation than in general for those who recorded the highest number of ‘A’ levels they were taking/had and the adult group with the higher levels of qualification. The apparent relationship for the 13-14 year-old age group could be explained by the National Curriculum constraints mentioned previously and the adult relationship may be due to the trend for those with the lowest qualifications to be the younger members of the age-group and once this was controlled through the global educational attainment categorisation the relationship no longer was significant. Indeed, by looking at the global categorisation of those with average or below average level of educational attainment, there was little difference in the types of users chosen.

The relationships between LOC and typical user were stronger for the female participants than the male ones and diminished with age from the 10-11 year-olds to the 16-18 year-olds with the relationships for undergraduates and older very weak. The strongest relationships for choice of typical computer user with other variables were with regards to the emotional sub-scales and again, this was stronger for the female participants than the male ones. The pattern of correlations was variable for gender and age-group indicating they were complex in nature and unreliable in being useful for predictive purposes across diverse samples.

Computer setting and choice of a typical user was not strongly related. The only indication of any link was with regards to the choice of the ‘feminised’ setting whereby for female participants choosing typical computer users as female, the preference for Computer Setting A increased and that for D decreased as illustrated in Figure 4.17.

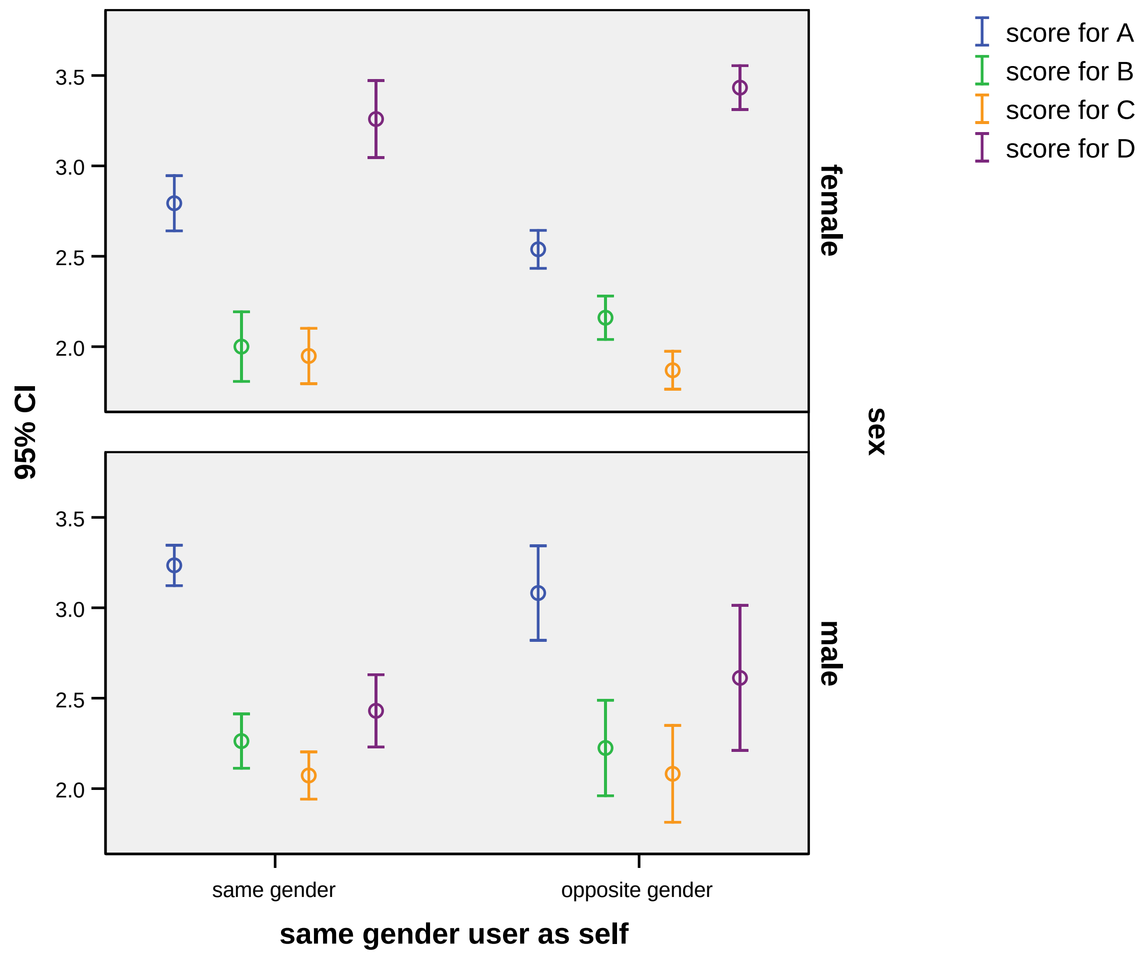

Figure 4.17: Mean values of ratings for computer settings based on choice of typical user as being of same or opposite gender to oneself.

Regression analyses are included in Appendix B-8 and summarised in Table 4.4 as the significant predictors that emerged alongside any typical user representation variables that acted to form the dependent variables. It seemed that there were several models towards emotions felt during computer use that indicated the representations an individual held of what constituted a typical user alongside a sense of personal control in a more general context led to engaging with and using computers. The strong associations between emotions felt during use being reflective of actual use.

The final area of analysis concerned the explicit measures of stereotypes and the responses to five questions that had a 4-point Likert response of agreement from a drop-down menu. The first question asked if it was traditional to think of a certain person as a computer user, whether that person was born to be a computer user, whether that person was necessarily male, if their interest did not alter over a lifetime and then finally whether that person was considered as younger rather than older. Table 4.5 illustrates that there were several significant effects of gender on the existence of stereotypes and computer users being typically male and young. There was also a significant effect of age on agreement with the existence of stereotypes, their intrinsic nature and the likelihood of being male.

Correlations with the implicit measures indicated that both were reliable in measuring the existence and type of stereotype of a computer user as a young male representation. The relationship of both the control subscale for work/education and the control subscale for a computing context with the intrinsic nature of computer enthusiasts was interesting and may indicate that there was a pattern of personal belief that was based on individual differences albeit not ones that were unalterable in life.

Table 4.4.
Regression Analyses of Independent Variables of Work/Education LOC, Computer LOC and Computer User Representation on Various Dependent Variables. Significant Predictor Variables only (p < 0.05).

Dependent variable	Independent variables that act as significant predictors	Standardised coefficients	% variance explained by regression model	Results of ANOVA		
				F	*N*	*p*
Overall Computer LOC	Overall life LOC	0.41**	17.7	43.22	390	<0.001
	Same gender user chosen	-0.14**				
Positive emotion	Overall life LOC	0.29**	11.2	10.44	370	<0.001
	Bob chosen as user	0.17**				
	Stereotypical user chosen	0.15**				
	Same gender user chosen	-0.12*				
	Same age user chosen	0.12*				
Negative emotion	Overall life LOC	-0.34**	12.7	27.87	368	<0.001
	Same gender user chosen	0.14**				
Measure of Engagement	Overall life LOC	0.27**	9.7	9.10	373	<0.001
	Bob chosen as user	0.17**				
	Stereotypical user chosen	0.15**				
	Same gender user chosen	-0.10*				
	Same age user chosen	0.10*				

Table 4.4 continued on next page.

Table 4.4.(continued).
Regression Analyses of Independent Variables of Work/Education LOC, Computer LOC and Computer User Representation on Various Dependent Variables. Significant Predictor Variables only (p < 0.05).

Dependent variable	Independent variables that act as significant predictors	Standardised coefficients	% variance explained by regression model	Results of ANOVA		
				F	*N*	*p*
Measure of emotionality	Overall life LOC	0.23**	7.7	7.30	371	<0.001
	Bob chosen as user	0.15**				
	Stereotypical user chosen	0.13**				
	Same gender user chosen	-0.10*				
	Same age user chosen	0.14**				
Rating of Computer Setting A	Overall computer LOC	0.13*	5.9	13.11	384	< 0.001
	Same gender user chosen	-0.25**				
Rating of Computer Setting D	Same gender user chosen	0.21**	4.3	30.36	646	< 0.001

Table 4.5. *Two-way ANOVA Results of Explicit Measures for Gender and Age-group Membership*

		Traditional stereotype exists	Computer users - born not made	Computer users not necessarily male	Computer users do not alter	Computer users are young
	N	461	459	460	458	460
Main effect of gender	*F*	11.03	0.60	21.64	0.11	6.44
	p	< 0.01	0.44	< 0.001	0.74	< 0.05
Main effect of age	*F*	2.91	4.39	6.93	0.80	0.85
	p	< 0.05	< 0.01	< 0.001	0.50	0.47
Interaction sex by age	*F*	1.02	2.29	1.53	0.64	0.84
	p	0.38	0.08	0.21	0.59	0.47

There was little difference between male and female participants in the correlations between explicit responses on stereotypes and emotion felt during computer use. The most significant relationships were based around the gender of any stereotype and how unchanging those skilled at computing are. The general acceptance of a stereotype and that it was a younger person was unrelated to the emotions reported during computer use.

There were some relationships between explicitly described beliefs about typical computer users and preference for various computer settings with computer setting D reflecting the triple considerations of stereotypes existed, that they were born as such and they were young figures. There was only one significant difference across the sample based on a categorisation of those who agreed or disagreed with the three statements and this was that those who believed the nature of a computer user was intrinsic significantly rated computer setting D less attractive than others ($t(451) = 2.60$, $p < 0.01$). The only other correlation between computer settings and the properties of any stereotype that led to a significant difference in ratings was for computer setting B and the opinion that stereotypes existed. Based on those who believed stereotypes existed, the popularity of B increased.

4.3 Chapter Discussion

Patterns of computer use were supported in line with Chapter Three. Although more 10-11 year-old girls had a computer in the home than boys of that age, male participants over the whole of the sample not only more often owned a computer of their own, they also accessed computers more often and spent more time using them. Despite girls aged 10-11 being favoured in access to a home computer, only very few (2%) returned it as their favourite subject at school compared to boys (13%). There were problems with the study in extracting favourite subject data for the 13-14 year-old age group due to the limited free choice of subjects from the National Curriculum. However the bias of male participants' preference for science based subjects from the 10-11 year-olds was still present in the 16-18 year-olds and 'A' levels of the undergraduates. This continued, as in Chapter Three, to be related to computer use.

The types and ratings of usefulness of various computer functions were often undifferentiated between genders but more male than female participants rated entertainment as a useful computer application. Interestingly, more male than female participants used online chat facilities. Programmability was differentiated for the 16-18 year-olds in that men considered it more useful than women. This has particular meaning at that age in terms of taking computing as a subject of study since valuing programmability as a computer function is essential towards pursuing a later career in computing. The undergraduate group reversed this consideration by women students valuing programmability more than men. Whether this is an effect of degree choice or a more confident and homogeneous group of participants whose career interests have already been determined remains to be evaluated.

The most challenging finding around computer use related to educational attainment with those with the best educational attainment consistently reporting less computer use both in terms of frequency of use and time spent than those with fewer likely or actual qualifications. Thus, the drive to increase computer use universally in schools seems to be questionable in terms of actual qualifications obtained since simple use is linked to lower performance. It remains to be quantified what level and type of use is helpful and what becomes detrimental.

The Locus of Control results indicated that the simple single measure was reliable and a fair indicator of overall sense of personal control. What was clear was that the 10-11 year-olds, unlike any other age group, considered control of a computer was a mainly shared experience thus confirming the results of Chapter Three. The transition of LOC to become more internalised was strongly linked to age with the 13-14 year-olds showing patterns more similar to 16-18 year-olds and in-between those and that of the 10-11 year-olds. The adults tended to have the most internalised sense of control and, across the whole sample, male participants in general had more sense of control over a computer than did female participants. Although the simple LOC measure correlated with and was supported by the % of time user/computer is in control of the process, these other variables did not return such a cohesive picture. This was particularly since data was not obtained from the 10-11 year-olds and the returns of the 13-14 year-olds indicated not all participants reliably knew what a percentage was. From 16-18 years onwards most responses for the two measures summated to 100% but this was not always the case.

Validating the simple measure against the overall LOC scales also supported its reliability. The more complex overall LOC scales illustrated the strong relationship between sense of personal control in one domain and sense of personal control in another. However, whereas there were no gender differences in the work/education context, there were highly significant ones in the computing context. Across the whole sample, female participants reported a higher sense of personal control in work/education compared to computing whereas male participants reported a higher sense of personal control over a computer. This was consistent and remarkable indicating that, whatever the age-group; men felt more in control of a computer than at work or at school/university whereas for women this was the reverse. This could simply be a reflection of increased use of computers by the male participants but this would not explain the decrease in the computing context for women and the increase from a more general setting for men.

Educational attainment was linked to overall sense of personal control of a computer and in a manner to support the complementary finding that increased use was related to increased sense of personal control. The more highly qualified reported less personal control than those with lower qualifications.

The simple measure of opinion of computers as ‘good’, ‘bad’ etc. was not as useful as the new scales reporting emotion felt during computer use. These scales were extremely reliable and useful as dependent variables to use towards explanations of attitudes towards computers. The less common semantic differential approach seemed to overcome some of the frequently encountered problems of questionnaire design in that participants answered all the questions in a highly consistent manner irrespective of age and gender producing robust factors that represented not only positive and negative affect as previously but also engagement and degree of emotionality.

In particular, the factor of engagement illustrated that male participants engaged more with computers than did their female counterparts as well as reporting more positive emotions and less negative ones. Looking at educational attainment this indicated, alongside a consistent finding that use increased with positive and reduced with negative emotion, there seemed to be less positive emotions experienced during computer use for the more qualified and that they felt less emotion whilst using them. The individual questions that related to a difference in educational attainment suggested relatively more depression, irritation, anger and humiliation. Unsurprisingly, sense of personal control increased with engagement but not so predictably, level of emotionality decreased perhaps indicating more confidence and use prompting more familiarity and so less emotional reaction.

The computer setting data confirmed much of Chapter Three in that computers with extra equipment and peripherals representative of game playing and add-ons were preferred by 10-11 year-olds and by some 13-14 year-olds then rejected by all other age groups. The only gender differences happened after the 13-14 year-old age group, indicating that the real division between male and female preferences was from around then and not necessarily beforehand. The move away from the previous favourite to the plainest of the neutral settings only continued up to the 16-18 year-olds. Afterwards the slight preference from the two neutral settings by the undergraduates and adults was towards the one with pens and an open book perhaps indicative of computers as either supplementary to work or more familiar alternatives. Women categorically rejected the favourite of the youngest age group reminiscent of computer games far more than men, some of whom retained it as their favourite across the entire age range. Women did not particularly endorse the feminised version other than to do so more than men. The combination of the soft toy and the flowers may have acted towards confusion since rejection of immature computer uses may have been instrumental in preference. The evidence, however, is that individuals use peripheral cues as to their liking for a computer and that these preferences have robust patterns with age and gender.

The final area of study concerned the prevalence of stereotypes and strongly confirmed the results of Chapter Three that a well-defined stereotype of a computer user exists and that person is a young male with glasses, poor skin, odd hairstyle and poor dress sense. ‘Bob’ was indeed representative to a large number of people of a ‘typical’ computer user. The pattern of assumption of this followed that of Chapter Three as 10-11 year-olds and 13-14 year-olds tended not to subscribe to Bob as much as older participants.

A striking result was the universally agreed representation of a computer user as young (80% of participants or above) both through open agreement with an explicit statement and choice of ‘typical’ computer user. The adult group did not differ in this despite many of themselves being computer users. Furthermore, of the relatively small number who did choose the older figures, ‘someone’s mum’ was chosen as often as ‘someone’s dad’ indicating that above a certain age gender was not particularly relevant. The only real presentation of older figures as users occurred in the youngest, 10-11 year-old, age group where there was a gender difference of more girls than boys putting forward older figures as role models.

The gender of the computer user as male followed an inverse ‘U’ with age so 10-11 year-olds and adults considered computer users less likely to be male than the midrange groups. However, even for these extremes in age, the proportion was 59% or above. The consideration of whether the user was the same gender as the participant rather than simply male provided a useful variable with which to work. It illustrated neatly the transition around the 13-14 year-old age group of same gender to opposite gender representations for the female participants. By the ages of 16-18, girls same gender representations were almost gone. The male participants had male, same gender representations nearly universally throughout albeit with the proportion of female representations increasing with adults. The explicit statement regarding computer users being necessarily male did not reflect the data from the choice of typical user.

The most significant finding regarding stereotypes of computer users from the data in this chapter was that the transition to Bob occurred later than one might have suspected. Many13-14 year-olds did not use stereotypes in the same way as 16-18 year-olds but retained the pattern of the 10-11 year-olds. Thus, the social cognitive processes that passed representation from personal experience to socially agreed versions happened well after any move for children from primary to secondary education. Once in place these stereotypes persisted and only in adulthood and for gender was there any relaxation of them.

The primary aim of the study in this chapter was to obtain fuller data across a wider age range with transitions in adolescence better defined. Using adult and 13-14 year-olds' data satisfied this and certainly gave better insight into the development of computing stereotypes. Educational attainment was also related more closely to computer use alongside a fuller definition of different computer applications. Comparison of LOC outside the context of computing was illuminating in the gender differences it produced as was the gender differences in emotions during computer use. Development of more complex scales for both of these gave greater reliability to the previous findings.

Finally, using a more quantitative method allowed regression models to be built that predicted various aspects of emotion during computer use. These reflections of attitude towards computer use were based on a more general sense of control in a context outside computing plus mental representation of the features that make up a ‘typical’ computer user. Thus, stereotypical representations were predictive alongside sense of personal control to influence emotional reaction during computer use.

A measure of computing performance was not addressed or related to the variables discussed in this chapter but remained for the next study, described in Chapter Five. Other areas that needed better resolution in the next piece of research were to see if the simple measures of control and emotion during computer use were predictive of any computing performance and the sense of accomplishment on completion of it. Rating oneself relative to others would also indicate a level of computer confidence that had not been examined previously. Investigation of whether holding one type of representation of a computer user over another would be applied to the self and degrade performance, however was to be the primary purpose behind the research as it would indicate if the theories of stereotype threat were useful in explaining women’s under-representation in computing..

Chapter Five

Stereotype Threat and Computing Performance Experiment.

5.1 Introduction

From the previous chapter it became clear that a powerful and robust stereotype of a computer user exists and is the predominant response from the ages of 13-14 years onwards. The presence of the stereotype appears to act as a predictor for other variables if considered in relation to the gender of the person holding the representation. Thus same gender representations enhance positive and reduce negative emotions during computer use plus increase a sense of engagement and emotionality. They also appear to increase sense of personal control during computer use in combination along with being related to sense of control in a more general context.

The study reported in this chapter represents the final piece of research that was conducted. The experiment described here examined the existence of a computer user stereotype in relation to any detrimental or helpful effect it may have during actual computer use.

Thus, it developed the outcomes of the research from the previous two chapters on the prevalence and occurrence of stereotypes towards actually seeing how these influence using a computer and how proficient one sees oneself at this, in isolation and in comparison to others.

5.1.1 Problems associated with the experimental measurement of stereotypes and their effects

To consider how the existence of such a strong male stereotype of a 'computer user' impinges upon women's computer performance some background information on the activation of stereotypes needs to be discussed.

It is supposed (Devine, 1989) that there are 'automatic' and 'controlled' components of a response to a situation that prompt different levels of stereotypical representation. These may act together or be dissociated but it is a process of categorisation that 'automatically' invokes the stereotype and as an intrinsic reaction to stimuli, this is very difficult to inhibit. However, the key part with regards to the processing of the person or situation is what happens after the initial categorisation and centres on the schema invoked or in effect the content of any stereotype. Content is formed based upon how much 'control' is present as this dictates the inclusion of both negative and positive aspects of the stereotype. Devine (1989) suggests that a person of low-prejudice will control the stereotype content to be more evenly composed and so attempt to inhibit its use by neutralisation and removal of any evaluative purpose. In contrast, a person of high-prejudice will not apply such levels of cognitive processing so is left with the automatic response that most likely will be evaluative and possibly negative. Interpreting this in the computing context, and more particularly this thesis, it would suggest those that have highly stereotypical representations of computer users will be more likely to behave in a less controlled and more automatic way to a computing task whereby they will see performance at it as typical of the stereotype. Those with more complex representations of a computer user will act in a more controlled manner and not be as affected by any features of a typical user since they can see good and bad features to being a computer user plus less reason to use it as a measure for performance.

Devine (1989) suggests a large part of the use of stereotypes and their control takes place unconsciously. This has been shown to be a well substantiated claim (Hewstone, Stroebe & Jonas, 2008) with one example of such being the case of self-reported anxiety by homosexual men as they interacted with nursery children failing to match that of coded observations of Non-Verbal Communication displays of anxiety (Bosson, Haymovitz & Pinel, 2004). In this case, it seemed self-application of a negative feature of the homosexuality stereotype, being dangerous to children, concerned participants and increased their anxiety albeit not to a level of conscious awareness.

Of course what is also important with regards to response based on use of a stereotype is whether a person is aware of the stereotype and considers it salient to the situation. To overcome this point, many studies, as with the study on sexual stereotypes above (Bosson, Haymovitz & Pinel, 2004), have primed for a particular stereotype or feature of it that may increase its availability. One of the most fascinating examples of implicit priming of a stereotype affecting subsequent behaviour is evident from an experiment by Bargh, Chen and Burrows (1996) that either gave mention of stereotypical features of the elderly or not prior to recording the time taken to walk down a corridor 'after' the experiment. Despite no explicit mention of slowness within the list of adjectives to describe the elderly, it appeared it was cognitively associated and was included by the students who had been exposed to the elderly stereotype condition to produce personal behaviour in line with a primed stereotype so they walked more slowly. Of course this leads to a methodological problem which will be discussed further later in how one primes for one stereotype or aspect of it over another. More importantly, however, is the determination and constancy of motivation because if it had been sufficiently important to them, it can be imagined that most of Bargh et al's students would have disregarded the elderly stereotype to which they had just been exposed and walked down the corridor in as fast a fashion as any cost or reward to themselves would have merited.

Thus, there may be a strong salient stereotype present either consciously or subconsciously but how easily is it disregarded? Dismissal may occur either: as discussed above, by stereotype content being habitually and unconsciously controlled to be neutral such as by a person of low general prejudice; consciously recognising a stereotype yet choosing to reject it; or simply overwritten by other more pressing causes to behaviour such as motivation. The first of these has been discussed previously (Devine, 1989) but the second, a conscious directive to not respond stereotypically has been found to often fail in its intent and that if people consider they may be applying a stereotype yet wish to avoid such, a 'rebound' effect occurs (Macrae, Bodenhausen, Milne & Jetten, 1994). The objective of suppressing a stereotype may actually make the content of that stereotype more available than otherwise through prompting its recall and examining its features. This is clearly a challenge to the ideas of political correctness but it indicates that once a stereotype is salient even the best-willed attempt to disregard it may actually produce a worse rather than better outcome.

Therefore, as two discordant thoughts around a subject are well known to cause distress (Festinger, 1954, as cited in Hogg & Vaughan, 2007), Macrae et al (1994) argue that most stereotype inhibition in the real world actually occurs at a subconscious level so the dilemma never occurs in the first place. They recognise the limitations of studying the processes of stereotyping in a laboratory setting and suggest that, rather than encounter the type of situation where conscious direction away from a stereotype is necessary to generate a control condition, it may be more ecologically valid to not invoke any type of stereotype and let cognitive dissonance take its course in the low-prejudiced participants. As a development to Devine's work, they propose that, if minded not to stereotype, people subconsciously use the same processes associated with stereotype activation to also act in stereotype inhibition. In effect, if sufficient motivation to go beyond a stereotype is present, the process of using situational cues such as skin colour, gender etc. to activate a stereotype will also be used as unconscious inhibition of the same by seeking out additional situational cues such as common interests or pleasant manner to process beyond initial, superficial features. For example, observing a person as female and knowing future contact with that person is unavoidable may increase motivation for an individual to seek out aspects of that person that are not based on a stereotype but will actually be useful in future interactions. In which case, the process of initially categorising the female stranger in a stereotypical manner, then subsequently having to remove features of the stereotype that do not apply or that one is socially forbidden to hold, never occurs in the first place. Instead, cognitive effort is diverted towards seeking out features of that individual that usefully defines her as an individual. As a way of reducing prejudice in a natural setting it appears that motivation to gain something at a personal level from seeking out information at an individual rather than stereotyped group level will outperform educational replacement of stereotype content.

Conscious overwriting of stereotype content will be particularly counter-productive if an observed behaviour or event regularly supports a stereotype despite the attempt to reject it (Macrae et al, 1994). For example, in the context of dismissing the stereotype of a computer user being male, telling girls or women they are as good as boys or men at computing will most likely ultimately produce a rebound effect if every time they enter a computer class or see something on the media involving a computer user it is a man. Furthermore, repeated negative encounters at computing will need overwriting if the stereotype is explicitly activated whereas if it is never brought to the fore and one is instead enabled to have or reminded of success at computing, the stereotype will be less salient and less likely to be attributed as a cause to any difficulty let alone used for social comparison with an outgroup.

Thus, whether a stereotype comes to the fore in a person's thoughts depends on their motivation to include it or not (Macrae, Bodenhausen et al, 1997) not only on their habitual tendency to suppress stereotypes in general but also as to whether there are more immediate concerns in terms of personal reward or cost. Evaluation clearly acts as a motivator for most people but then it also may induce anxiety. Since motivation is likely to enhance performance and anxiety detracts from it, this is a difficult balance unless one can be assured that anxiety is measurable by the use of control conditions. The next section discusses the implications of self-stereotyping and how anxiety may become a product of that process.

5.1.2 Stereotype Threat Theory

It was discussed earlier (Section 2.6 in Chapter Two) that if computing is defined as a masculine activity, then women may 'dis-identify' with it to maintain their sense of femininity or because they consider they lack innate ability (Spencer, Steele & Quinn, 1999).

This concept lends its origins to the work by Claude Steele and Joshua Aronson (Steele & Aronson, 1995) on disengagement from school by certain social groups whose belief in their own ability is damaged by the negative stereotypes that exist of that group's intelligence. For example, Afro-American students may under perform or even avoid academic study because it is seen as a white activity or anxiety occurs through consideration that they lack the essential ability found in whites in an academic context (Steele & Aronson, 1995). Termed Stereotype Threat, this puts forward the idea that high identification with a stigmatised group that has features that include low ability in a particular domain will undermine performance in that domain. This effect will be particularly evident when evaluation of ability is present as is the case for an IQ test or examination situation and when the domain in question is important to the individual. It will also increase in effect and reduce performance when the negative stereotype is activated and self-awareness of a particular social identity becomes salient such as being in a group where all others are different on a defining feature of that social identity, for example; skin colour or gender.

With regards to gender and an academic environment, evaluation is often present which alongside the masculine association of certain subjects is important in that women may underperform and shun these areas of study. This may become a self-fulfilling prophecy since as female interest reduces, girls become a minority in the class and their gender more salient (Spencer, Steele & Quinn, 1998). Indeed many women who are good at mathematics report the need to reject characteristics associated with femininity to that of mathematicians or may disparage characteristics of mathematicians to retain their sense of self as female (Pronin, Steele & Ross, 2003). Pronin, et al. (2003) refer to this as 'identity bifurcation' and state it is a development of Social Identity Theory (Tajfel &

Turner, 2001) towards the later theory of Self-categorisation (Turner & Hogg, 1987) whereby choice of which group to identify with will be dependent on which produces the most positive self-evaluation. Identity bifurcation goes further than this in that it suggests a selection of group characteristics from the overall set and a rejection of others to best enhance self-definition and self-esteem. Thus, a female mathematician will suppress talk of having children, wear less make-up and act in a less overtly feminine manner amongst her maths class but consider she is superior to the other members in social skills as that is a feminine trait. Nosek, Banaji and Greenwald (2002) support this by suggesting that it may be a symbiotic relationship between identities that drives the reluctance of women to engage in subjects such as mathematics; as liking for maths dilutes their sense of femininity and femininity dilutes liking for mathematics. In terms of stereotypical representations it may be that a negative stereotype of a mathematician protects one from low ability at mathematics and this again becomes a self-fulfilling prophecy.

In addition, more subtle forms of threat towards affiliation with and acceptance within a group may also be effective in making individuals perform to their full capacity. Oswald and Harvey (2000) produced stereotype threat conditions by asking undergraduate women to complete a mathematics test in a room with a derogatory cartoon depicting poor maths ability in women. This relatively mild hostile environment with no counter from a ST removal statement (males and females are equally able at mathematics) reduced performance on a maths test. The amelioration of the hostile environment by removal of ST improved performance over a control condition.

Thus, the research on gender and mathematics consistently illustrates stereotype threat as a factor in performance. However, Stereotype Threat has not been studied in a computing context, yet it is an area that has clear stereotypes of those who are successful at it (geeks) with a well defined set of associated features. It can also explain avoidance of computing as a career by those who see the typical user as a negative stereotype or as having qualities that do not apply to them such as being young, masculine and willing to commit to many hours of computer use. This obviously not only applies to women who may avoid careers in computing but also the elderly or those without the time to commit to learning effective computing skills.

5.1.2 The Methodology of Stereotype Threat Research

Much research involving stereotype threat has relied upon complex methodology to trigger the effect and to identify under what conditions it becomes relevant. It seems that the critical areas are: task difficulty; stereotype activation; comparison performance data for individuals in similar tasks and finally, personal motivation to do well in the domain.

5.1.2.1 Difficulty of Task and Stereotype Threat

To address the first of these, the design of this study included unfamiliar tasks of reasonable difficulty that took around twenty minutes overall to complete and required a good level of thought and concentration to perform. Thus, they encouraged a questioning of one’s ability in relation to the task and required a fair degree of perseverance. These have been shown to be key in prompting the effects of stereotype threat (Spencer, Steele & Quinn, 1999), as a trivial or easy task does not seem to prompt insight as to ones difficulties and possible causes for a lack of ability in that domain. The design of this study examined performance in a computing context using a method adapted from that previously used for African Americans and White Americans in a Raven Advanced Progressive Matrices IQ test (McKay, Doverspike, Bowen-Hilton & Martin, 2002) where stereotype threat appeared to inhibit performance through a lower score by African Americans on the task once a link was made between performance and ability.

Further to stereotype threat research, in addition to the effects of stereotype threat there will also be factors such as self-confidence based on a positive self-concept or attributional style that generally encourages perseverance and sufficient self-esteem to buffer against possible failure. Those who are generally used to success will tend to persist longer than those without such past experience (Ross, Lepper & Hubbard, 1975). The actor-observer difference in attribution will dictate that those who perceive themselves to be above average will assume that should they have difficulties with a task, then others will likewise find the task hard. Then to keep the differential and their self-concept intact, the 'high achievers' will judge others to have performed even worse than themselves, conversely those with low confidence will attribute their difficulties as personal rather than situational.

5.1.2.2 Priming and Stereotype Threat

To consider the impact of implicit personal association with a stereotype, as with the aforementioned research on the effect of race (Steele & Aronson, 1995, Studies 3 & 4) where identification with race was recorded through a pre-test racial identity scale, much of the work on stereotype threat theory activates a stereotype prior to test or attempts to measure this implicit association. Previous research has primed participants for group membership through racial attitude scales (McKay, Doverspike et al., 2002), framing the task in terms of gender differences (Oswald & Harvey, 2001 or Spencer, Steel et al., 1999,) or explicitly linking performance to support or question a racial stereotype (Steele and Aronson, 1995, Studies 3 & 4 or Aronson, Lustina, Good & Keough, 1999). The approach that was taken in the current study was to try to measure implicit association rather than prime for it. So, there was no prime for masculinity, femininity, association with computer expertise or any particular group membership. Instead, the experiment returned to the original format used by Steele and Aronson (1995, Studies 1 & 2) which sought to use naturally occurring representations to measure identification with a group associated with success at a task. This was considered a more ecologically valid approach.

To describe the rationale behind the procedure chosen more fully the central features of a typical computer user leading to identification with that prototype as with any ST experiment, need to be defined. It has been seen from the results in the previous chapters, the primary features of a stereotypical computer user are gender, age and appearance in terms of glasses, unhealthy looking skin and dress sense. By assessing ST amongst a student population of roughly equivalent ages, the readiest feature in terms of identification with a stereotype of a computer user from this collection of features was gender. Thus, in ST terms, the aim was to measure the level of stigmatisation of an individual through identifying the image of a typical computer user that was held in general by an individual and from the gender associated with that figure determine its relationship to the participant.

Since the questionnaires from the previous chapters in this thesis provided measures of an individual's mental representation of a 'typical' computer user, they were a useful mechanism to extract implicit data. The design rationale to link an individual's data on stereotypes to performance using the online questionnaires also allowed a large number of other variables associated with computers and computing to be directly linked to performance.

Although explicit gender related priming was not undertaken, Stereotype Threat relies upon engagement with the task as being evaluative and a reflection of personal attributes so presenting the test as a reflection of ability is vital. Anxiety with the task indicates women holding male stereotypes would see themselves as having lesser ability than those who chose same gender stereotypes. Conversely, framing the task in a more general context and without an evaluative component would relieve the need for dissociation so would be less affected by the stereotype of computer users held and also would reduce anxiety so increasing performance and self-rating.

5.1.2.3 Comparison data for Stereotype Threat conditions

To generate comparison data, a base measure of ability for the participant from a non-computer task was required to control for individual skill. This approach has been previously used to investigate stereotype threat by Steele and Aronson (1995) collecting verbal Scholastic Aptitude Test (SAT) scores prior to testing under stereotype threat conditions on a verbal component of Graduate Record Examination (GRE). For the study described here, comparison was achieved by the use of two similar tasks either using a card-sorting task or a computer programming equivalent. In terms of the computing context, there is evidence that the computer application may be critical in terms of framing the activity as masculine or feminine (Oosterwegel, Littleton & Light, 2004). For example, asking participants to complete a word-processing task may be considered a less masculine use of computers than a mathematical programming task. As with stereotype threat in an academic context (Nosek, Banaji & Greenwald, 2002), certain subjects are more associated with masculine than feminine traits and a task seen as mathematical with the use of angles of rotation and displacements would emphasise this aspect of programming and numerical manipulation within computing so representing gender in relation to a computing context further.

5.1.2.4 Controlling for variability in motivation from Stereotype Threat conditions

It is a common problem in ST research that by framing the task as a measure of ability rather than presenting it in a non-evaluative way, participants automatically increase their motivation. Motivation has also been found to act against stereotype threat in some cases as individuals want to prove a stereotype wrong and apply themselves full-throttle to act as a counter-stereotype (Aronson, Lustina, Good et al., 1999). Part of the variation in motivation particularly for performance on a written test is associated with task difficulty so explanation and reassurance of the task as being designed to stretch can increase perseverance and level out differences in motivation (Steele & Aronson, 1995).

For the design used in this experiment, students were in a one-to-one setting with the researcher and aware of her holding a stopwatch. In such a setting and with no comments to encourage or discourage apart from the written instructions, students should have been reasonably motivated to complete the tasks as speedily as possible. Once completed, they would have accrued the required course credit and then be free to leave.

5.1.3 Summary of rationale for the methodological approach taken in the current study

To summarise, this study assessed how an individual's perception of a typical computer user may affect performance, self rating and rating of oneself in relation to others. The method was to create conditions associated with stereotype threat theory to test its application to a computing context. The experiment did not prime for gender or computer expertise but took measures of implicit and explicit attitudes towards computers derived from the questionnaire of Chapter Four. It set an individual's data from the questionnaire on educational attainment, self-described level of computer expertise, Locus of Control, affect towards computers and representation of a typical computer user against empirical measures of computing performance, self-evaluation of performance and evaluation of others' performances. A baseline measure of performance on a non-computer task was included to identify any individual differences in ability in the computing task in order to assess the relative effect of stereotype threat. The task was of reasonable difficulty and emphasised mathematical rather than word-processing or communicative ability. To mitigate for any increase in motivation due to ST methodology, participants were tested in a one-to-one setting in which it was clear that task completion time was being measured.

5.2 Hypotheses

The hypotheses for this experiment are associated with the two facets of Stereotype Threat Theory (Steele & Aronson, 1995) in terms of either dissociation or anxiety with the computing task as follows:

5.2.1 H1: Past academic success will increase competence beliefs (Ross, Lepper & Hubbard, 1975) and increase self-ratings in line with increased performance and any differential with ratings for others

Educational attainment is hypothesised to affect performance through higher confidence arising from academic success resulting in lower anxiety. Thus, performance. for those with above average attainment scores will be affected positively by ST conditions as framing the computer task in terms of ability will prime success rather than failure and so increase an association with the task and also provide relatively less anxiety over evaluation. The converse will be true for those with less academic success.

Educational attainment will affect self-ratings so that higher confidence from academic success will manifest itself through higher self-ratings. If ratings of others are lower then performance should improve. The ST condition will increase these effects.

5.2.2 H2: Above average perceptions of own computer expertise should produce better performance (Steele & Aronson, 1995) and the expectation to be above average or not will be reflected in ratings for self and others (Ross, Lepper & Hubbard, 1975)

Self-described above average computer users will be less affected by ST conditions than those with below average self-perceptions since they should be less likely to experience evaluation anxiety because they perceive themselves to be more competent than most.

Individuals who see themselves as above average computer users will rate themselves as better than others. Under ST conditions, self-rating will increase as it is an area with which they identify above average ability and ratings for others will decrease.

5.2.3 H3: There will be an interaction between self-perception of computer expertise and sense of personal control such that those with an internal sense of control will produce a worse performance under ST conditions if low in confidence and a better performance if they consider themselves above average (Steele & Aronson, 1995). Self and others' ratings will reflect performance to best profit self-esteem by decreasing the differential between them if performance was poor and increasing it if performance was good (Ross, Lepper & Hubbard, 1975)

Under stereotype threat conditions, when the task is framed as a measure of ability, it will inhibit performance in those with a higher sense of personal control as it will be seen as evaluative and personal, so it will increase anxiety and reduce performance. Those who do not generally report personal control over computers will be motivated to engage more under stereotype threat conditions as it becomes framed as an evaluative measure of ability and so their performance will improve.

Locus of control will affect self-rating in that those with a higher sense of personal control will give their selves higher ratings than those who have a more external locus of control unless they consider their ability is low in which case they will rate themselves based upon that. Under ST conditions, those with a higher sense of personal control will increase their self-rating to enhance self-esteem and lower others' ratings. Those with a more external LOC will also increase self-ratings under ST conditions and reduce others as they are moved towards considering the task as more associated with their selves.

5.2.4 H4: Positive regard for computers will result in better performance and higher self-ratings (Steele & Aronson, 1995)

Those who consider computers as 'good' or more ambivalently as 'good and bad' will engage more with the task and hence perform better. Those reporting simple positive regard towards computers will be more motivated to perform well. Under stereotype threat conditions, when the task is framed as a measure of ability, any differences in performance based on attitudes towards computers will reduce.

Those with a higher regard for computers will rate their selves more highly than those who have less regard for computers. There is no prediction for how others will be rated. Under ST conditions, any differences in performance based on attitudes towards computers will reduce.

5.2.5 H5: Knowledge of a computing stereotype will impact performance and self-ratings among those who do not conform to it (Steele & Aronson, 1995).

Gender of the figure chosen as the computer user will mean that considering computer users as being of the opposite gender to oneself will affect performance negatively. Stereotype threat conditions will increase this effect as association with being an able computer user will be primed, this would be inhibited by opposite gender stereotypes and facilitated by same-gender through a combination of dissociation and anxiety over the requisite ability.

Gender of the figure chosen as the computer user will mean that considering computer users as being of the opposite gender to oneself will lower self rating and increase rating for others. ST conditions will increase this effect.

5.3 Method

5.3.1 Participants

The sample who undertook the ST experiment comprised 179 Psychology undergraduates (144 women, 35 men) from the University of Leicester who received course credit in return for participation. They were aged from 18 to 37 years with a mean age of 19.3 years (*SD* = 1.9). A follow up online questionnaire was administered to 147 (120 women, 27 men) of the original sample.

5.3.2 Design

The design focussed upon three main independent variables. The first variable had two levels and was whether participants experienced the diagnostic (Stereotype Threat) or non-diagnostic condition. The second was self rating on a five-point scale of type of computer user from novice to expert. The third variable was a measure of a participant's level of educational attainment, the 'g-score'. The 'g-score' is an average of the grades achieved for an individual's 8 best GCSE results, the grades are allocated scores from 0 (no GCSE passes) to 8 (8 grade A*) so the g-score can range from 0-8. It is commonly used within secondary education to set target grades for AS and A2 level attainment.

The dependent variables were two repeated measures of, first, time to complete letter forming tasks and, second, self-reported level of success for self and others on these tasks. The first measure was time taken to correctly order a series of printed commands on cards to form the letters 'A', L' and 'M' and the second measure was time taken to input programming commands to a laptop to form the same letters using a simple programming language. Self-reported levels of success were marks out of ten for each of the tasks. For a subset of the participants (*N*=85) the rating of performance for the self was followed by comparison through ratings for "others".

Further variables were collected from a follow-up online questionnaire from volunteer participants (*N*=147) who gained additional course credit. The online questionnaire was that used in Chapter Three with particular focus on locus of control and stereotypes of computer users.

5.3.3 Materials

The initial task for participants was to sequence the operations required to form three capital letters by a series of pen movements and rotations. The letters chosen, as comprising linear elements only, were ‘A’; ‘L’ and ‘M’. Commands for each letter were printed off in the correct sequence on card and then cut up to form a collection of cards (2.5cm by 15cm) that on correct sequencing would reform the necessary string of commands to form each letter. Cards to form the letter ‘A’ were printed on a white background, those to form the ‘L’ on pale yellow card and those to form the ‘M’ on pale pink card. The cards comprised commands to move the pen such as “Rotate pen through 90^{o}”, “Move forward 82mm”, “Lift pen from paper” .

Instructions on an A4 sheet were given to participants along with the cards that described the process required of them. The A4 sheet depicted angles and lengths sufficient to generate the geometry of the letter as represented on the available cards for all three letters. The most complex letter, ‘A’, was required first, so help with the correct sequence of the cards for the ‘A’ was included for this letter only on the A4 card to assist students. These materials are included as Appendix C-1.

For the computing task, the computer program MSWLogo was used on a Compaq laptop with a Celeron 1.50GHz processor operating under Windows XP. The MSWLogo program is generally used by 10 and 11 year-olds in the UK to interactively form geometric shapes such as stars on a visual display using a simple programming language. MSWLogo is freeware and the version used in this experiment was downloaded from http://www.softronix.com/logo.html. It was used for this study as it represents an easily acquired, simple programming language indicative of computing ability and confidence to program. MSWLogo thus provided the facility to design an appropriate computing task for comparison with an equivalent baseline task framed in a non-computing context.

At the end of the card-sorting and computing tasks, participants were asked to complete a short written questionnaire which is included within Appendix C-1. It comprised questions on: age; gender; previous examination grades and subjects; and current course. It also asked for participants to rate themselves and ‘others’ out of 10 for each of the tasks. Finally, it asked participant to report how they saw themselves as computer users: novice; below average; average; above average; or expert.

The questionnaire also included a section, completed during the tasks by the experimenter, to record the times taken for each of the tasks. Participants had no reference for their own times and were able to see them but only after they had completed the questionnaire as it was on the reverse of the sheet used.

The online questionnaire for those that agreed to take part further was that used in Chapter Four to collect student data. It was available on the Internet at the following URL: http://www.le.ac.uk/pc/eavm1/attitudeugrada.html. The follow-up questionnaire was completed anonymously online.

For the purposes of this study the variables extracted from the online questionnaire and used were the simple locus of control measure from the single question; an overall evaluation of computers as ‘good’/’good and bad’/’bad’; and a series of statements that required agreement or disagreement relating to features of a computer enthusiast such as their existence, innateness, being male, unchanging nature, and being young rather than old. Further to these direct measures of attitudes towards typical computer users, participants were also asked to make the same choice from one of six pictures as to which was the ‘computer user’. The pictures were the same as previously used in Chapter 4 and selected from those drawn in Chapter 3 Again, factors that the choice represented were sex, age and apparently most typical features of a stereotypical computer user (glasses, poor skin, poor dress sense, name of ‘Bob’ for male or name of ‘Cynthia’ for female).

5.3.4 Procedure

Participants were individually tested in a small computer room and given the sheet of A4 instructions described previously. A standardised demonstration on a blank sheet of A4 of the pen movements to form an ‘A’ was conducted by the researcher. Participants were then handed the collection of randomly shuffled cards to arrange into the correct sequence to form the letter ’A’. Using the second part of the instructions sheet for the geometry of the ‘L’ and ‘M’, the participants completed sequencing the relevant cards for the two other letters in the same manner. The three tasks were timed from the point at which the participant responded positively to the researcher’s question “are you ready?” to the point at which they responded to the question “have you finished?”. For each letter, the researcher stopped the stopwatch and checked the sequence and if incorrect asked the participant to continue until it was correct, adding this time to the first. The time taken for the three letters formed a total that represented performance of the task in a non-computer setting.

Participants were then given the instructions that represented either the diagnostic or non-diagnostic condition which was alternated from one participant to the next.
The wording for the ST Threat condition was:

“*Thank you for completing the first part of the experiment. This next stage is to do with computer use and examines how well you can do the same task as previously* *(forming the letters 'A', 'L' and 'M') using a simple programming language. It will assess your ability with computers. You should not expect to do this straight away because it is not that easy, but this experiment needs to be fairly difficult to look at factors behind why some individuals perform better than others in the use of computers and programming languages in particular*."

The wording for the non-diagnostic condition was:

"*Thank you for completing the first part of the experiment. This next stage is to do with how letters are formed and examines how well you can do the same task as previously (forming the letters 'A', 'L' and 'M') but this time it happens to be using a computer. It looks at the different ways that people approach such things. You should not expect to do this straight away because it is not that easy, but this experiment needs to be fairly difficult to look at how people approach quite difficult concepts such as letter forming.*"

They were told to follow these instructions, again with supporting details of geometry, to type in a sequence of commands into the MSWLogo programme that would form the letters 'A', 'L' and 'M' again. Time taken to form each of the letters was recorded following the same procedure as for the card task. This formed another total for the three letters. Finally, participants were asked to complete the questionnaire regarding educational background, computer expertise and ratings for self and others.

After participants had completed the performance part of the experiment they were asked if they would like to take part in the follow up questionnaire in order to earn further course credit. An identification number was assigned to each participant to use should they wish to complete the questionnaire, in order to cross-reference with their performance and ratings data. There was a further cross-reference of the date and time that the experiment took place so that course credit for participation could be assigned to the relevant student. This was the only identification of the data to the individual and no direct cross-reference of names to data existed. The experiment had received approval through the School of Psychology, University of Leicester Request for Ethical Approval system. Although participants received course credit they were told they could withdraw at any point without penalty and it was entirely voluntary for them to complete the follow-up online questionnaire.

5.3.5 Data Analysis

The average g-score for the sample ranged from 4.9 to 7.8 with a mean value of 6.63, (SD = 0.63, N = 174) indicating an average grade across 8 best GCSE's of between a grade A and a grade B (roughly equivalent to 5 A's and 3 B's). The correlation between g-score and UCAS score was highly significant (Pearson's correlation: $r(142) = 0.35$, $p < 0.001$) indicating that it was valid to use it as a measure of educational attainment for participants with higher qualifications as well as those for whom it was the current level. To use g-score as a categorical variable in order to compare high versus low educational attainment within the sample, the mean value was used to divide the sample into two groups of above and below GCSE achievement. The below average GCSE group for the sample consisted of 22 men and 65 women with a mean g-score of 6.13 (SD = 0.43, typically equivalent to seven B's and one A) and the above average GCSE score consisted of 13 men and 74 women with a mean g-score of 7.12 (SD = 0.28, typically equivalent to seven A's and one A*).

Due to participant responses with only one person describing themselves as a novice and only three describing themselves as expert, type of computer user was collapsed from the five-point novice to expert scale to two categories of below average/average computer user (*N* = 126, (70%)) and above average/expert computer user (*N* = 53, (30%)).

It is common within the Stereotype Threat literature for results to be analysed using methods of covariance as ST data often sits in relative isolation to other data on stereotypes and does not need to conform to previous patterns of analysis. However in this case it was felt to continue the approach of the previous chapters and treat all variables independently would allow a more cohesive picture within the thesis to form. Thus, analysis of the ST data applying covariant analysis may illuminate the topic of Stereotype Threat Theory in a computing context further but may not be best suited to an initial inquiry into appropriate methodology for ST in a new context and to relate it to other attitudes associated with that context. Treating the variables independently to represent the experimental conditions and reporting performance and ratings independently should therefore allow easier initial interpretation.

5.4 Results

5.4.1 Instances of computer user stereotypes

To examine the experimental condition in relation to declared levels of engagement with the task in accordance with Stereotype Threat Theory, participants were examined in terms of their representations of computer users. Data from the online questionnaire provided measures of existence of stereotypes of computer users, computer users being male and also of being young. These results are presented in Table 5.1. There was no significant effect of sex of participant, experimental condition experienced, g-score or level of computer user in any of these responses.

Results of the selection of 'computer user' from the six pictures available are presented in Table 5.2. The definition of a stereotype response was that participants choosing either Bob or Cynthia as being young male/female figures with the attributes of poor skin, glasses and odd hairstyle.

There was no significant effect of sex of participant, experimental condition experienced or g-score on choice of stereotypical or not, sex, age and 'Bob' or not figure of a 'typical computer user'. Level of computer user was a significant effect with more self-described average or below users than above average computer users choosing a stereotypical (Mann Whitney: $z(141) = -2.62$, $p < 0.01$), male (Mann Whitney: $z(141) = -2.70$, $p < 0.01$) or 'Bob' (Mann Whitney: $z(141) = -2.89$, $p < 0.01$) as the computer user.

Table 5.1.

Proportions (%) of Participants Choosing to Strongly Agree or Agree with Statements Describing Certain Stereotypic Features of Computer Users in the Online Questionnaire

Group	A stereotype of a 'computer user' exists	Computer users are male	Computer users are young
Overall	84	53	54
Men	85	59	56
Women	84	52	54
Average or below GCSE score	79	53	50
Above average GCSE score	89	54	57
Average or below computer user	84	50	55
Above average computer user	86	62	52
LOC with user	86	55	55
LOC shared or with computer	82	53	52
Computers are 'good'	89	50	49
Computers are 'good and bad'	80	58	59
Non-diagnostic condition	87	55	48
Diagnostic condition	83	52	60

Table 5.2.
Proportions (%) of Participants Choosing Particular Features of a 'typical computer user' in the Online Questionnaire

Group	Stereotype of a user	Male user	Young user	'Bob' chosen
Overall	70	82	93	63
Men	59	82	89	52
Women	73	83	94	66
Average or below GCSE score	73	84	94	65
Above average GCSE score	69	81	93	63
Average or below computer user	77	88	95	71
Above average computer user	55	69	88	45
$\chi^2(1)$ for computer expertise (Φ)	7.02** (0.22)	7.32** (0.23)	2.15 (0.14)	8.46** (0.24)
LOC with user	69	80	91	59
LOC shared or with computer	73	86	95	69
Computers are 'good'	70	81	93	60
Computers are 'good and bad'	70	83	93	66
Non-diagnostic condition	69	84	94	63
Diagnostic condition	72	82	92	64

Correlations between the verbal descriptions and the pictorial representations of computer users (coded as 0 or 1) are shown in Table 5.3. Significant results related to the statement that computer users exist which correlated with the choice of male pictures for the computer user. In terms of the statement that computer users are young, this correlated with the age of the pictorial representation chosen.

Table 5.3.
Correlation Coefficients (N=147) between Choice of a Typical Computer User from Six Possibilities and Statements Associated with Stereotypes of Computer Users

	Features of Computer User picture			
Statement	Stereotypical user	Male user	Young user	'Bob' is a typical computer user
Stereotypes of computer users exist	0.06	0.21*	0.03	0.12
Computer users are male	0.05	0.01	0.13	0.05
Computer users are young	0.15	0.02	0.19*	0.12

5.4.2 Performance times on the cards vs. computer tasks

The average time taken to complete the initial letter forming task was 652 seconds (10 minutes, 52 seconds) (SD = 184). Men ($M(35) = 549$, SD = 144) were significantly faster ($F(1,173) = 4.49$, $p < 0.05$) than women ($M(144) = 677$, SD=184). Above/below average educational attainment was not a significant effect.

The time taken to perform the subsequent computer task was 444 seconds (7 minutes, 24 seconds) (SD = 141 seconds). Whether participants experienced the ST condition or not was not a significant factor in time taken for the computer task ($F(1,177) = 0.43$, $p > 0.05$). There were also no significant main effects of sex, level of computer user or interactions between these variables. However, there was a significant main effect of level of educational attainment ($F(22,173) = 1.91$, $p < 0.05$) but no interactions between this and any other variables. Despite no significant overall relationship between time taken and computer expertise, there was a significant correlation (Spearman's rho: $r(179) = 0.21$, $p < 0.001$) between level of computer expertise and time relative to others (above/below average performance). Of those who described themselves as average computer users or below, 49% took more than the average time and 51% took less. Of those who described themselves as above average computer users; 74% were indeed above average but 26% were not.

91% of participants performed better on the second task in comparison to the first. Those who performed worse differed significantly from the rest of the sample on several variables. The independent variable of g-score was significantly lower ($t(172) = -2.55$, $p < 0.05$) for those whose performance deteriorated ($M(15) = 6.24$, $SD = 0.61$) than for those who improved ($M(159) = 6.66$, $SD = 0.61$). This effect was supported by the group with above academic achievement having a higher proportion of improvers ($\chi^2(1) = 4.67$, $p < 0.05, \Phi = 0.18$) than those from below average (97% in higher GCSE group compared to 86% in lower GCSE group). The measure of % of time the user is in control of a computer was also significantly lower ($t(143) = -2.82$, $p < 0.01$) for those who worsened ($M(12) = 62.5$, $SD = 15.4$) on the second task compared to those who improved ($M(133) = 74.9$, $SD = 14.5$). There was also a significant increase ($t(142) = 2.34$, $p < 0.05$) in the amount of time the computer was in control for those who worsened ($M(12) = 37.5$, $SD = 21.8$) compared to those who improved ($M(132) = 25.8$, $SD = 16.0$).

Simple linear regression showed the time taken for the first task accounted for 25.7% of the variance in the second one ($F(1,177) = 61.35$, $p < 0.001$). Simple linear regression models also illustrated that gender was not a significant predictor of time taken to complete the computer task whereas g-score (actual score rather than binary categorisation) accounted for 5% of the variance ($F(1,172) = 9.47$, $p < 0.01$).

5.4.3 Speeds of task completion

For the purposes of this study the tasks were treated as dissimilar and so independent groups' differences in performance and ratings were used rather than repeated measures analyses.

Difference in times taken or ratios of time taken for the two tasks were considered but were rejected in favour of presenting the results using speed of task completion. Differences in time taken would have been contrary to the direction of ratings and ratios of times taken would have indicated the processing for the two tasks was more identical than could be justified. Speed of task reflected the concept that there were two nominally independent tasks to perform and the quicker one was able to do either, so the more proficient one was. Difference in speeds indicated the difference in proficiency from one context to another.

The average time taken for the card task was 652 seconds so this can be viewed, albeit with no real physical meaning, as participants on average, completing 1.53 card tasks per 1000 seconds with a range across participants of completing from 0.85 to 3.51 tasks per 1000 seconds (equivalent to the range of times taken of from 1182 to 285 seconds). Similarly, the computer task on average took 444 seconds which relates to 2.25 tasks per 1000 seconds and a range of from 1.16 to 5.32 tasks per 1000 seconds or from 859 to 188 seconds taken.

Thus the inverse value of time taken was used and multiplied by 1000 to generate a tasks per 1000 seconds quantity. The difference in speeds between the tasks generated values that represented how many more computer tasks than card tasks could be achieved in the standard timeframe of 1000 seconds (M = 0.72). The calculated values ranged from -1.11 to 2.89 with a negative value indicated a worse performance on the computing task and a positive one, improvement. This also allowed values of performance to be positively correlated with ratings for improvements. Speed was seen to represent ST as a reflection of ability, dissociation (de-motivation) and anxiety (hesitancy from low confidence in ability).

Figure 5.1 illustrates the distribution of speeds for the card and computer tasks.

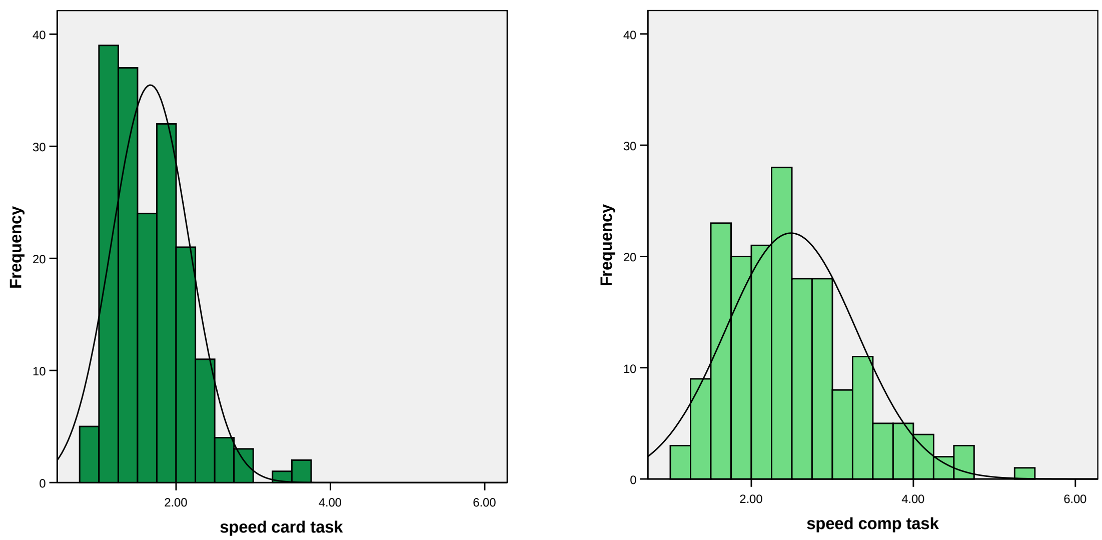

Figure 5.1: Distribution of participants of speeds for card and computing tasks.

Figure 5.2 indicates the distribution without and with ST conditions (without ST: *M* = 0.78, *SD* = 0.55, skew = 0.01, kurtosis = 0.53; with ST: *M* = 0.86, *SD* = 0.77, skew = 0.32, kurtosis = 0.58).

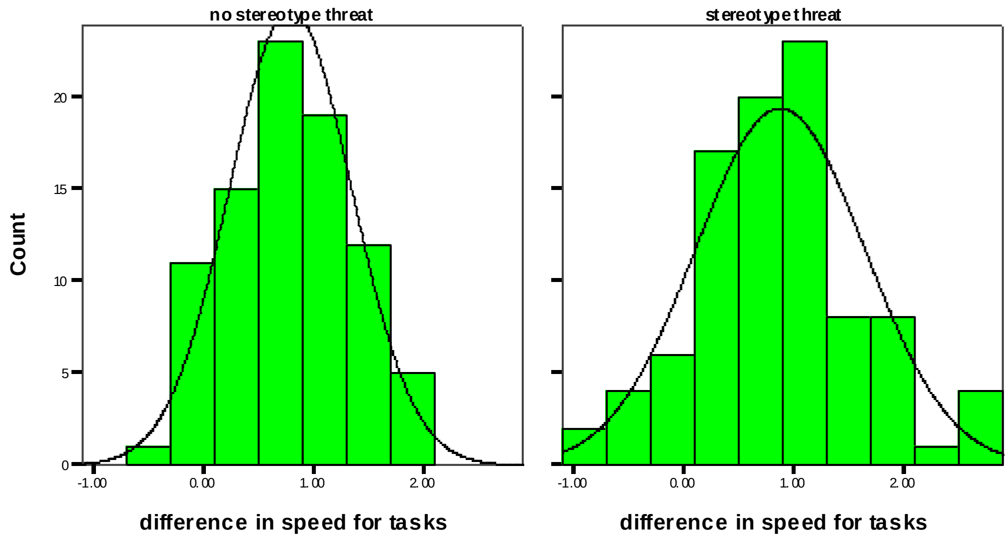

Figure 5.2: Distribution of participants for difference in speeds between computing and card tasks for each experimental condition.

Table 5.4 indicates the relative performance for men and women for each of the experimental conditions. 2-way ANOVA analysis of these values showed there were no significant main effects of gender or experimental condition or an interaction between these two variables.

Table 5.4.
Difference in Performance Speeds for each Task against Gender and Experimental Condition

	Non Diagnostic (no ST)			Diagnostic (computer ST)		
	Mean	*SD*	*N*	Mean	*SD*	*N*
Men	0.77	0.63	17	0.98	1.11	18
Women	0.78	0.54	69	0.84	0.66	75
t-test results comparing genders	$t(84) = -0.08$, $p = 0.94$			$t(91) = 0.69$, $p = 0.50$		

In relation to educational attainment affecting task performance, there was a significant correlation between g-score and difference in task speeds (Pearson's correlation: $r(174) = 0.19$, $p < 0.05$).Treating educational attainment on the basis of classification of above or below average GCSE score, there was a highly significant correlation (Pearson's correlation: $r(174) = 0.25$, $p < 0.01$) between difference in task speeds and group membership. This was a reflection of the earlier result of improvers generally having higher attainment than those who worsened on the second task. Table 5.5 illustrates these differences in performance speeds across the two tasks.

Table 5.5.
Difference in Performance Speeds for each Task against Level of GCSE Attainment and Experimental Condition

	Non Diagnostic (no ST)			Diagnostic (computer ST)		
	Mean	SD	N	Mean	SD	N
Average or below GCSE score	0.75	0.56	43	0.59	0.76	44
Above average GCSE score	0.85	0.52	38	1.11	0.68	49
t-test results comparing groups	$t(79) = -0.85$, $p = 0.40$			$t(91) = -3.48$, $p < 0.01$		

To analyse this further, an ANOVA was conducted for differences in speed between the cards and computer tasks. This indicated that there was a main effect of GCSE attainment group for differences in speed ($F(1,173) = 10.13$, < 0.01) but no main effect of experimental condition. However, there was a significant interaction between experimental condition and GCSE group on differences in speeds ($F(1,173) = 4.59$, $p < 0.05$) that indicated that those experiencing the stereotype threat condition improved if they were above average GCSE score more than those who were below. This effect was absent from those who did not experience ST conditions.

Table 5.6 displays the relative speeds of performance for participants who described themselves as either average or below computer users or above average computer users for each experimental condition.

Table 5.6.
Difference in Performance Speeds for each Task against Level of Computer User and Experimental Condition

	Non Diagnostic (no ST)			Diagnostic (computer ST)		
	Mean	*SD*	*N*	Mean	*SD*	*N*
≤ average computer user	0.68	0.55	64	0.70	0.62	62
> average computer user	1.05	0.48	22	1.20	0.92	31
t-test results comparing groups	$t(84) = -2.77$, $p < 0.01$			$t(91) = -3.11$, $p < 0.01$		

Analysis of the data shown in Table 5.6 using ANOVA indicated that there was a significant effect of level of computer user on relative task performance speeds across the sample ($F(1,178) = 16.50$, $p < 0.001$). Experimental condition was not a significant effect and did not interact with level of computer user on relative performance speed.

Table 5.7 illustrates the relationship between a simple locus of control measure from the online questionnaire reduced to a binary categorisation of control lying with the user or not against relative performance for each experimental condition. The table includes data overall and for the groups of above and below average GCSE score.

Table 5.7.
Difference in Speed for each Task in Terms of Online Questionnaire Responses to simple LOC measure of control with user or not overall and in relation to GCSE score

	Non Diagnostic (no ST)			Diagnostic (computer ST)		
	Mean	SD	N	Mean	SD	N
	Overall					
Control with user	1.05	0.53	29	0.96	0.75	49
Control with computer or shared	0.60	0.50	36	0.76	0.47	26
t-test results comparing groups	$t(63) = 3.57, p < 0.01$			$t(73) = 1.23, p = 0.22$		
	Average or below GCSE score					
Control with user	0.94	0.65	14	0.69	0.76	18
Control with computer or shared	0.60	0.54	15	0.65	0.55	13
t-test results comparing groups	$t(27) = 1.54, p = 0.14$			$t(29) = 0.16, p = 0.88$		
	Above average GCSE score					
Control with user	1.16	0.38	15	1.12	0.71	31
Control with computer or shared	0.59	0.49	21	0.87	0.36	13
t-test results comparing groups	$t(34) = 3.75, p < 0.01$			$t(42) = 1.18, p = 0.25$		

Overall, there was a main effect of locus of control in terms of difference in speeds ($F(1,139) = 3.55, p < 0.01$) but no significant interaction between experimental condition and LOC.

By looking at LOC for each of the educational achievement groups: there remained a main effect of LOC for the above average group for ratio of performance times ($F(1,79) = 2.95, p < 0.01$) but this was not present for the below average group ($F(1,59) = 1.29, p = 0.26$).

By looking at LOC for each category of computer user and for the sample as a whole, there was a significant main effect of LOC ($F(1,139) = 9.86$, $p < 0.01$) but no significant interaction between experimental condition and LOC. For the average or below users; there was a main effect of LOC on performance speeds that approached significance ($F(1,97) = 2.23$, $p = 0.14$) and for the above average users this was significant ($F(1,41) = 5.13$, $p < 0.05$).

Table 5.8 presents the results of relative performance in relation to seeing computers as ‘good’ or ‘good and bad’ for each diagnostic condition. There were no significant effects or interaction between the experimental condition and response to this question either overall or for separate groups based on GCSE attainment or self-described level of computer user.

Table 5.8.
Difference in Performance Speeds for each Task in Terms of Online Questionnaire Responses to Whether Computers are seen as ‘good’ or ‘good and bad’

	Non-diagnostic (no ST)			Diagnostic (computer ST)		
	Mean	SD	N	Mean	SD	N
Computers as ‘good’	0.87	0.55	36	0.96	0.82	36
Computers as ‘good and bad’	0.66	0.60	35	0.82	0.48	39

Table 5.9 includes the difference in speed of performance for participants based on the explicit measure of positive or negative response to the question as to whether a stereotype of a computer user existed.

Table 5.9.
Difference in Speeds for each Task in Terms of Online Questionnaire Responses to whether a stereotype of a computer user exists overall and in relation to GCSE score

	Non Diagnostic (no ST)			Diagnostic (computer ST)		
	Mean	SD	N	Mean	SD	N
A stereotype exists	0.77	0.54	58	0.90	0.70	62
A stereotype does not exist	0.90	0.70	9	0.87	0.51	13

Table 5.10 offers the alternative, more implicit measure of choice of figure or not as a 'typical computer user' as stereotypical (male or female). There were no significant effects or interactions with other variables of either of these measures (explicit or implicit) regarding existence of a stereotype on performance.

Table 5.10.
Difference in Speed for each Task in Terms of Online Questionnaire Responses to choice of 'typical computer user' as stereotype or not overall and in relation to GCSE score

	Non Diagnostic (no ST)			Diagnostic (computer ST)		
	Mean	SD	N	Mean	SD	N
Stereotype chosen	0.71	0.55	46	0.87	0.57	54
Stereotype not chosen	0.96	0.55	21	0.96	0.88	21

Table 5.11 contains data regarding the choice of 'typical computer user' as being of the same or opposite gender to the participant. A two-way ANOVA indicated there was a significant main effect ($F(1,141) = 14.94$, $p < 0.001$) of choice of typical user's gender on performance and a significant interaction ($F(1,141) = 5.54$, $p < 0.05$) between this and experimental condition. There was a main effect of same gender of user chosen

for all levels of GCSE attainment; both below average or average (F(1,61) = 7.03, p < 0.05) and above average (F(1,79) = 7.76, p < 0.01). However, the interaction between experimental condition and gender of user chosen was only significant for the above average attainment group (F(1,79) = 4.13, p < 0.05).

Table 5.11.
Differences in Speed for each Task in Terms of Online Questionnaire Responses to choosing 'typical user' as same gender or not; overall and in relation to GCSE score

	Non Diagnostic (no ST)			Diagnostic (computer ST)		
	Mean	SD	N	Mean	SD	N
	Overall					
Same gender user chosen	0.89	0.66	21	1.42	0.71	21
Opposite gender user chosen	0.75	0.51	46	0.68	0.53	54
t-test results comparing groups	t(65) = 0.94, p = 0.35			t(73) = 4.94, p < 0.001		
	Average or below GCSE score					
Same gender user chosen	0.87	0.73	14	1.24	0.76	6
Opposite gender user chosen	0.64	0.47	17	0.54	0.58	25
t-test results comparing groups	t(29) = 1.07, p = 0.30			t(29) = 2.52, p < 0.05		
	Above average GCSE score					
Same gender user chosen	0.92	0.53	7	1.50	0.70	15
Opposite gender user chosen	0.81	0.53	29	0.81	0.44	29
t-test results comparing groups	t(34) = 0.48, p = 0.64			t(42) = 3.96, p < 0.001		

Linear regression analyses were conducted overall and for each experimental condition using the main variables of educational attainment, self-described level of computer expertise, LOC, view on computers and whether a same gender figure was chosen as a ‘typical computer user’. The results of these are shown in Table 5.12.

Table 5.12.
Linear Regression Model Standardised Coefficients (β) of and % of variance explained by Variables on Difference in Speeds for each Task, overall and in terms of each experimental condition.

	Overall		Non Diagnostic (no ST)		Diagnostic (computer ST)	
Variable	*β*	*% var*	*β*	*% var*	*β*	*% var*
Experimental condition	0.05	0.3	-	-	-	-
Sex	-0.03	0.1	0.03	0.1	-0.07	0.5
Educational attainment group	0.25*	6.0	0.10	0.9	0.34**	11.7
Level of computer expertise	0.29**	8.0	0.24*	5.8	0.31**	9.6
2-way Locus of Control	-0.27*	6.0	-0.41**	16.8	0.14	0.7
View on Computers	-0.11	1.2	-0.12	1.4	-0.11	1.1
Same gender user chosen	-0.33**	10.7	-0.12	1.3	-0.50**	25.1

* *significant predictor variable, p < 0.05*
** *significant predictor variable, p < 0.01*

5.4.4 Results of Self-Rating scores

In terms of self-scoring, the average mark out of ten given for the card task was 5.28 (SD = 1.97) and for the computer task, 6.54 (SD = 1.72). The card task self-ratings ranged from 0 to 10 and the computer self-ratings from 2 to 10. Simple linear regression indicated that 40.4% of the variance in the self-score for the computer task was due to self-score for the card task ($F(1,177) = 119.8$, $p < 0.001$) and 13.0% of the variance was due to the self-categorisation of level of computer expertise ($F(1,177) = 26.5$, $p < 0.001$).

73% of participants gave themselves a higher rating for the computer task than the card task, 16% gave themselves the same rating and 11% rated themselves worse. Sex, GCSE score, self-categorisation of computer expertise and experimental condition were not significant factors in this.

Self ratings of success at the card task were closely related to performance on the card task (Pearson's correlation: $r(174) = 0.45$, $p < 0.001$) and to the subsequent computer performance (Pearson's correlation: $r(174) = 0.45$, $p < 0.001$). Self-score on the card task was significantly related to g-score (Pearson's correlation: $r(174) = 0.22$, $p < 0.05$) and to categorisation of GCSE performance (Pearson's correlation: $r(174) = 0.26$, $p < 0.05$).

Self ratings of success at the computer task were closely related to performance on the computer task (Pearson's correlation: $r(174) = 0.58$, $p < 0.001$) and to the earlier card performance (Pearson's correlation: $r(174) = 0.30$, $p < 0.001$). Self-score on the computer task was significantly related to g-score (Pearson's correlation: $r(174) = 0.19$, $p < 0.05$) and to categorisation of GCSE performance (Pearson's correlation: $r(174) = 0.29$, $p < 0.001$). The simple Locus of Control measure regarding computing was also significantly related to self-rating of computer performance (Pearson's correlation: $r(145) = -0.23$, $p < 0.01$).

Examining relative ratings between the two tasks for individuals gave the mean value of difference between self-reported scores for individuals of 1.27 ($SD = 1.61$). In more detail, Table 5.13 indicates the relative self-ratings respectively for men and women for each of the experimental conditions. 2-way ANOVA analysis of these values showed there were no significant main effects of gender or experimental condition or an interaction between these two variables for differences in self-rating.

Table 5.13.
Differences in Self-ratings of Performance for each Task against Gender and Experimental Condition

	Non-diagnostic (no ST)			Diagnostic (computer ST)		
	Mean	SD	N	Mean	SD	N
Men	1.53	1.28	17	0.89	1.23	18
Women	1.38	1.84	64	1.21	1.56	75

In relation to educational attainment, ANOVA's were conducted for the data shown in Table 5.14, the difference in self-ratings for the cards and computer tasks. These indicated that there was no significant effect of class of GCSE attainment or interaction with experimental condition.

Table 5.14.
Differences in Self-ratings of Performance for each Task against Level of GCSE Attainment and Experimental Condition

	Non-diagnostic (no ST)			Diagnostic (computer ST)		
	Mean	SD	N	Mean	SD	N
≤ average GCSE score	1.35	1.60	43	1.20	1.79	44
> average GCSE score	1.47	1.89	38	1.09	1.21	49

Table 5.15 displays the difference in self-ratings for participants who described themselves as either average or below computer users or above average computer users. Analysis of these data using ANOVA indicated there were no significant effects or

interactions for level of computer user on self-rating of performance on the computer task in relation to the card task.

Table 5.15.
Differences in Self-ratings of Performance for each Task against Level of Computer User and Experimental Condition

	Non-diagnostic (no ST)			Diagnostic (computer ST)		
	Mean	SD	N	Mean	SD	N
≤ average computer user	1.23	1.66	60	1.05	1.66	62
> average computer user	1.90	1.87	21	1.34	1.11	31

Table 5.16 illustrates the relationship between a simple locus of control measure from the online questionnaire reduced to a binary categorisation of control lying with the user or not against relative self-ratings for each experimental condition. The tables include data overall, for the groups of above and below average GCSE score and for the groups of above and below self-described computer expertise.

Overall, there were no main effects of or interaction between locus of control and experimental condition on difference in self-ratings. Conducting two-way ANOVA's for each educational attainment group separately indicated that for the higher GCSE scoring group this continued to be true but for the lower achieving group, there was a significant interaction between LOC and experimental condition ($F(1,59) = 5.55$, $p < 0.05$).

By looking at LOC for each of each category of computer user: there were no main effects or interaction for below average or average users on difference in self-ratings but for above average computer users there was a near significant main effect of LOC condition ($F(1,41) = 3.60$, $p = 0.07$) and a near significant interaction between LOC and experimental condition ($F(1,41) = 3.52$, $p = 0.07$).

Table 5.16.
Difference in Self-ratings of Performance for each Task in Terms of Online Questionnaire Responses to simple LOC measure of control with user or not overall and in relation to GCSE score

	Non-diagnostic (no ST)			Diagnostic (computer ST)		
	Mean	SD	N	Mean	SD	N
	Overall					
LOC = user	1.97	1.70	29	1.05	1.16	49
LOC = computer or shared	0.89	1.86	36	1.12	1.82	26
	Average or below GCSE score					
LOC = user	2.07	1.73	14	0.83	1.20	18
LOC = computer or shared	0.60	1.64	15	1.46	2.30	13
	Above average GCSE score					
LOC = user	1.87	1.73	15	1.18	1.13	31
LOC = computer or shared	1.10	2.02	21	0.77	1.17	13
	Average or below Computer User					
LOC = user	1.47	1.33	17	0.89	1.20	28
LOC = computer or shared	0.94	1.97	31	1.09	1.90	22
	Above average Computer User					
LOC = user	2.67	1.97	12	1.26	1.09	21
LOC = computer or shared	0.60	1.14	5	1.25	1.50	4

The results of relative self-ratings in relation to seeing computers as ‘good’ or ‘good and bad’ for each diagnostic condition are presented in Appendix C-2. There were no significant effects or interaction between the experimental condition and response to this question either overall or for separate groups based on GCSE attainment or self-described level of computer user.

Data regarding the choice of ‘typical computer user’ as being of the same or opposite gender to the participant are presented in Appendix C-2. Two-way ANOVA’s indicated there was no main effect of choice of typical user’s gender or interaction with experimental condition on self-rating either overall or for any of the sub-groups based on computer expertise or GCSE score.

Linear regression analyses on difference in self-ratings were conducted overall and for each experimental condition using the main variables of educational attainment, self-described level of computer expertise, LOC, view on computers and whether a same gender figure was chosen as a ‘typical computer user’. The results of these are presented in Appendix C-2 and indicate that the only significant predictor ($\beta = -0.26$, $p < 0.05$) was the binary categorisation of the simple LOC measure as to whether control was with the user or elsewhere for the diagnostic condition only.

5.4.5 Results of ratings for others scores

The average mark out of ten given for ‘others’ for the card task was 6.67 (*SD* = 1.47) and for the computer task, 7.14 (*SD* = 1.40). The card task others’ ratings ranged from 2 to 10 and the computer task others’ ratings from 2 to 10.

11% of participants gave themselves a higher rating for the card task than others, 28% gave themselves the same rating and 61% rated themselves worse. Gender ($\chi^2(2) = 6.30$, $p < 0.05, \Phi = 0.27$) and self-categorisation of computer expertise ($\chi^2(2) = 15.28$, $p < 0.05, \Phi = 0.42$) were significant factors in this pattern. Experimental condition, GCSE score, LOC and view on computers were not significantly associated with rating self in comparison to others for the card task.

22% of participants gave themselves a higher rating for the computer task than others, 26% gave themselves the same rating and 52% rated themselves worse. Gender ($\chi^2(2) = 8.32$, $p < 0.05$, $\Phi = 0.31$), self-categorisation of computer expertise ($\chi^2(2) = 20.07$, $p < 0.05$, $\Phi = 0.49$) and relative performance against others on the computing task ($\chi^2(2) = 8.32$, $p < 0.05$, $\Phi = 0.31$) were significant factors in this pattern. Experimental condition, GCSE score, and view on computers were not significantly associated with rating self in comparison to others for the computing task. LOC had a near significant association with ratio of self to others ($\chi^2(2) = 5.91$, $p = 0.05$, $\Phi = 0.28$).

Simple linear regression indicated that 43.8% of the variance in the others' score for the card task was due to self-score for the card task and 23.6% of the variance in the others' score for the computer task was due to self-score for the computer task. To examine the influence of the experimental condition on rating of self and others with regards to the computing task, Table 5.17 contains the results of simple linear regression models of the sample split into sub-groups. The sub groups were gender, above or below average GCSE attainment, self-declared level of computer expertise, locus of control measure, view on computers, types of computer user chosen as typical and a new categorisation of those whose performance times were either faster or slower than the average time.

Table 5.17.
Computer task ratings for self and others and proportions of the variance explained by a simple linear regression model of self-rating on ratings of 'others'. Participants grouped on various criteria.

	Non-diagnostic (no ST)			Diagnostic (computer ST)		
Variable	Self *Mean*	Others' *Mean*	*% var*	Self *Mean*	Others' *Mean*	*% var*
Overall	5.0	7.1	22.0	5.5	7.1	25.5
Men	5.0	6.9	43.1	6.2	6.4	5.8
Women	5.0	7.3	10.8	5.4	7.5	57.0
≤ average GCSE	4.5	6.7	24.7	5.0	6.9	18.3
> average GCSE	5.4	7.7	8.6	6.0	7.4	26.3
≤ average user	4.8	7.1	30.2	5.2	7.2	54.9
> average user	5.6	7.2	8.7	6.2	7.0	19.7
LOC with user	5.2	7.3	18.3	5.8	6.9	25.0
LOC shared or with computer	4.9	7.1	30.0	5.2	7.6	40.0
Computers are 'good'	5.3	7.4	11.6	5.7	6.9	20.3
Computers are 'good and bad'	4.8	6.9	30.7	5.5	7.3	28.4
Stereotypical user chosen	6.2	7.2	29.3	6.5	7.1	20.8
Stereotypical user not chosen	6.7	7.3	9.2	7.1	7.1	26.5
Same gender user chosen	6.5	6.9	32.1	7.4	6.7	2.2
Opposite gender user chosen	6.2	7.4	17.1	6.4	7.4	48.8
≤ average comp. performance	4.5	6.7	35.2	4.5	6.6	25.7
> average comp. performance	5.4	7.3	7.8	6.3	7.5	12.1

Regression analyses of various variables on differences between self and others' ratings are shown in Tables 5.18 and 5.19 for the card and computer tasks respectively. Only variables that were significant predictors are included. GCSE attainment, view on computers and whether a stereotypical figure was chosen or not were not significant predictors of differences in self to others ratings for either task and 2-way LOC was not a significant predictor for the card task but was for the computer task.

Table 5.18
Standardised Regression Coefficients, % variance and significance of variables on linear regression model of differences between ratings for self and others for the card task

	Non Diagnostic (no ST)			Diagnostic (computer ST)		
Variable	*β*	*% var*	*p*	*β*	*% var*	*p*
Sex	-0.11	1.1	0.52	-0.42	17.3	0.00
Computer expertise	0.50	25.5	0.01	0.41	14.6	0.01
Same gender user	-0.14	2.0	0.42	-0.36	12.7	0.03
Actual performance	0.14	2.1	0.38	0.39	15.3	0.01

Table 5.19
Standardised Regression Coefficients, % variance and significance of variables on linear regression model of differences between ratings for self and others for the computer task

	Non Diagnostic (no ST)			Diagnostic (computer ST)		
Variable	*β*	*% var*	*p*	*β*	*% var*	*p*
Sex	-0.19	3.4	0.26	-0.48	23.1	0.00
Computer expertise	0.45	20.5	0.00	0.51	26.4	0.00
2-way LOC	-0.38	14.4	0.02	-0.37	13.6	0.02
Same gender user	-0.12	1.4	0.50	-0.48	23.4	0.00
Actual performance	0.31	9.4	0.06	0.34	11.9	0.02

Table 5.20 presents the increase in ratings between the tasks (rating for card task subtracted from rating for computer task) for participants in relation to their ratings for self and for others. Amounts of variance explained in the rating for others based on self-rating are also included.

Table 5.20.
Differences in ratings between tasks (computer-card) for self and others plus proportions of the variance explained by a simple linear regression model of difference in self-ratings on difference in ratings of 'others'. Participants grouped on various criteria.

	Non-diagnostic (no ST)			Diagnostic (computer ST)		
Variable	Self *Mean*	Others' *Mean*	*% var*	Self *Mean*	Others' *Mean*	*% var*
Overall	1.26	0.59	25.6	0.78	0.37	41.8
Men	1.56	0.75	11.6	0.50	-0.29	30.6
Women	1.04	0.48	29.1	0.91	0.66	47.0
≤ average GCSE	1.14	0.62	28.5	0.75	0.42	23.4
> average GCSE	1.40	0.60	53.4	0.82	0.32	25.8
≤ average user	1.25	0.50	23.3	0.66	0.48	44.0
> average user	1.27	0.82	47.9	1.00	0.18	50.0
LOC with user	1.69	0.63	15.3	0.85	0.26	39.6
LOC shared or with computer	0.95	0.68	29.3	0.27	0.45	42.4
Computers are 'good'	1.56	1.00	29.0	0.84	0.42	62.9
Computers are 'good and bad'	1.00	0.29	26.6	0.53	0.21	48.0
Stereotypical user chosen	1.16	0.60	31.6	1.10	0.43	30.4
Stereotypical user not chosen	1.70	0.80	18.8	1.00	0.00	24.7
Same gender user chosen	1.36	0.79	22.8	0.83	-0.08	29.1
Opposite gender user chosen	1.24	0.57	31.1	0.62	0.50	36.6

Table 5.21 shows the results of regression analyses of the main variables on the difference between self and others' ratings for the increase in ratings between the two tasks. Only significant predictors of the difference between self and others across both tasks are included. Gender of participant, GCSE score, view on computers, whether a stereotypical figure was chosen or not and actual performance were not significant predictors.

Table 5.21
Standardised Regression Coefficients, % variance and significance of variables on linear regression models of increase in ratings between the tasks of self-ratings subtracted from increase in ratings between the tasks of ratings for others

	Non Diagnostic (no ST)			Diagnostic (computer ST)		
Variable	*β*	*% var*	*p*	*β*	*% var*	*p*
Computer expertise	-0.10	0.9	0.57	0.27	7.4	0.07
2-way LOC	-0.28	7.9	0.10	-0.30	8.9	0.07
Same gender user chosen	0.03	0.1	0.85	0.32	10.0	0.05

The data were further examined using t-tests to identify significant differences between groups for each of the experimental conditions. Overall and for each experimental condition separately, there were no significant differences across the whole sample or between groups based on gender, GCSE score, view on computers and actual performance. For the stereotype threat condition only, there was a marginally significant difference in increase in self to others' ratings across both tasks based on gender of user chosen in comparison to own. For the stereotype threat condition only again, there were near significant differences based on self-described computer expertise and LOC. Table 5.22 shows the values obtained for these variables.

Table 5.22
Increase in rating for self between the two tasks subtracted from equivalent increase in ratings for others.

	Non Diagnostic (no ST)			Diagnostic (computer ST)		
Sub-group	*mean*	*SD*	*N*	*mean*	*SD*	*N*
Below average user	0.75	1.58	28	0.17	1.10	29
Average or above user	0.45	0.93	11	0.82	1.19	17
t- statistic and *p*-value	$t(33) = 0.58$, $p = 0.57$			$t(36) = 1.88$, $p = 0.07$		
LOC = user	1.06	1.34	16	0.59	1.15	27
LOC = shared/computer	0.26	1.45	19	-0.18	1.17	11
t- statistic and *p*-value	$t(33) = 1.68$, $p = 0.10$			$t(36) = 1.87$, $p = 0.07$		
Same gender user chosen	0.57	1.34	14	0.92	1.16	12
Opp. gender user chosen	0.67	1.53	21	0.12	1.14	26
t- statistic and *p*-value	$t(33) = -0.19$,$p = 0.85$			$t(36) = 2.00$, $p = 0.05$		

The values of increase in self to others rating across the two tasks comprised two elements, one of which was generally positive (most people increased the ratings for the computer task relative to the card task) and one of which is generally negative (others are rated more highly than the self).

Figures 5.3 and 5.4 illustrate the pattern of self to others' ratings across the two tasks for level of computer expertise and LOC respectively. Figure 5.3 reflects the non-significant interaction between level of computer expertise and experimental condition. Increase in rating for self compared to others' across the two tasks without stereotype threat was greater for average or below average users than for above average users. This was mainly due to the less able group rating others worse than themselves but both groups having similar self-ratings. However, in the stereotype threat condition, the increase in self to others rating was more for the more expert group than the non-expert group. Self-rating was less than the non-ST condition for both groups but the pattern of assigning a rating for others was reversed with the more expert group thinking the difference between self and others was far greater than the non-expert group. This may indicate that explicitly linking the computer task to computing ability forced both groups to adjust their ratings to tie in with their self description.

There is no interaction visible in Figure 5.4 but it is clear that there is a non-significant trend for appraisal of self in relation to others to worsen once ST conditions are in place irrespective of LOC. The group with higher personal control rated others far lower relative to themselves in the non-ST condition but decreased the difference once the task was framed as evaluative. Participants with a more external LOC had a smaller difference between self and others for both conditions but it changed sign from the non-ST to ST conditions. This suggests a reflection of participants with a more external LOC considering they were slightly worse than others if explicitly told that the task was evaluative.

Figures 5.5 and 5.6 contrast the difference in considering gender as a category in looking at the effect of ST on self to others ratings (Figure 5.5) with the category of gender of typical computer user chosen which partitions those who may dissociate by gender from computer use from those who may not (Figure 5.6).

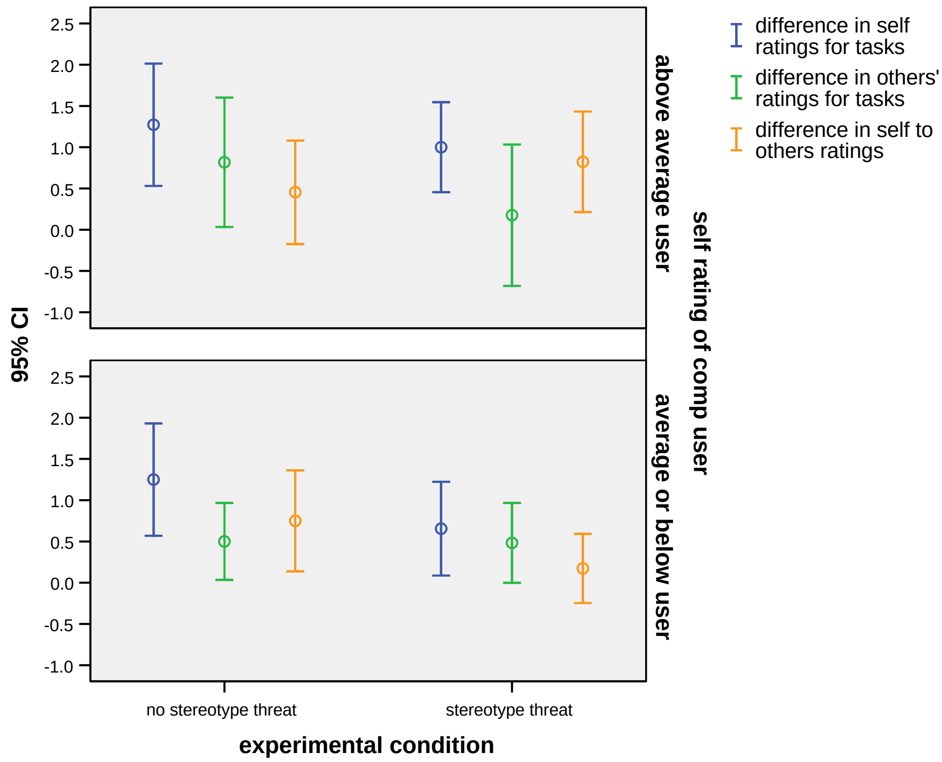

Figure 5.3: Self described computer expertise and difference in self to others' ratings across the two tasks.

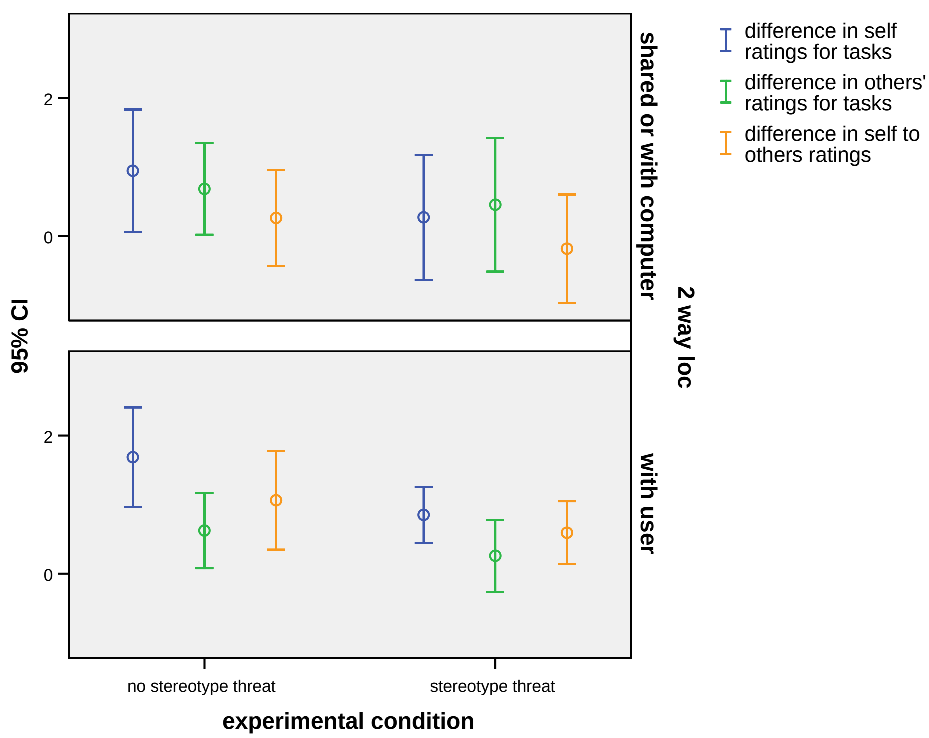

Figure 5.4: Locus of Control and difference in self to others' ratings across the two tasks.

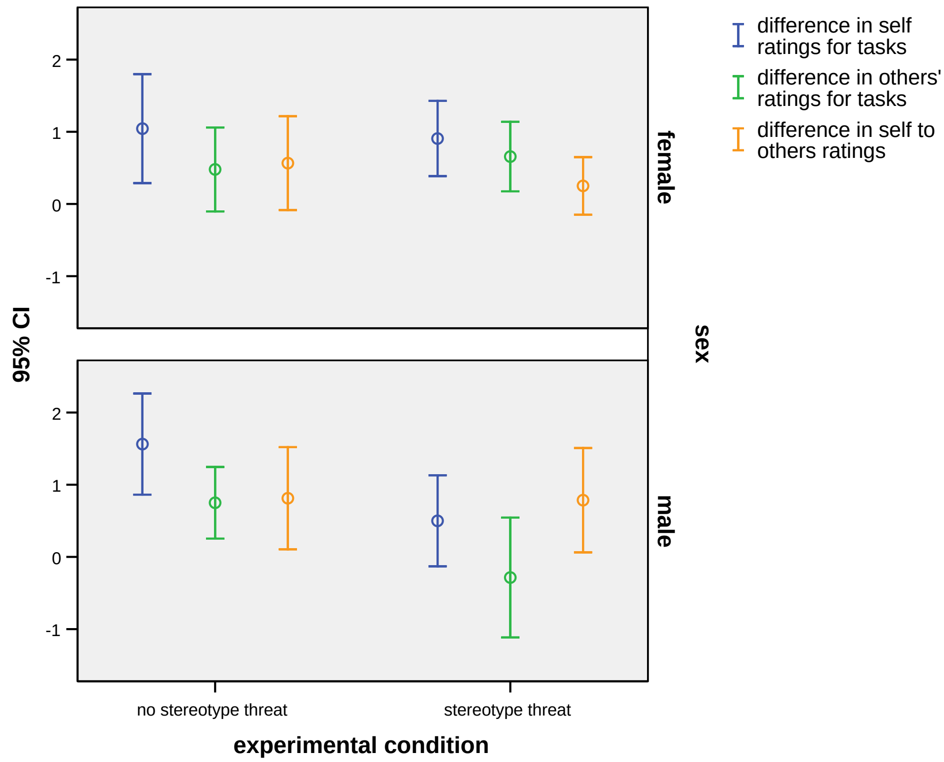

Figure 5.5: Gender and difference in self to others' ratings across the two tasks.

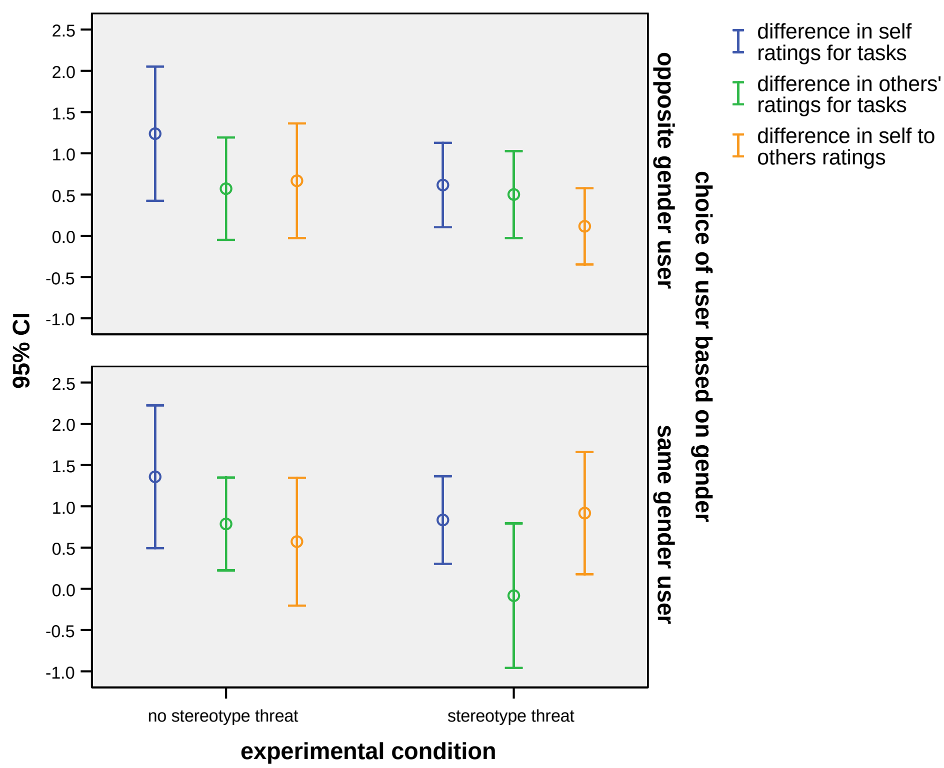

Figure 5.6: Gender of computer user chosen in relation to self and difference in self to others' ratings across the two tasks.

5.5 Discussion

The first concern with this study was that for Stereotype Threat theory to operate there must be evidence of the existence of a prototype which is associated with success in a particular domain. The findings of the previous chapters were robustly supported in this current study with regards to the domain of computing as a stereotype of a typical computer user existed and again, that stereotype was best represented by ‘Bob’. The features of ‘Bob’ were: a young male; with glasses; poor skin and unfashionable dress sense. The sample were well-educated men and women who as psychology undergraduates were better aware than most of stereotypes, yet still ‘Bob’ was chosen as the prototype with no difference between men and women students in this. Participants concurred with the explicit measure that a stereotype existed but were reluctant to explicitly ascribe its gender as male although they did agree it was a young person. Again, implicit measures seemed to be a better reflection of mental representations than responses to explicit statements.

Significantly, the only group that did not choose ‘Bob’ was those who considered themselves to be of above computing ability. This fits with the principle that one would not want to represent oneself in such a stereotypical and unflattering light plus these individuals most probably possess better personal knowledge and availability of counter-stereotypes to the ‘Bob’ persona.

Despite men being faster than women at the card task this effect was not maintained for the computer task. Indeed, those who were fastest at the computer task were those with the higher GCSE scores. This group had not been significantly faster at the card task indicating that they were a group good at improving or naturally had higher computing skills. This latter possibility was not the case as there was no difference in the self-ascribed level of computer expertise between those with lower or higher GCSE scores. The other factor in being faster at the computer task was the percentage of control that a participant felt they had over a computer. This was unrelated to computer expertise and did not appear to be related to any other variables.

Generally participants rated themselves worse than others for both tasks but the difference was less for the computer task than the card one. The rating for others was often based on self-rating with approaching half the variance in the score for others based on the self-score for the card task. This had reduced to only a quarter of the variance for the computer task irrespective of whether it was the stereotype threat conditions that participants experienced or not. There were different patterns in this based on different groups but in general there was a good correlation between performance and self-rating and from this it was assumed most others were similar but slightly better.

5.5.1 H1: Past academic success will increase competence beliefs and increase self-ratings in line with increased performance and any differential with ratings for others

There was a significant difference in the proportion of high or low GCSE achievers between those who improved and those who worsened on the two tasks and a strong correlation between GCSE attainment and improvement in speed for the two tasks. This could either be through certain individuals being better learners generally as reflected not only in higher academic success but also by having learnt more from the card task towards completion of the computer task. Alternatively as the first hypothesis stated, it could be lower anxiety and an experience of perseverance and application being rewarded.

On further examination, the effect only appeared under ST conditions. Priming the participants on evaluation and ability seemed to reduce the improvement for those with low GCSE scores and markedly increase the performance for those with above average scores. For the non-ST conditions there was little difference between high and low achievers. Thus, framing the computer task in terms of ability and evaluation polarised the differences between the groups and whether through anxiety or association with ability those with higher educational attainment responded positively to stereotype threat whereas those without were negatively affected. What is remarkable with this is the small difference in educational attainment (on average one grade better for 8 GCSE's) that separated the groups yet still stereotype threat produced a significant difference in performance based on educational attainment.

There was little difference in self-ratings or difference between self and others based on educational attainment for either of the tasks. Better performance of those with higher GCSE scores was reflected in higher self-ratings but this group also scored others more highly. The only marginal effect was that those from the lower group had higher scores for self and others from the non-diagnostic to ST conditions whereas the above average group despite increasing their own score under ST conditions reduced the score for others. This tends to suggest that although not significant this group adopted a different strategy once ability and evaluation were included compared to the lower achieving group.

5.5.2 H2: Above average perceptions of own computer expertise should produce better performance and the expectation to be above average or not will be reflected in ratings for self and others

Individuals who saw themselves as above average computer users performed better at the computing task than those who did not. It was not possible to determine if this was through higher ability or less anxiety. The effect was present for both experimental conditions with only a marginal improvement under stereotype threat conditions for the above average users and no reduction in performance for the below average users. Thus, the second hypothesis could not be supported fully in that stereotype threat conditions did not seem to polarise performance on the computing task depending on self-description of computer ability. Hence, from the outcome to the previous hypothesis, identification with level of computer expertise did not seem to be as strong a predictor of performance on a computing task as general academic ability despite the task being framed as an evaluation of ability at computing.

Individuals who saw themselves as above average computer users rated themselves better than others throughout. There was little effect of the experimental condition on ratings other than to note the different way in which the score for others was ascribed with below average users using their own score to derive the score for others (30% of variance for non-ST and 55% for ST) against the more expert users using their own rating to generate the rating for others far less often (9% variance for non-ST and 20% for ST). Under ST conditions, it seemed the tendency to use ones own performance to rate others increased in general and was particularly used by less confident computer users. This could be seen as less engagement with computing at a personal level and less readiness to see oneself as a unique user.

What was also interesting was that groups based on actual performance and groups based on self-described level of expertise followed very similar patterns with regard to ratings. The main discrepancy between self-described expertise and actual performance was in the way people generated their scores for others. In the case of the self-described average or below average computer users, most of the score for others was derived from their own self-rating and it was more common under ST conditions to take this approach than non-ST conditions. However, for the group that actually were the worse performers, there was a greater tendency to use the self-score to generate the score for others in the non-ST condition. This indicates that self-perception rather than actual performance is a greater factor in positioning oneself relative to others when the task is evaluative and if it is not evaluative then actual performance is used to generate a relative score. One explanation for this could be that under evaluation in a domain in which participants were less confident, they avoided cognitive dissonance by confirming their self-perception that “I am average or below” by consistently adding a quantity to their self-score to generate the score for others. However, in the non-evaluative condition participants were less consciously aware of their self-description and took more regard of their actual performance to generate the score for others.

5.5.3 H3: There will be an interaction between self-perception of computer expertise and sense of personal control such that those with an internal sense of control will produce a worse performance under ST conditions if low in confidence and a better performance if they consider themselves above average. Self and others' ratings will reflect performance to best profit self-esteem by decreasing the differential between them if performance was poor and increasing it if performance was good

There was no overall effect of Locus of Control on performance but the pattern that developed under ST conditions indicated that LOC was a factor in engaging with the computing task. For the non-diagnostic condition, those who had a high sense of personal control performed better than those with a more external LOC, either through a reflection of motivation or a sense of personal responsibility for the outcome. However, this effect disappeared under ST conditions as framing the computer task as evaluative and a reflection of personal ability reduced the differences between those with an external LOC and those with an internal LOC. What was particularly interesting was that this effect was more significant for those with above average GCSE scores than those of the lower ability group. For the lower ability group, stereotype threat had little relative effect on those with an external LOC but did engage those with an internal LOC. For the higher ability group, framing the task as evaluative barely affected those with an internal LOC but did seem to engage those with a more external LOC, albeit only at the level of a trend.

Locus of control affected self-rating and ratings in comparison to others in a similar way to its effect on performance although no results were significant and patterns of self-rating and ratings for others only reached the level of a trend. The pattern of variance reflected that seen earlier for self-described computer expertise with those with low personal control using self-score to generate the score for others whereas those with higher personal control generating the score for others less from their own. Again ST increased the tendency to use own score to generate the one for others, particularly for those with less sense of personal control who unusually, compared to other categorisations made within the sample, tended to rate others better than themselves.

By examining the values of self and others increase in ratings across the two tasks and assuming that LOC is a measure of engagement or personal identification with the domain of computing, those with an external LOC seemed more willing than those with an internal LOC to consider others to be better than them. Thus, since computing is an unimportant domain to those who do not consider themselves to be in personal control, the normal processes to protect self-esteem against performance on a test of ability do not come to bear on the relative ratings for self and others.

5.5.4 H4: Positive regard for computers will result in better performance and higher self-ratings

The hypotheses regarding view on computers were not supported either overall or for different experimental conditions. There was some degree of a trend for the performances to improve under stereotype threat conditions and this was more marked for those who saw computers as ‘good and bad’ as opposed to simply ‘good’ perhaps representing more engagement.

Results from participants’ regards for computers produced little data to support any hypotheses around ratings of self or others during the computer task. There were in general higher ratings for the self based on a more positive attitude towards computers irrespective of experimental condition. This also applied for others in the non-diagnostic condition but under ST the marginal trend was reversed with others surprisingly rated more highly by those with the less positive attitude. This may have been a mechanism to maintain self-esteem and the difference between self and others despite performing a task that one did not fully engage with but yet one which was aware of as evaluative.

5.5.5 H5: Knowledge of a computing stereotype will impact performance and self-ratings among those who do not conform to it

There was a non-significant trend for both explicit question on the online questionnaire and the implicit measure through choice of a ‘typical computer user’ to show least improvement on performance in the non-diagnostic condition for participants that believed a stereotype of a computer user existed. This implies that unless directed to consider the computer task as a reflection of ability, participants who held a stereotype tended to be less motivated to engage or underperformed relative to others through anxiety at seeing computer users as stereotypes.

There was strong evidence that the type of stereotype reported by individuals as it pertained to the self was a factor in performance. The gender of the figure chosen as the computer user as being of the opposite gender to oneself significantly affected performance such that participants that chose same gender users improved their performance on the computer task more than those that saw computer users as being of the opposite gender. There was also an interaction between choice of gender of a typical user in relation to the self and ST conditions. Framing the task as an evaluation of computing ability saw those with same-gender representations strongly improve and those with opposite-gender representations perform less well in comparison to the non-diagnostic condition.

What was notable was that this interaction was only present for the high attainment group indicating that linking ability to the task generally increased performance but if the representation of someone success at that task was dissimilar to the self then the normal increase in performance was inhibited. Furthermore someone seen as successful that shared common features increased performance particularly if that performance was evaluative.

There were no significant patterns in forming the ratings for others from self-ratings or differences between the values that supported any hypothesis relating to the existence of a stereotype of not. It seemed it was not the presence of the stereotype as much as the features associated with it that was more important in terms of self-perception.

Simple gender categorisation has men showing little difference between non-ST and ST conditions and consistently higher self to others ratings than women. The major trend is that for the ST condition, men consider that others have improved far less than they have (indeed worsened) from the card to the computer task. Not only do women generally rate their own improvement to be less than do their male counterparts they also rate others’ improvement less in the non-ST condition. However, in the ST condition women consider they have improved but so also have others leading to less self to others advantage in overall rating. This could well be because the men participants in this study are aware that most other participants in the study are likely to be women who traditionally are worse at computing than themselves.

The pattern for the same gender of user categorisation follows similar lines as for the men-women divide as nearly all men and relatively few women chose typical computer users to be other than male. That said, there were counters to this in sufficient number to turn a trend into a significant difference. In terms of ST theory it presented strong evidence that there was an effect on self-perception of success based on possible dissociation from a typical computer user based on a feature of the stereotype. It went from merely having self and others positioned because of general differences between men and women on self report of success in an evaluative situation to the more specific domain of computing and implicit measures of mental representations of those associated with that domain.

5.5.6 Critique of method used

The evidence that supported stereotype threat in relation to representations of successful others and features of these people in relation to the self was present despite the many other parameters that play alongside this such as general confidence in personal ability, expectation of success and motivation . Therefore, the method proved useful in extracting the effects of stereotype threat in a computing context. It also indicated that to get measurable differences in performance from stereotype threat there needed to be strong stereotypes available with simple features that could separate them from any self-concept. This was particularly true in a setting where motivation and engagement world be affected by the experimental framework that accompanies introducing stereotype threat conditions.

There was more variability in time taken for the card task than for the computer one. There were several strategies open to solving the card task problem whereas there was only the one available solution to the computer task. For the card task some individuals reduced the problem to sorting lengths and angles to sequence that was not an option with sequential computer programming commands. The manner in which individuals laid out the cards also varied greatly with some having better strategies to display the sequence than others in order to check it. Some individuals insisted on holding all the cards in their hands so precluding the opportunity of visual inspection of the sequence. This was difficult to prevent and modifications to the method would be required to force participants to be more prescribed in their strategies for solution to the task. Most of this variation was the difference in how long it took individuals to familiarise themselves with the required procedure. Any unfamiliar task presents a learning process and often those who are slowest initially actually develop deeper understanding of the problem and principles involved for solution than those who operate on a trial and error basis. By including the time taken for the ‘A’ this was accommodated within the method used and using three letters was certainly more worthwhile than just one or two.

Perhaps the biggest drawback to the method used was that it did not make full use of the data available from the online questionnaire. Most particularly the affect scale described in Chapter Four with regards to the three factor model of positive, negative emotion and engagement. Also the much more complex LOC scale was not used. Explicit attitudes towards various uses of computers such as word-processing and databases were also not included in the analysis. This was a matter of time available and simplification towards examining primary areas associated and previously researched around stereotype threat theory.

Chapter Six

Overall Discussion

This thesis is based upon three pieces of research that embraced an initial paper questionnaire study, a refinement of this through an online questionnaire and ultimately performance measures in a laboratory setting that were related back to responses from the online questionnaire. An attempt has been made to define essential features of computing such as patterns and type of use associated with gender and then to build knowledge about these to form an overview of attitudes towards computers based on cognitive, affect, behaviour and perceived control components. Once methods were in place to measure attitudinal components, they were examined as predictor variables in the context of determining any effect on actual performance and perception of such.

In terms of results from the research, starting with the fundamental area of interest for this thesis that the gender divide in attitudes towards computers exists (Brosnan & Davidson, 1994), this was supported throughout as less positive emotions were recorded from female participants than from their male counterparts. However, the overwhelming response to computers from both genders was that they were useful and of value. So, despite liking them less than their male counterparts, very few girls, as previously found (Smith, 2005), described them as ‘boring’. There were gender differences in patterns of use and emotions recorded during computer use but none were so substantive for any participant to declare total antipathy towards computers across the large number of participants who contributed.

The initial data collected for this thesis related to computer use and supported the literature that had gone before; (e.g. Durndell & Thomson, 1997) that boys and men use computers more than girls and women. This is despite undifferentiated access in schools through essential elements of the National Curriculum having been in place for several years and no gender differences in favour of boys or men found in the possibilities of access to a home computer. At the time of the online survey (2005) more men than women had their own computers but amongst an undergraduate population, owning a computer was almost universal and it can be assumed that there will be a time that barring socio-economic factors everyone will own a computer. Indeed, the undifferentiated high level of use of the Internet on a mobile phone and the finding that people were accessing computers at least daily indicated such a pattern already.

The acquisition of a computer for personal use stemmed from the ages of 16-18 years old with more male participants than female participants possessing their own. The declared uses of games and chatting online by 16-18 year-old male participants supported the idea that they acted to increase independence from parents (Kamptner, 1995) through providing ones own entertainment and having a private and free means of communication with friends in a manner dissimilar to that which parents generally used.

Social use of computers by 16-18 year-old boys was greater than for the girls dispelling the myth that boys only used computers alone and for gaming (Kendall, 1999). The ‘nerd’ as a social outcast certainly seemed to prevail in the stereotype of a typical user being unattractive and with features associated with non social compliance such as odd hairstyle and poor dress sense. The prevalence of glasses also suggested introversion indicating this was someone who spent a considerable amount of their time on their own developing computer expertise or some other area of personal interest. The level of agreement on typical users being young males was remarkable, particularly from an adult cohort. This supports the research by Schott & Selwyn (2000, p298) using focus group interviews with 16-17 year-olds that, irrespective of personal use or even being an ICT student oneself, the ‘geek’ is still put forwards as a “swotty kid typing up their work”, “all down there in the computer room”. The open responses from the first study also supported the notion that even if a female stereotype existed she often was a derivative of a male one and was called ‘bobette’ compared to ‘bob’ or similar.

Determining the onset of the use of stereotypes was an important aim of this research and from the initial study where 10-11 year-olds offered far fewer stereotype responses it was clear it occurred between the ages of 11 and 16 years. For the youngest participants, Archer’s (1984) views on girls using their mothers as role models and boys using peers was supported to some extent as there was a gender difference amongst the 10-11 year-olds in terms of the age of the ‘typical’ user. Girls tended to put a parent forward but not necessarily their mother whereas boys chose a contemporarily aged male. However, it was the online study and the introduction of the 13-14 year-old age group that was most useful towards clarifying the use of stereotypes. This age group adopted a position between that of the 10-11 year-olds and the 16-18 year-olds by still providing responses that were not stereotypes but to a lesser degree. This provided strong support to the evidence that this is the age at which stereotypical representations really ‘kick in’. There is substantiation that this effect operates at the level of more general social cognitive development as it not only applies to the context of computing but also stereotypes of people who ‘do sport’ appear to come to the fore from the ages of 13-14 onwards (Colley, Berman & van Millingen, 2005).

It was not only the representation of a computer user that was a robust result but also the preference of a particular computer setting. Again age and gender effects followed a similar pattern to the use of stereotypes in that the youngest boys and girls both preferred the computer with the most peripherals whilst the adults universally rejected it. The ages in between had male participants preferring the computer with peripherals more than the female participants who most likely associated it with computer games in which they had less interest. Women generally preferred the computer with a vase of flowers more than their male counterparts who were very ready to reject it as feminine (Eisenberg-Berg, Murray & Hite, 1982). The finding that the pattern of computer setting choice paralleled that of the use of stereotypes was interesting in that it supported the idea than inanimate objects can become genderised in their own right and that even the masculine or feminine choice of a vocal accompaniment to a computer programme can affect outcomes such as computer based learning (e.g. Nass, Moon & Green, 1997, Cooper & Stone, 1996).

The scales that examined Locus of Control were very illuminating in that there was a cross-over from a more general context to a computing context yet this worked in an opposing fashion for men and women. The higher sense of control men had over computers to a more general setting was the reverse of that for women. This was a remarkable finding as it was consistent across all age ranges that contributed data. Furthermore, the level of control was no different between men and women in the work/education context whereas it was in the computing context. The literature is limited in this and such a type of analysis has not been conducted before but it may go some way to explain women's relative lack of "mastery" at computing and their wish not to take it on as a career. Self-categorisation Theory (SCT: Turner & Hogg, 1987) suggests an individual will disengage from a social identity with which they are not comfortable, interested or is not self-serving. So, female self-esteem, as with any person using SCT, remains intact through avoidance, dis-identifying with the domain (low internal LOC) or devaluing proficency/the proficient in that domain through ascribing a negative feature or even a collection of them to form an associated negative out-group social identity.

The transition from shared (10-11 year-olds) to personal control with age appeared a reflection of social cognitive development and a sense of personal effectiveness linked to the move to independence and autonomy in adolescence. The result that overall LOC increased with age from the age-group of 13-14 onwards was a reflection of a more general finding that this is the case (e.g. Lewis, Ross & Mirowsky, 1999).

The longitudinal studies conducted by Skinner et al. (1998) identified factors such as overall control, perception of ability, personal capacity and strategies, luck and powerful others. This gave considerable support to the various factors of sense of personal control of a computer that emerged here. However, the low level of reliability and one cross-sectional analysis does not provide as much application as further testing and a monitoring programme of longitudinal studies.

The outcome that LOC was linked to level of computer use was not surprising and repeats that of Solvberg (2002) however the covariant effect this may have had in terms of educational attainment was difficult to quantify. It had been previously expected that those with better academic success would be the most confident but the inescapable and reliable result that less computer use was related to higher educational attainment confounded this reasoning. Therefore, the multi-faceted rationale as to why some people engage with computers on the basis of general self-confidence and high LOC in an alternative domain was not as readily resolved as expected and further research and analyses are required to resolve this.

The scales for emotion felt during computer use were also extremely valuable and again, have not appeared in the literature to date as a method to explain individuals' disengagement with computing. It was particularly rewarding to see the reliability of the scales across the sample to measure three factors including engagement for comparison elsewhere. In terms of the sustained relationship with Locus of Control that women are less engaged than men then these scales can serve as a way to translate work/education LOC into improved emotional experience of computing. The regression models developed serving to illustrate that a combination of general LOC and mental representation of a computer user being predictive.

The most critical part of this thesis was to tie the background information of a participant to how they actually behaved using a computer. The final study using Stereotype Threat conditions used a very limited sample but did produce useful data towards understanding the types of conditions and background factors that affected performance and self-perception of such. In particular the mental representation of a typical computer user as same gender or not seemed to be instrumental in the outcome of not only performance but also self-rating and comparison of self to others. Locus of control was evident in the non-diagnostic condition where individuals intent on personal involvement were more motivated than those with an external LOC. Turning the task into an evaluative one increased the motivation of those with a lower LOC to take up the challenge and so perform better illustrating the methodological problems of controlling for motivation in any ST research. This lower LOC for women is reminiscent of the dis-identification that Spencer et al (1999) refer to as low motivation to persevere with a difficult task. This is critical in some subject areas where complex abstract concepts need to be mastered and to do so requires a reasonable expectation that one has the ability to do this whereas in some subjects improvement is more gradual and may not rely upon an “Eureka“ moment that comes after protracted perseverance. For example, essay writing and subjects described as “soft“ can be seen as a matter of skill and knowledge acquisition with more subjective appraisal than subjects such as mathematics where failure is often clear-cut and not necessarily as closely related to endeavour.

Motivation is critical in relation to Stereotype Threat Theory on many levels as in a hostile environment there will be some individuals destined to increase motivation just to prove a stereotype wrong. This is fine if the task is accomplishable as they will be satisfied by behaving counter-stereotypically but particularly harmful to those with a high sense of personal control who wish to succeed yet do not because they lack some element to the task (Oswald & Harvey, 2001).

The suggested ways to overcome Stereotype Threat in terms of a gender stereotype include many mechanisms. One example is siting a competent female example in the room or making people aware of her which overwrites the negative stereotype momentarily if not eventually (Marx & Roman, 2002). Alternatively, framing the task as not evaluative and emphasising that there are no known gender differences may act alongside persuading individuals that the ability required to succeed is malleable and not necessarily assigned to a social group (Spencer et al, 1999). Finally, acting to influence people to have a higher personal sense of control can be effective since although such individuals are more often affected detrimentally by ST, they actually have a higher starting point so any loss in performance will still leave them better than average, just not as good as they might have been. Over time the ST threat will disappear as it no longer becomes personally relevant and then their full potential will be in operation. (Cadinu, Maass, Lombardo & Frigerio, 2006).

The closing parts to this discussion relate to the methodology used. Throughout there have been three parallel problems: extracting implicit attitudes rather than socially desirable ones or those not consciously available; establishing the covariance of variables and the ecological validity of the data collected.

The first of these was addressed using the ’draw-a-computer-user’ method described by Brosnan (1999). It worked well but had limitations in terms of coding and application to older age-groups. A better way of gather implicit attitude data may be to adopt that of Nosek, Banaji et al (2002) who measured response latencies to computer images and phrases assuming lower latency represents more implicit agreement. This is a method that would work well in controlled circumstances such as with an undergraduate sample requiring course credit but, as with much social psychology research, finding volunteers to contribute data beyond a time and place of their own convenience can be problematic and not only possibly reduce the available numbers but also introduce more bias than necessary into the sample. Priming for a stereotype could also be easily introduced by this method and its effect quantified against any implicitly held stereotype.

By the same token, identification with an element of that stereotype would also be a useful extension as it could be conducted on several levels; femininity; computer user; love of gadgets and technology generally etc.

The second concern regarding covariance may be resolved with further statistical analyses of the Stereotype Threat data already collected but as explained in Chapter Five that would have detracted from the overall aims and presentation of this thesis. Measuring identification with computing itself would indicate motivation to alleviate one of the uncertainties ST conditions prompt and controlling for educational attainment and reported usage would also be worthwhile.

The last comment on methodology relates to ecological validity. The decision not to prime for computer stereotypes or gender was discussed in Chapter Five and was considered to be a better option. However, the biggest criticism that can be levelled at this research is that it collected private attitudes rather than those displayed in a social setting such as a classroom or the workplace. The presence of others, peers or whoever often leads to ‘home-grown’ stereotypes that the group endorses through pluralistic ignorance (Prentice & Miller, 2002). Thus there may be a group of girls who privately like using computers but through pluralistic ignorance no-one admits to it and this becomes a self-fulfilling prophecy. Also the presence of others may naturally bring the salience of a stereotype to the fore or suppress it. What perhaps is the best instance of the imagined presence of others was the reluctance to show agreement with the explicit statement on gender of a computer user. Thus, socially desirable answers can operate yet the universal agreement that computer users were young did not seem to fall prey to this effect in the same way. The double effect of having two features distinct from the prototypical user was not assessed so elderly women may be doubly affected in a manner similar to the maths performance of Latino women (Gonzales, Blanton & Williams, 2002).

To conclude, the aim of this thesis was to apply social psychological principles to the question as to why there is an imbalance in the number of women pursuing careers in computing. It was apparent from looking at the literature much of it was dispirit and a more integrated picture needed to be drawn once some baseline data gave direction. The initial study adopted a multi-faceted approach towards a broad investigation of what children and adolescent's attitudes towards computing were. It considered the cognitive (mental representations of users), emotional and behavioural (use) components of attitudes and included open response methods. At this point it became clear there were different patterns of use, emotions experienced and images of a computer user between the genders and age groups that were worthy of further investigation. The second study provided focus to the initial inquiry by examining a finite number of quantitative measures towards determining relationships between cognition, emotion and behaviour. Patterns of use were confirmed and became better defined in terms of different computer applications and for a wider age range. Emotions were more reliably measured using a more sophisticated scale that also gave detail to different components that may form an attitude. The form, prevalence and onset of stereotypes was derived to usefully operate with a more complex LOC measure to be predictive of emotion and hence attitude towards computers. The final study applied Stereotype Threat theory to provide detail of how actual performance, self-perception of such and social comparisons were related to the cognitions an individual held about computing as they pertained to the self. This study proved illuminating in that same gender representations affected performance under stereotype threat conditions indicating gender and computing were effective applications of ST theory and the under-representation of women in computing careers was traceable to effects seen in parallel domains and different social groups. The methods throughout have been seen to be effective in extracting and collecting data from large samples that gives validity and reliability to the findings.

Thus, the journey started with a wide horizon and travelled towards a location where answers in terms of practical possibilities to change the framework of computing could increase its popularity amongst any stigmatised social group. Clearly this need not only be women, it could equally apply to the elderly, ethnic minorities, socially or educationally disadvantaged groups, and so on.

In short, do not prime for stereotypes as this may be counter-productive through increased salience of the stereotype content and cause a "re-bound" effect. Instead, assuming they are present but not consciously activated, set up an ethos of intolerance to any stereotype not just the ones that pertain to the people present. Then habitual subconscious inhibition will moderate any negative stereotype (Macrae et al, 1994) plus reduce the salience of any stereotype that will prompt a negative feature based on social identity that detracts from the task (Spencer, Steele & Quinn, 1999). This may be through include the teaching of genderised subjects in single sex groups or more imaginatively conduct two types of class in the same room as visually integrated as possible. If one is popular and one is unpopular with a particular gender so the salience of gender and priming of a stereotype in both tasks is reduced by equal numbers of each gender being visible. Clearly, this could work for more boys doing girls' subjects as well as girls doing boys'.

The results around general sense of LOC indicate that reminding people of their general confidence and sense of self-efficacy in an alternative domain would have a beneficial effect in the computing domain, although in the case of men, maybe this could work in reverse and increased confidence in a general domain could be generalised from the computing domain.

By increasing people's motivation but not at a level it becomes pressurised and increases anxiety should focus people on rewards rather than detractors particularly if past successes are salient. Framing the task in terms of anticipated success rather than allowing people to dwell on the reasons for failure should also shift the focus from an internal attribution to an external cue that may similarly prompt for external attributions for failure. Due to the powerful effect of framing a task in terms of personal relevance and as a measure of success in an area that one cares about rather than as dissociated from the self and non-evaluative can increase anxiety to a point it intrudes on performance so the phrasing of requests to use computers and such needs to be more sensitive than is commonly supposed.

Finally, the good news that came from the research is support for the idea of 'stereotype lift' from a meta-analysis of stereotype threat experiments (Walton & Cohen, 2002). Here those seeing themselves as more competent in a domain based on social identity than an out-group tend to perform better than usual in the evaluative presence of a salient stereotype of the out-group that generally contains a negative attribution. Indeed, men tended to benefit from being reminded of women's stereotypical skill at computing, even if it was to counter it, and if women could also use comparison in as effective a way of increasing self-confidence, reducing anxiety, higher motivation or whatever, they too may see themselves in the same light as relatively superior at the task thereby making an excellent way forwards. Albeit whether a mention of a suitable stereotype such as the elderly may have ethical implications if not sensitively introduced and thoroughly removed in the debriefing or any future research in this area.

The fact that stereotype lift has been seen to exist reflects two seminal theories in social psychology: that of social comparison (Festinger, 1957, cited in Hewstone et al, 2008) and social facilitation (Allport, 1924, cited in Hewstone et al, 2008). Alongside earlier comments on the inhibition of stereotypes through cognitive dissonance (Festinger, 1954, cited in Hewstone et al, 2008) this serves to remind that the problems of women taking up computing careers actually has resonance with many social psychology theories that touch on individual/intergroup comparison, the presences of others and resolving distress through conflicting cognitions . Social facilitation and inhibition are often explained by sense of competence in a practised or unpractised task that increases arousal through appraisal or the presence of others resulting in the dominant response of poor or good display of skill (Zajonc, 1965, cited in Hewstone et al, 2007). This fits many of the results seen here and may offer a simpler explanation than stereotype threat theory in some instances but does not explain why those holding a particular mental representation of someone good at the task perform differently than those that do not. An uncomfortable display of incompetence in front of others is distressing whether it is playing “Chopsticks” badly on the piano or failing to move through a website proficiently. In such instances whether most piano players or computer users are male or female most likely is a secondary consideration and not of as much relevance as finding a way out of an embarrassing situation particularly if it challenges self-esteem. Temptation to hand the piano or computer keyboard over to a more practised player of the instrument may simply be a way of alleviating temporary distress that could become self-fulfilling as it does not provide longer term resolution. More importantly, long term resolution may just require motivation by suggesting that one will have to improve as there is a concert one is entered in with big prize money in a week or there is a superb deal on cheap flights and to pass any assignment, it needs to be word processed.

Thus, maybe one of the final conclusions to this thesis is that stereotype threat theory offers some useful insight but the methodology around it to ensure ecologically valid circumstances are represented in the first instance and teasing motivational and anxiety factors apart is somewhat problematic. Generating scales of engagement, motivation and anxiety go a long way towards qualifying its outcomes and seem a very helpful extension to try to resolve this unknown.

However, as stereotype threat relates to the cognitive component of an attitude, the basic problem of measuring implicit attitudes whether cognitively, affectively or behaviourally based is perhaps the biggest challenge of all. What is also particular to the subject of this thesis is the rapidly changing position of computers and technology in society that makes generating a continuum of research with a stable social backdrop almost impossible. What worsens the state of an already shifting platform with regards to development and use of technology is the problem of studying the cognitive component of an attitude during adolescence when it is at its most fluid. Turmoil in the school system through restructuring much of the examination and qualifications system plus altering syllabuses has also not been helpful in tracking career options and choices. Perhaps it is no surprise that cognitive resources are not available to those from around the ages of 13 onwards to process abstract concepts such as a ‘computer’ user in anything other than the simplest of schemas. What is worrying however, is the effects on the self that allow a self-fulfilling prophecy of computer users always to be young, male and not anything towards which to aspire.

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Appendix A-1

Participants' schools comparison with national data and school rating calculations

Comparison of schools' performances with National Data

The list of schools with Year 6 pupils that consented is as follows:

Primary Schools in Daventry & South Northamptonshire
(two-tier system, pupils aged 5-11)

School Reference code	School	KS2 2000 results Northamptonshire League position *	KS2 2000 Score (sum of %English, %Maths, %Science at Level 4+) **	2000 Total of Year 6 Pupils (Number with SEN) **	Number of Participants who Provided Data
BuP	Bugbrooke Community Primary School	56	263	52 (1)	46
GNP	Green's Norton C of E Primary School	12	288	24 (0)	34
GuP	Guilsborough Cof E Primary School	15	287	31 (2)	30
WoP	Wootton Primary School	67	255	52 (2)	48

Middle Schools in Northampton (three-tier system, pupils aged 8-13)

School Reference code	School	KS2 2000 results Northamptonshire League position *	KS2 2000 Score (sum of %English, %Maths, %Science at Level 4+) **	2000 Total of Year 6 Pupils (Number with SEN) **	Number of Participants who Provided Data
BM	Blackthorn Middle School	152	-	-	Unusable data (wrong age)
COM	Cherry Orchard Middle School	134	207	160 (6)	28
KPM	Kingsley Park Middle School	145	196	124 (4)	92
KM	Kingsthorpe Middle Community	105	230	149 (4)	28
MM	Mereway Middle School	114	224	126 (39)	29

* from 159 Northamptonshire Schools' League Education Tables for 2000 Key Stage 2 results (aggregate percentage scores for English, Maths, Science at or above level 4) at http://www.news.bbc.co.uk/hi/english/static/…2000/ retrieved on 2nd July 2001.

** from dfEE published data at www.dfee.gov.uk/performance/primary.html retrieved on 1st July 2001

The list of schools with Year 12 pupils that consented is as follows:

Mixed Comprehensive Schools in Daventry & South Northamptonshire
(two-tier system, pupils aged 11-18)

School Reference Code	School	2000 results A/AS score/pupil [a] (GCSE score/pupil [b])	2000 Number of 16-18 year olds taking 2+ A/AS levels (% [c])	2000 Average point score per pupil of these [a]	2000 Total of 16-18 year old Pupils	Number of Participants who Provided Data
RoS	Roade School	18.8 (44.5)	89 (37.6)	19.2	237	22

Upper Schools in Northampton (three-tier system, pupils aged 13-18)

School Reference Code	School	2000 results A/AS score/pupil [a] (GCSE score/pupil [b])	2000 Number of 16-18 year olds taking 2+ A/AS levels (% [c])	2000 Average point score per pupil of these [a]	2000 Total of 16-18 year old Pupils	Number of Participants who Provided Data
MU	Mereway Upper School	23.6 (28.9)	8 (10.0)	23.8	80	46
NSB	Northampton School for Boys	20.8 (46.5)	135 (41.8)	20.8	323	33
WFU	Weston Favell Upper School	17.0 (33.9)	88 (33.2)	17.3	265	23

Single Sex Secondary Schools in Warwickshire
(two-tier system, pupils aged 11-18)

School Reference Code	School	2000 results A/AS score/pupil [a] (GCSE score/pupil [b])	2000 Number of 16-18 year olds taking 2+ A/AS levels (% [c])	2000 Average point score per pupil of these [a]	2000 Total of 16-18 year old Pupils	Number of Participants who Provided Data
LSB	Lawrence Sheriff School for Boys	18.2 (58.9)	97 (39.8)	18.2	244	27 Males
RHS	Rugby High School for Girls	20.8 (60.5)	90 (39.0)	22.0	231	38 Females

[a] England Average A/AS Level score per pupil taking 2 or more A/AS/AGNVQ examinations = 17.3, , data retrieved from http://www.dfee.gov.uk/perform.shtml on 1st July 2001.

[b] England Average GCSE score per pupil = 38.9, data retrieved from http://www.dfee.gov.uk/perform.shtml on 1st July 2001.

[c] Based on % of 16-18 year olds roll and score of those taking more than 2 A/AS/AGNVQ exams (% total roll x average score per pupil)

Results of A level choices from schools

NSB (a school in the sample) had an apparent administration bias with mainly non-science student responses however, as shown belong, this tended to compensate the whole sample that had previously been biased in reverse relative to National data so NSB results were included.

	Survey Results without NSB (with)		National Results [d]	
	% of candidates attempting subject		% of candidates attempting subject	
	Males	Females	Males	Females
English	24.2 (22.0)	54.5 (56.6)	21.3	43.9
*Mathematics**	53.2 (41.5)	35.2 (32.3)	31.6	16.6
*Physics**	43.5 (32.9)	9.1 (8.1)	20.7	5.0
*Chemistry**	17.7 (13.4)	18.2 (16.2)	16.2	13.8
*Biology**	24.2 (20.7)	31.8 (32.3)	16.2	23.0
*Technology**	40.3 (32.9)	6.8 (6.1)	9.8	3.6
Geography	21.0 (15.9)	13.6 (12.1)	17.1	12.7
History	14.5 (30.5)	29.5 (33.3)	15.2	15.0
Language/French	8.1 (7.3)	21.6 (20.2)	4.4	8.8
Business Studies	38.7 (36.6)	20.5 (20.2)	16.3	11.6
General Studies	11.3 (8.5)	26.1 (23.2)	41.5	40.3
*Average Science**	35.8 (28.3)	20.2 (19.0)	18.9	12.4
Average non-Science	21.3 (22.5)	27.9 (28.4)	12.8	15.8

[d] candidates aged 17-18 for academic year 2000/2001 taken from http:/www.dfes.gov.uk retrieved on 10th November 2001.

* indicates science subject

Recorded % A levels taken as science-based	42.3	26.0
Recorded % A levels taken as non science-based	57.7	72.8

Ratios of male to female participants' A level choices

	Survey Results Ratio of %males to %females		National Results* Ratio of %males to %females
	without NSB	with NSB	
English	0.444	0.389	0.485
*Mathematics**	1.511	1.285	1.904
*Physics**	4.780	4.062	1.140
*Chemistry**	0.973	0.827	1.174
*Biology**	0.761	0.641	0.704
*Technology**	5.926	5.393	2.722
Geography	1.544	1.314	1.346
History	0.492	0.916	1.103
Language/French	0.375	0.361	0.500
Business Studies	1.888	1.812	1.405
General Studies	0.433	0.366	1.030
*Average Science**	1.772	1.516	1.524
Average non-Science	0.763	0.792	0.810

* indicates science subject

Calculation of School Rating values

10-11 year-old age group

The school rating factor for year 6 pupils was based simply on the % scores of KS2 pupils attaining level 4 across the three basic curriculum subjects. Although the results represented the previous year's cohort it was felt they were the best indicators available of the educational expectations and ethos of the participants' schools.

School Reference code	KS2 2000 Score (sum of %English, %Maths, %Science at Level 4+) *
BuP	263
GNP	288
GuP	287
WoP	255
COM	207
KPM	196
KM	230
MM	224

16-18 year-old age group

The school rating value is based on % of 16-18 year olds school roll that take more than 2 A/AS/AGNVQ exams and the score they achieve for them. The rationale behind this was that this approach reflects the academic ethos and expectations of the school in year 12. The use of GCSE achievement in year 11 was considered an unreliable indicator through diverse patterns of transition from year 11 to year 12. For example, one school (a girls' grammar) had near 100% transferral whereas another school opened year 12 to new entrants on a selective basis and a third, an urban comprehensive, reduced its roll significantly from year 11 to 12 as pupils left. The use of published year 13 A level results alone did not reflect the participants' education since not all were taking 2+ A levels.

Thus, schools where year 12's are composed entirely of those taking 2+ A levels have a higher first factor calculated than those whose year 12 include large proportions of GNVQ, diploma and other more vocational subjects under study.
The second factor (average score per pupil for those taking 2+ A levels) is taken from national data for the school

ie.

school rating = (% total roll) x (average score per pupil)

School Reference Code	Calculated rating value for 16-18 year olds**	Average number of GCSE's
RoS	722	9.43
MU	238	6.57
WFU	574	8.73
LSB	724	9.41
NSB	869	9.42
RHS	858	9.91
Overall Mean	664	8.76

Appendix A-1

Appendix A-2

Questionnaires used

10-11 year-olds – full version

16-18 year-olds – edited version without attitude questions

School Reference: __________
Participant Reference: __________
Date: __________

COMPUTER ATTITUDE SURVEY 2001 (10 – 11 year olds)

These questions are part of a study of what young people think about computers. Thank you for agreeing to help. Please follow the instructions given and if there are any problems then ask.

First, please fill in the following details:

Age: __________

Boy or Girl: ______________

Favourite subject at school: ______________________________

Now, please answer the following questions by ticking *one* of the possible answers

1. In the last month have you used your own PC?

Yes	
No	

2. In the last month have you used the family's PC?

Yes	
No	

3. In the last month have you used a PC at school?

Yes	
No	

4. In the last month have you used a PC at a friend's house?

Yes	
No	

5. In the last month have you been on the Internet at all?

Yes	
No	

6 For how many hours each week do you usually use a PC?

Less than one hour	
Between one and five hours	
More than five hours	

7. What is the thing you like best about computers?

I can tell them to do things	
I can do what they tell me to do for help or information	
I can ask them for help or information	

Now, look at the pictures of the four computers, (A, B, C and D) on the separate sheet. Next choose which of the four you would like to use most, second most, third most and least of all. Then, fill in the table below with A, B, C and D next to the choice you have made for each computer.

First choice computer to use	
Second choice computer to use	
Third choice computer to use	
Last choice computer to use	

Finally, please turn over and use the back of this sheet to draw a computer user and fill in their name at the bottom of the page.

My Picture of a Computer User

The name of the computer user I have just drawn is ……………………….……………………………..

Thank you very much for your answers, your picture and your help.

COMPUTER ATTITUDE SURVEY 2001 (16-18 year olds)

This questionnaire is the basis of a study of young peoples' attitudes towards computers. Thank you for agreeing to participate in the study. Please follow the instructions given and if there are any queries then please add a comment to your answer. Your answers will be kept anonymous and confidential with their use limited to the confines of this study.

First, please enter the following details:

Age: ________ Male / Female: ___________ Number of passes of GCSE (grade C or above): _______

A/AS levels or other exams currently being taken: ____

____

Have you or are you intending to apply to University? ____

How many hours per week, in total, do you generally spend using a PC? ______________________

Please tick any of the four options below that you have used in the last month

A family PC at home		Your own PC at home		A PC at school		A PC at a friend's house	

Please tick the choice that best describes you in terms of computing experience

Average, OK with most things		Novice, unsure of things		Expert, confident user	

Please tick the option that best describes how you see computers

They instruct me how, what and when to do things		They do as I command		They ask me to make choices	

How many times per week do you access the Internet? _______________________________________

If you use the Internet, how many hours per week do you generally spend on it? _______________

Attitudes towards Computers and software, generally

A series of statements about computers and computing follow. Indicate how strongly you agree or disagree with each statement by circling one of the five choices. Try to avoid neutral answers unless you really have no opinion.
A quick first impression is all that is required so please do not spend too long on each answer.

Attitudinal questions inserted here (omitted from this report)

More attitudinal questions

40: The length of time that I would study computing on its own to help get a job would be …

Not at all	One week	One month	Six months	More than a year

41: When I use a computer, I feel the computer is telling me what to do for the following percentage of the time …

0%		10 %		20 %		30 %		40 %		50 %		60 %		70 %		80 %		90 %		100 %

42: When I use a computer, I feel in command of the computer for the following percentage of the time …

0 %		10 %		20 %		30 %		40 %		50 %		60 %		70 %		80 %		90 %		100 %	

43: The main emotion I feel when I am using a computer is …………………………………………

44: Looking at the pictures of the four computers, (A, B, C, D) on the separate sheet, please rank them in the order in which you would like to use them by putting A, B, C or D alongside each choice.

First choice computer	
Second choice computer	
Third choice computer	
Last choice computer	

Question 45

Lastly, in the space below, please draw a computer user.

Question 46

The name of the computer user I have just drawn is ……..…………………………..

Have you answered all the questions?
Thank you very much for taking the time to complete this questionnaire. It is very much appreciated. If you have any comments to make about any aspect of it then please feel free to write them below and continue overleaf.

THANK YOU

Appendix A-2

Choice of Computer

Photograph A

Photograph B

Photograph C

Photograph D

Appendix A-3

Coding and categorisation of results for favourite subject, A/AS levels and favourite interest or hobby

Results of average rankings of subjects by girls and boys; Table I reproduced with permission and extracted from Colley, Comber & Hargreaves (1994)

	girls	boys	Mann-Whitney U-test
English	2.83	4.61	612.5, $p < 0.001$
Mathematics	4.98	4.76	NS
Science	5.98	4.54	683.5, $p < 0.001$
Humanities	3.50	5.24	632.5, $p < 0.001$
French	6.50	6.14	NS
Art and Design	4.37	4.80	NS
CDT	5.77	5.08	NS
Music	5.78	6.32	NS
PE	5.35	3.52	637.0, $p < 0.001$

NS – Not significant

Results of statistically significant correlations between sex-role stereotyping and subject rankings (Pearson's *r*); Table II reproduced with permission and extracted from Colley, Comber & Hargreaves (1994) with CSRI M and CSRI F derived from Boldizar (1991)

	CSRI M	CSRI F
Positive correlates		Humanities, $r = 0.317$**
		Music, $r = 0.224$*
Negative correlates	English, $r = -0.225$*	PE, $r = -0.256$*

* $p < 0.05$; ** $p < 0.01$

Results of Questionnaire for 10-11 year olds – administered to members of entire classes

	of boys (%)	of girls (%)
Recorded favourite subject as science-based		
Maths	19.4	14.5
Science	3.6	3.0
Design And Technology	12.1	14.5
ICT	17.0	12.1
	52.1	34.1
Recorded favourite subject as non science-based		
English	7.9	15.2
Art	13.9	27.3
History	1.2	1.2
	23.0	43.7
Recorded favourite subject as neutral		
P.E.	23.6	7.9
Other *e.g. Music, Geography, French, Form period*	1.2	3.6
	24.8	11.5

Results of Questionnaire for 16-18 year olds – administered opportunistically to sixth formers

A/AS Levels coded as either science or non-science with

Science subjects as
Maths, Further Maths, Biology, Physics, Chemistry, ICT, Computing, Design & Technology, Product Design

Non-science subjects as
Economics, Business Studies, English (Literature & Language), Drama, Art, Performing Arts, French, German, Spanish, Latin, History, Geography, Music, Media Studies, Sociology, Psychology, Law, Religious Studies, Communication Studies, PE, Photography

	% of candidates attempting subject	
A level subject	Males	Females
English	22.0	56.6
*Mathematics**	41.5	32.3
*Physics**	32.9	8.1
*Chemistry**	13.4	16.2
*Biology**	20.7	32.3
*Technology**	32.9	6.1
Geography	15.9	12.1
History	30.5	33.3
Language/French	7.3	20.2
Business Studies	36.6	20.2
General Studies	8.5	23.2

The participants' choice of A levels was then processed based on the categorisation of subject as science or non-science to those taking a majority, equal balance or minority of science subjects

	% of males	% of females
Majority science		
4 science	18.1	5.1
3 science, 1 non-science	9.6	5.1
3 science	0.0	0.0
2 science, 1 non-science	2.4	0.0
2 science	0.0	0.0
1 science	0.0	0.0
Minority Science		
5 non-science A levels	0.0	2.0
4 non-science	8.4	30.3
1 science, 3 non-science	16.9	24.2
3 non-science	17.9	11.1
1 science, 2 non-science	4.8	5.1
2 non-science	1.2	2.0
1 non-science	3.6	4.0
Equal Balance		
2 science, 2 non-science	12.0	11.1
1 science, 1 non-science	2.4	0.0

Appendix A-4

Chi-squared analyses of interests, computer use and Locus of Control

Science vs. Non-Science Interests of Participants

	count of each age group and sex of participants			
	10-11 year olds		16-18 year olds	
	male	female	male	female
Science activity	86	73	25	10
Neutral	40	16	12	11
Non-science activity	38	72	43	78

Association of sex with science/non-science interests
Both age groups χ^2 (2) = 55.97; $p < 0.001$
10-11 year-old age group χ^2 (2) = 21.83; $p < 0.001$
16-18 year-old age group χ^2 (2) = 14.75; $p = 0.001$

Association of age group with science/non-science interests
Both sexes χ^2 (2) = 32.09; $p < 0.001$
Males χ^2 (2) = 22.68; $p < 0.001$
Females χ^2 (2) = 36.26; $p < 0.001$

Types of Computer Used

		count of each age group and sex of participants			
		10-11 year olds		16-18 year olds	
		male	female	male	female
Computer at school	Yes	138	134	75	80
	No	30	32	14	20
Computer in the home	Yes	137	129	67	84
	No	31	37	22	16
Own Computer	Yes	85	62	35	16
	No	83	104	54	84
Friend's Computer	Yes	86	79	33	27
	No	82	87	56	73

Association of sex with use of computer at school
Both age groups χ^2 (1) = 0.514; $p > 0.05$
10-11 year-old age group χ^2 (1) = 0.111; $p > 0.05$
16-18 year-old age group χ^2 (1) = 0.582; $p > 0.05$

Association of age group with use of computer at school
Both sexes χ^2 (1) = 0.026; $p > 0.05$
Males χ^2 (1) = 0.185; $p > 0.05$
Females χ^2 (1) = 0.021; $p > 0.05$

Association of sex with use of computer at home
Both age groups χ^2 (1) = 0.039; $p > 0.05$
10-11 year-old age group χ^2 (1) = 0.758; $p > 0.05$
16-18 year-old age group χ^2 (1) = 2.229; $p > 0.05$

Association of age group with use of computer at home
Both sexes χ^2 (1) = 0.005; $p > 0.05$.
Males χ^2 (1) = 1.396; $p > 0.05$
Females χ^2 (1) = 1.541; $p > 0.05$

Association of sex with use of own computer
Both age groups χ^2 (1) = 16.76; $p < 0.001$
10-11 year-old age group χ^2 (1) = 5.95; $p = 0.015$
16-18 year-old age group χ^2 (1) = 13.00; $p < 0.001$

Association of age group with use of own computer
Both sexes χ^2 (1) = 14.88; $p < 0.001$
Males χ^2 (1) = 2.97; $p > 0.05$
Females χ^2 (1) = 13.73; $p < 0.001$

Association of sex with use of own computer
Both age groups χ^2 (1) = 2.221; $p > 0.05$
10-11 year-old age group χ^2 (1) = 0.433; $p > 0.05$
16-18 year-old age group χ^2 (1) = 2.208; $p > 0.05$

Association of age group with use of own computer
Both sexes χ^2 (1) = 15.35; $p < 0.001$
Males χ^2 (1) = 4.660; $p = 0.031$
Females χ^2 (1) = 11.04; $p = 0.001$

Amount of Computer Use

	count of each age group and sex of participants			
	10-11 year olds		16-18 year olds	
	male	female	male	female
Less than one hour	48	58	2	5
One to five hours	91	92	15	40
Over five hours	29	15	68	52

Association of sex with time spent using a computer
Both age groups χ^2 (2) = 9.669; $p = 0.008$
10-11 year-old age group χ^2 (2) = 5.377; $p = 0.068$
16-18 year-old age group χ^2 (2) = 14.053; $p = 0.001$

Association of age group with time spent using a computer
Both sexes χ^2 (2) = 160.30; $p < 0.001$
Males χ^2 (2) = 95.545; $p < 0.001$ **
Females χ^2 (2) = 72.757; $p < 0.001$ **

For computing vs. non-computing students

	count of A/AS level students and sex of participants			
	Computing students		Non-computing students	
	male	female	male	female
Less than one hour	0	0	2	5
One to five hours	1	2	14	38
Over five hours	25	4	43	48

Association of sex with time spent using a computer
All students χ^2 (2) = 14.053; p = 0.001
Computing students since cell sizes are small, use Fisher's exact test which gives p = 0.083
Non-computing students χ^2 (2) = 6.088; p = 0.048

Association of A/AS level choice of computing with time spent using a computer
Both sexes χ^2 (2) = 10.67; p = 0.005
Males χ^2 (2) = 6.146; p = 0.046
Females χ^2 (2) = 0.063; p > 0.05

Computer Experience

For computing vs. non-computing students

	Count of A/AS level students and sex of participants			
	Computing students		Non-computing students	
	male	female	male	female
Expert	19	3	15	11
OK with most things	8	3	42	73
Novice	0	0	5	10

Association of sex of participant with computer experience
All students χ^2 (2) = 14.775; p = 0.001
Computing students since cell sizes are small, use Fisher's exact test which gives p = 0.375
Non-computing students χ^2 (2) = 4.253; p = 0.119

Association of A/AS level choice of computing with computer experience
Both sexes χ^2 (2) = 36.649; p < 0.001
Males χ^2 (2) = 17.539; p < 0.001
Females χ^2 (2) = 7.115; p = 0.029

Locus of control

	count of each age group and sex of participants			
	10-11 year olds		16-18 year olds	
	male	female	male	female
With user	34	20	69	57
Shared	108	130	14	23
With computer	24	12	6	15

Results of chi-squared analyses for sense of control during computer use

Association of sex with locus of control

Both age groups χ^2 (2) = 7.400; p = 0.025

10-11 year-old age group χ^2 (2) = 9.616; p = 0.008

16-18 year-old age group χ^2 (2) = 7.001; p = 0.030

Association of age group with locus of control

Both sexes χ^2 (2) = 151.11; p < 0.001

Males χ^2 (2) = 79.079; p < 0.001

Females χ^2 (2) = 80.979; p < 0.001

Appendix A-5

Emotion during Computer Use

Full list of emotions expressed, their frequency and categorisation

Those categorised as Negative affect (75 responses into 25 distinct emotions)

Emotion	Frequency of occurrence
Aggression	1
Anger/rage	5
Annoyance/irritation	6
Anxious	1
Boredom	18
Confusion	1
Dis-heartening	1
Distress	1
fed up/pissed off	4
Frustration	14
get the work done and get off it	1
hate for technology	1
help me	1
Hunger	1
I hate this + please don't go wrong	1
Impatience	5
Introspective	1
Melancholy	1
NO!!!!!	1
Numbness	1
Overwhelmed	1
Stress	5
tired-annoyed	1
tired (cos of sore eyes)	1
Tragedy	1

Those categorised as Neutral (without) affect (37 responses into 11 distinct emotions)

Apathy	2
Concentration	5
burn with desire/lust	2
? / don't know	2
don't often use one	1
Doss	1
Enjoyment and anger	1
Indifference	3
Mixed/varies	2
Neutral	8
Nice pair of eyes	1
none much	5
Normal	4
pure ecstasy/pleasure	2

Those categorised as Positive affect (52 responses into 19 distinct emotions)

at ease/chilled/calmness	3
Comfort	3
Confident	1
enjoy, helpful	1
Enlightenment	1
Excited	2
Fine	1
Fun	1
Happy	9
High	2
in control	5
Interest/intrigue	4
Power	3
Relaxed	8
Relief	1
Satisfaction	5

Emotions expressed in terms of sex and affect

Figures in brackets show the number of responses

Sex of Participant	Affect	Emotions
Male (76)	Negative (30)	Boredom (11), anger(3), impatience(3),frustration(3), annoyed (2), rage, disheartening, tragedy, hunger, aggression, stressed, fed up, introspective
	Neutral (12)	Mixed/varies(2), indifference(2), apathy(2), none(2), focus, normal, nice pair of eyes, enjoyment & anger
	Positive (34)	Relaxed (6), happy(5), satisfaction(5), power(3), control(2), high(2), comfort(2), fun, relief, pure ecstasy, interest, excitement, calmness, enlightenment, fine, at ease
Female (88)	Negative (45)	Frustrated (11), bored(7), annoyed(5), fed up(3), stressed(4), impatient(2), anxious, melancholy, overwhelmed, distress, angry, no!!!!!, tired, numbness, confusion, help me, get the work done and get off it, I hate this and please don't go wrong, hate for technology
	Neutral (22)	Neutral (8), concentration(4), normal(3), none(3), don't know(2), indifferent, don't often use one
	Positive (21)	Relaxed(3), happy(3), in control(3), interest(3), comfortable, doss, excited, enjoy/helpful, confident, pure pleasure[a], ecstatically happy[a], lust[a], burn with desire[a]

[a] results marked as such came from a single school and may have been subject to collusion amongst participants

Distribution of affect for 16-18 year-olds

	Count		
	males	females	combined
Negative affect	30	45	75
Neutral	12	22	34
Positive Affect	34	21	55

Effect of taking ICT/Computing A/AS levels on distribution of affect

	count			
	Taking ICT A/AS levels		Not Taking ICT A/AS levels	
	males	females	males	females
Negative affect	4	3	26	42
Neutral	5	0	7	22
Positive Affect	16	3	18	18

SPSS Syntax used to code emotions from free response question to positive, neutral or negative affect

IF (emotion = 'burn with desire' or emotion ='lust') emocode = 2 .
EXECUTE .
IF (emotion = 'aggression') emocode = 1 .
EXECUTE .
IF (emotion = 'anger' or emotion = 'angry') emocode = 1 .
EXECUTE .
IF (emotion = 'annoyance' or emotion = 'annoyed') emocode = 1 .
EXECUTE .
IF (emotion = 'anxious' or emotion = 'help me' or emotion = 'hate for technology') emocode = 1 .
EXECUTE .
IF (emotion = 'get the work done and get off it' or emotion = 'Hurry up!' or emotion = 'I hate this + please dont go wrong') emocode = 1 .
EXECUTE .
IF (emotion = 'impatience' or emotion = 'impatients' or emotion = 'irritated') emocode = 1 .
EXECUTE .
IF (emotion = 'confusion' or emotion = 'dis-heartening' or emotion = 'distress') emocode = 1
EXECUTE .
IF (emotion = 'fed up' or emotion = 'frustrated' or emotion = 'frustrating') emocode = 1.
EXECUTE .
IF (emotion = 'frustration - they always crash and are bloody annoying' or emotion = 'frustration') emocode = 1 .
EXECUTE .
IF (emotion = 'irritation' or emotion = 'melancholy' or emotion = 'NO!!!!!') emocode = 1 .
EXECUTE .
IF (emotion = 'overwhelmed' or emotion = 'pissed off' or emotion = 'rage') emocode = 1 .
EXECUTE .
IF (emotion = 'stress' or emotion = 'stress/headache') emocode = 1 .
EXECUTE .
IF (emotion = 'stressed' or emotion = 'tired-annoyed' or emotion = 'tired (cos of sore eyes)') emocode = 1 .
EXECUTE .
IF (emotion = 'tragedy') emocode = 1 .
EXECUTE .
IF (emotion = 'apathy' or emotion = 'apathy/boredom' or emotion = 'bored') emocode = 2 .
EXECUTE .
IF (emotion = 'boredom' or emotion = 'Boredom' or emotion = 'boredom/tediousness') emocode = 2 .
EXECUTE .
IF (emotion = 'calmness/neutral' or emotion ='hunger') emocode = 2 .
EXECUTE .
IF (emotion = 'concentration' or emotion = 'concentration, focus' or emotion = 'focus') emocode = 2 .
EXECUTE .
IF (emotion = 'just concentrate' or emotion = 'just what to do' or emotion = 'mixed') emocode = 2 .
EXECUTE .

```
IF (emotion = 'enjoyment, anger' ) emocode = 2 .
EXECUTE .
IF (emotion = 'dont know' or emotion = 'dont often use one' or emotion = 'doss') emocode =
2 .
EXECUTE .
IF (emotion = 'indifference' or emotion = 'indifferent' or emotion = 'introspective') emocode
= 2 .
EXECUTE .
IF (emotion = 'neutral - dont need emotions 2 use a computer' or emotion = 'neutral' or
emotion = 'neutral (dont really think about it)') emocode = 2 .
EXECUTE .
IF (emotion = 'neutrality (no real emotion) depend on what Im doing' or emotion = 'Nice
pair of eyes' ) emocode = 2 .
EXECUTE .
IF (emotion = 'no significant emotion' or emotion = 'none' or emotion = 'none much' )
emocode = 2 .
EXECUTE .
IF (emotion = 'normal' or emotion = 'normal (?)' or emotion = 'normality' ) emocode = 2 .
EXECUTE .
IF (emotion = 'not much. calm' or emotion = 'nothing' or emotion = 'numbness' ) emocode =
2 .
EXECUTE .
IF (emotion = 'varies' or emotion = '1' or emotion = '?' ) emocode = 2 .
EXECUTE .
IF (emotion = 'at ease' or emotion = 'calmness' or emotion = 'chilled' or emotion =
'comfort') emocode = 3 .
EXECUTE .
IF (emotion = 'comfortable' or emotion = 'confident' or emotion = 'control' or emotion =
'control to a point') emocode = 3 .
EXECUTE .
IF (emotion = 'enjoy, helpful' or emotion = 'enlightenment' or emotion = 'excited') emocode
= 3 .
EXECUTE .
IF (emotion = 'excitement' or emotion = 'extaticly happy' or emotion = 'fine') emocode = 3 .
EXECUTE .
IF (emotion = 'fun' or emotion = 'Happy cos Im killing someone on battlefield') emocode =
3 .
EXECUTE .
IF (emotion = 'happy' or emotion = 'Happy' or emotion = 'high') emocode = 3 .
EXECUTE .
IF (emotion = 'joy and happiness' or emotion = 'I get high') emocode = 3 .
EXECUTE .
IF (emotion = 'in command' or emotion = 'in control' or emotion = 'interest') emocode = 3 .
EXECUTE .
IF (emotion = 'interest depends on task' or emotion = 'intrigue' or emotion = 'high')
emocode = 3 .
EXECUTE .
IF (emotion = 'power' or emotion = 'power & control' or emotion = 'pure ecstasy') emocode
= 3 .
EXECUTE .
```

IF (emotion = 'pure pleasure' or emotion = 'relaxation' or emotion = 'relaxed') emocode = 3
EXECUTE .
IF (emotion = 'relief' or emotion = 'relaxed/varies' or emotion = 'satisfaction' or emotion = 'that of interest') emocode = 3 .
EXECUTE .

Length of time willing to study computing on it own to help get a job

Distribution of length of time willing to study computing for 16-18 year-olds

	Count				
	males	females	taking ICT	not taking ICT	combined
Not at all	5	7	0	12	12
One week	15	21	1	35	36
One month	19	40	9	50	59
Six months	20	21	9	32	41
One year	24	7	14	17	31
χ^2 goodness of fit	$\chi^2(4)$ = 12.60 *	$\chi^2(4)$ = 38.38 **	$\chi^2(3)$ = 10.51*	$\chi^2(4)$ = 31.45**	$\chi^2(4)$ = 32.26 **
Pearson's Correlation with use (hrs)	r(72) = 0.32 **	r(94) = 0.12	r(26) = 0.21	r(6) = 0.16	r(173) = 0.31 **
Pearson's Correlation with affect	r(73) = 0.18	r(81) = 0.22 *	r(25) = 0.00	r(6) = 0.17	r(154) = 0.28 **
χ^2 test of association with sex	-	-	$\chi^2(3)$ = 0.56	$\chi^2(4)$ = 11.99 *	$\chi^2(4)$ = 17.30 **
χ^2 test of association with taking ICT	$\chi^2(4)$ = 10.54 *	$\chi^2(4)$ = 8.31	-	-	$\chi^2(4)$ = 24.04 **

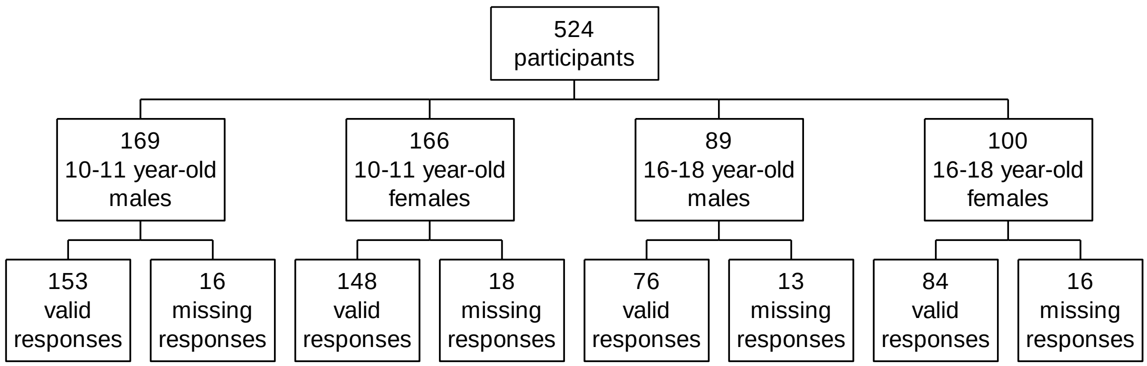
*** indicates significant at level of $p < 0.01$*
** indicates significant at level of $p < 0.01$*

Effect of taking ICT/Computing A/AS levels on distribution of length of time willing to study computing

	count			
	Taking ICT A/AS levels		Not Taking ICT A/AS levels	
	males	females	males	females
Not at all	0	0	5	7
One week	1	0	14	21
One month	7	2	12	38
Six months	7	2	13	19
One year	12	2	12	5

Appendix A-6

Extended results from 'draw-a-computer-user' task



Categorisation of computer user drawings

Chi-squared tests for association of sex and age of participant with sex, age, type and mood of computer user drawn

	Count of each age group and sex of participants			
	10-11 year olds		16-18 year olds	
Characters drawn	Male	female	male	female
Sex of User				
Male	117	46	65	39
Female	9	71	4	25
Indeterminate	27	31	7	20
Age of user				
Contemporary	70	71	59	57
Older	39	23	6	7
Indeterminate	44	54	11	20
Type of user				
Real	76	68	24	18
Imaginary	37	30	48	62
Indeterminate	40	50	4	4
Mood of user				
Unhappy	87	106	38	57
Happy	21	5	11	6
Indeterminate	45	37	27	21

Association of sex with sex of user drawn

Both age groups	χ^2 (2) = 101.83; p < 0.001
10-11 year-old age group	χ^2 (2) = 79.19; p < 0.001
16-18 year-old age group	χ^2 (2) = 27.63; p = 0.001

Association of age group with sex of user drawn

Both sexes	χ^2 (2) = 5.60; p = 0.061
Males	χ^2 (2) = 2.99; p = 0.224
Females	χ^2 (2) = 7.94; p = 0.019

Association of sex with age of user drawn

Both age groups	χ^2 (2) = 5.78; p = 0.055
10-11 year-old age group	χ^2 (2) = 5.07; p = 0.079
16-18 year-old age group	χ^2 (2) = 2.33; p = 0.312

Association of age group with age of user drawn

Both sexes	χ^2 (2) = 28.81; p < 0.001
Males	χ^2 (2) = 21.78; p < 0.001
Females	χ^2 (2) = 8.69; p = 0.013

Association of sex with type of user drawn

Both age groups	χ^2 (2) = 2.33; p = 0.312
10-11 year-old age group	χ^2 (2) = 2.20; p = 0.332
16-18 year-old age group	χ^2 (2) = 2.24; p = 0.326

Association of age group with type of user drawn

Both sexes	χ^2 (2) = 101.35; p < 0.001
Males	χ^2 (2) = 36.11; p < 0.001
Females	χ^2 (2) = 66.81; p < 0.001

Association of sex with mood of user drawn

Both age groups	χ^2 (2) = 16.34; p < 0.001
10-11 year-old age group	χ^2 (2) = 12.27; p = 0.002
16-18 year-old age group	χ^2 (2) = 5.31; p = 0.070

Association of age group with mood of user drawn

Both sexes	χ^2 (2) = 1.05; p = 0.592
Males	χ^2 (2) = 0.95; p = 0.621
Females	χ^2 (2) = 1.71; p = 0.425

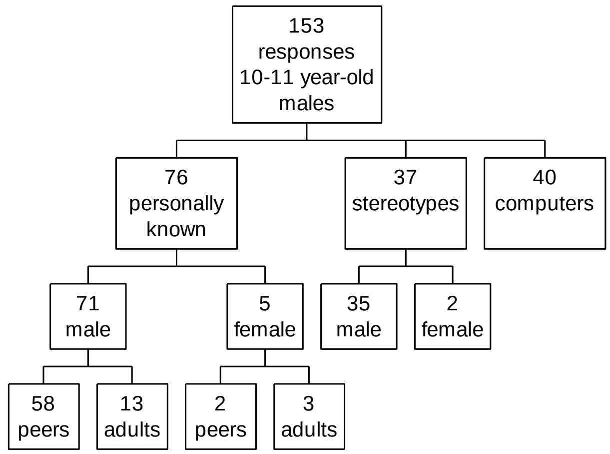
Distribution of names of users drawn

	Names of computer users found in particular age groups and sex of participants		
10-11 year old females	Business man (4), professor (3), headmaster, scientist, company man, student, teacher, pilot, office worker, bank manager	Me (3), my dad (4), my mum (3), a child (2), my brother (2)	Dexter
10-11 year old males	Travel agent, bank manager, computer worker, female computer worker, doctor	My mum (3), my dad (3), me (2), my brother, a child (4)	Bob(3), Dexter
16-18 year old females		Me (1)	Bob (10), Dave (5), Malcolm (3), Fred (3), Dexter
16-18 year old males	A young business man	Me (4)	Bob (7), Bobina (2), Bob(ette), Dave (2), Malcolm (2), Fred(2)

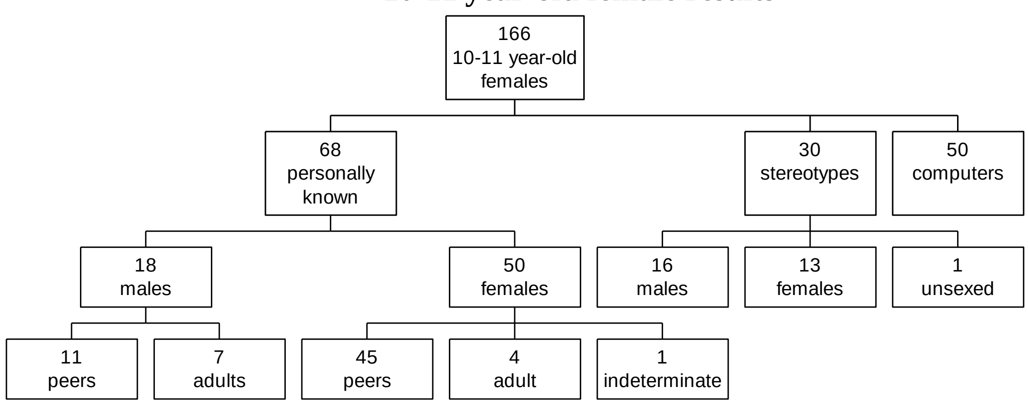
Categorisation of computer user drawing into role models, peers and stereotypes

Based on *type of user* being real or imaginary followed by *sex of user* drawn and then *age of user* drawn for each participant

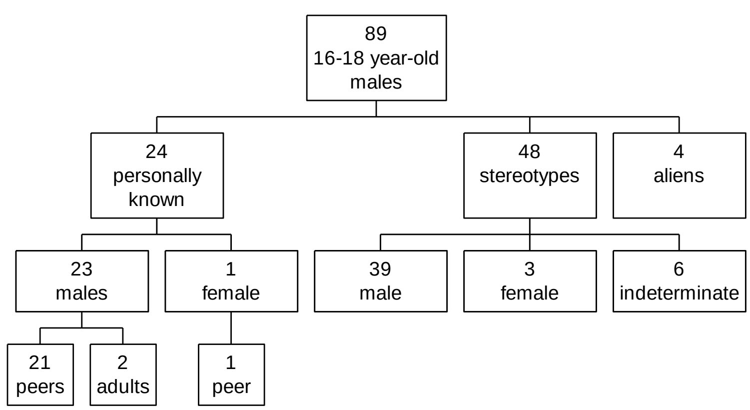
10-11 year-old male results



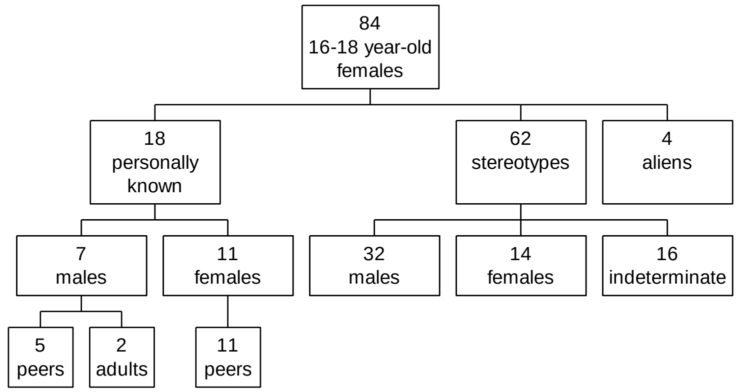
10-11 year-old female results



16-18 year-old male results



16-18 year-old female results



Chi-squared tests for association of sex or age of participant with sex of friends, role models and stereotypes drawn

	Count of each age group and sex of participants			
	10-11 year olds		16-18 year olds	
Characters drawn	male	female	male	female
Self/Friends				
Male	58	11	21	5
Female	2	45	1	11
Role Models				
Male	13	7	2	2
Female	3	4	0	0
Stereotypes				
Male	35	16	39	32
Female	2	13	3	14
Indeterminate	0	1	6	16

sex of friend drawn	χ^2 for gender of pp		χ^2 for age of pp	
	χ^2 (1)	*p*	χ^2 (1)	*p*
Both age groups	88.28	< 0.001	1.04	0.31
10-11 year-old age group	70.43	< 0.001	0.60	0.81
16-18 year-old age group	17.67	< 0.001	0.97	0.33

sex of role model drawn	χ^2 for gender of pp		χ^2 for age of pp	
	χ^2 (1)	*p*	χ^2 (1)	*p*
Both age groups	0.86	0.35	1.34	0.25
10-11 year-old age group	1.05	0.31	0.45	0.50
16-18 year-old age group	not enough occurrences		1.05	0.31

sex of stereotype drawn	χ^2 for gender of pp		χ^2 for age of pp	
	χ^2 (2)	*p*	χ^2 (2)	*p*
Both age groups	25.69	< 0.001	12.89	< 0.01
10-11 year-old age group	15.58	< 0.001	5.08	0.08

16-18 year-old age group	10.74	< 0.001	8.50	< 0.05

Appendix B-1

Online Questionnaires used

10-11 year-olds – full version

13-14 year-olds – full version

16-18 year-olds – edited version without attitude questions

Undergraduates – edited version without attitude questions

Adults – edited version without attitude questions

School of Psychology

This questionnaire is anonymous and answers will be treated confidentially.

No email details are collected and no returns (unless requested by you in the comments section) will result.

Welcome

to those aged from 10 to 11

Please answer all questions by clicking on the answer most appropriate for yourself and then click the SUBMIT button below.

Do not spend too long on each answer and be as honest as possible.

First, please fill in the following details:

School identification

(Ask your teacher for the correct choice for your school)

Your age

Male or female

Favourite subject at school

	yes	no
1. Do you have a computer at home?		
2. If you have a computer is it in your bedroom or mainly yours?		
3. Apart from now, have you used a computer at school in the last month?		
4. In the last month have you used a computer at a friend's house?		
5. In the last month have you been on the Internet at all?		

6. How many hours per week do you usually use a computer?

- **Less than one hour**
- **Between one and five hours**
- **More than five hours**

7. What is the thing you like best about computers?

- **I can instruct them to do things**
- **They can instruct me to do things**
- **I can work with the computer to do things**

8. I think computers are …

- **Good**
- **Bad**
- **Good and bad**

9. Now, look at the pictures of the four computers, (A, B, C and D) below:

Computer A (above)

Computer B (above)

Computer C (above)

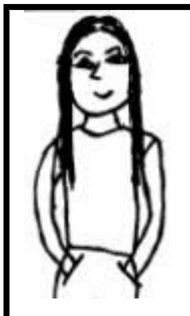
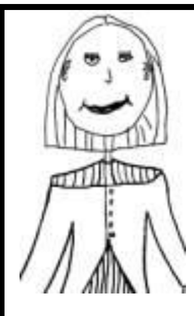
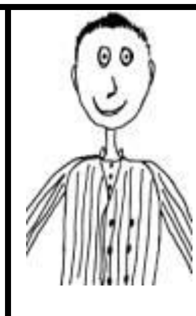
Computer D (above)

Next, chose which of the four you would like to use most, second most, third most and least of all.

Then, fill in the table below by clicking on A, B, C or D next to the choice that you have made for each computer.

	A	**B**	**C**	**D**
First choice computer to use				
Second choice computer to use				
Third choice computer to use				
Last choice computer to use				

10. Finally, please choose ONE of the following six people that you think is a computer user

					
Emma	**Someone's mum**	**Cynthia**	**Nathan**	**Someone's dad**	**Bob**

I think the computer user is …

Select submit to send your questionnaire or reset to clear the form and begin again.

Thank you very much for your answers and your help.

If you wish to email any comments about this questionnaire then please **click here**

University of Leicester School of Psychology

This questionnaire is anonymous and answers will be treated confidentially.

No email details are collected and no returns (unless requested by you in the comments section) will result.

Welcome

to those aged from 13 to 16

Please answer all questions by clicking on the answer most appropriate for yourself and then click the SUBMIT button below.

Do not spend too long on each answer and be as honest as possible.

First, please fill in the following details:

Place you are completing this questionnaire	
Identification code	
Identification number	
Your age	
Male or female	
How many sisters do you have?	
How many brothers do you have?	

In terms of the GCSE subjects you are interested in please indicate the number of each you are taking

	not taking	one	two	three
English, Drama or literature based subject				
Maths, statistics etc.				
History, Geography or other humanities				
Business studies, Economics or financially based subject				
Biology, Chemistry, Physics, General Science or other pure science				
ICT, Computing, Systems & Control or computer programming qualification				
French, German or other modern languages				
Art, Graphics, Photography, Music or other art based subject				
Design, Technical Drawing, Resistant Materials or other technology related subject				
Other				

	yes	no
Do you have your own mobile phone with Internet access?		
Do you have a computer at home?		
If you have a computer is it in your bedroom or mainly yours?		
In the last month have you used a friend's computer?		

How often do you generally use a computer?

How many hours per week do you usually use a computer?

How often do you access the Internet?

How many hours per week do you usually use the Internet?

Indicate any or all of the things that you use regularly on the Internet

	yes	no
email		
computer games downloaded/played online		
chat rooms or message/discussion boards		
buying (shopping, downloading music, booking travel/entertainment etc.)		
information sources (sports, what's on, news, maps, travel information etc.)		
education (research for topic, courses available/online, online revision etc.)		

Rate the following uses of computers.

communication - eg. email, advertising, finding information etc.

neatness and presentation - eg. word processing, powerpoint etc.

entertainment - eg. computer games, music, animation, special effects etc.

convenience - eg,. online banking, shopping, spreadsheets for calculations etc.

calculation - eg. design software for building/manufacture/engineering etc.

reliability - eg. automated processes, traffic control, safety/reminder devices etc.

programmability - the user being able to define the computer's task by adapting, creating or using software for a specific customised purpose eg. website design, BASIC programming, SPSS syntax commands, spreadsheet formulae etc.

Record the option that best describes how you see computers?

They do as I command

They instruct me how, what and when to do things

They ask me to make choices

I think computers are …

Good

Bad

Good and bad

What percentage of the time do you think the user is in control of the computer?

What percentage of the time do you think the computer is in control?

Now, look at the pictures of the four computers, (A, B, C and D) below.

Computer A (above)

Computer B (above)

Computer C (above)

Computer D (above)

Next, choose which of the four you would like to use most, second most, third most and least of all.

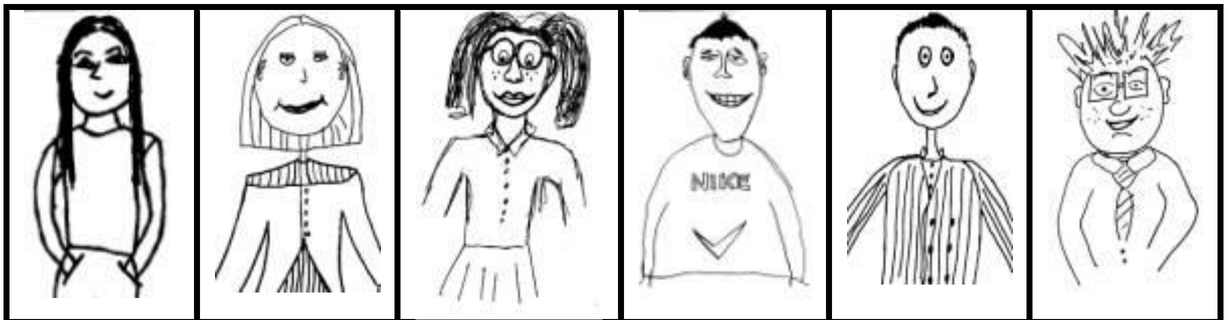
First choice computer to use

Second choice computer to use

Third choice computer to use

Last choice computer to use

Please choose ONE of the following six people that you think is a computer user



Emma	Someone's mum	Cynthia	Nathan	Someone's dad	Bob

I think the computer user is …

Considering your experiences at school indicate how true you think each of the following statements is as applied to yourself

I don't have the brains to do very well at school.

I have trouble working hard at school.

I can't stop myself from doing poorly in school.

I'm pretty lucky when it comes to getting good marks.

I can't get good marks, no matter what I do.

I think I'm pretty clever at school.

I'm just not able to get on with my teacher.

I can't do well in school, even if I want to.

If I want to do well on my schoolwork, I just need to try harder.

When I'm at school, I can work hard.

I don't know how to keep myself from getting bad marks.

If I'm not clever at a school subject, I won't do well at it.

I am unlucky when it comes to schoolwork.	
If I get good marks it's because of good luck.	
If I get bad marks, it's because I don't get along with my teacher.	
If I decide to learn something hard, I can.	
When I do well at school, I can usually figure out why.	
If I get bad marks, it's because I don't try hard enough.	
I have to be clever to get good marks at school.	
I am able to get my teacher to like me.	
I can do well in school if I want to.	
If I want to get good marks in a subject, I have to get along with my teacher	
If I don't get good marks, it's because of bad luck	
I can get good marks in school.	

Click on the position between the two extremes you think most represents the way you feel generally whilst using a computer.

alienated							**engaged**
comforted							**depressed**
frustrated							**unperturbed**
heartened							**irritated**
aggravated							**relaxed**
calm							**angry**
bored							**excited**
interested							**tedium**
fed up							**content**
impatient							**patient**
stressed							**at ease**
satisfied							**thwarted**
encouraged							**discouraged**

upset	○	○	○	○	○	○	pleased
useful	○	○	○	○	○	○	useless
empowered	○	○	○	○	○	○	humiliated
neutral	○	○	○	○	○	○	animated
indifferent	○	○	○	○	○	○	wound up
emotional	○	○	○	○	○	○	unaffected
detached	○	○	○	○	○	○	absorbed

Considering your experiences using a computer indicate how true you think each of the following statements is as applied to yourself

I'm not clever enough to use computers well.	
I have trouble applying myself to use computers better.	
I can't stop myself from being useless with computers.	
I am pretty lucky when using computers.	
The computer seems to work anyway, no matter what I do.	
I think I've got the ability to be good at using computers.	
The ICT teacher(s) and I don't get on.	
I can't get a computer to work, even if I want to.	
If I want to use computers better, I just need to try harder.	
When I'm using a computer I work hard and concentrate.	
I don't usually know how to prevent computers going wrong.	
I'm not clever enough with computers to use them well.	
I am unlucky when using computers.	
If I get the computer to work, it's because of good luck.	
If I'm no good at using computers it's because I don't get along with those teaching me.	
If I decided to learn about computers, I could.	

When I am successful with the computer, I can usually work out why.	
If I can't get a computer to do what I want, it's because I don't try hard enough.	
I need to be clever to get a computer to do what I want.	
I am able to get those teaching me ICT to like me.	
I can be very good using a computer if I want to be.	
If I want to succeed using a computer, I have to get along with those teaching me.	
If I don't get the computer to work, it's because of bad luck.	
I can use a computer well.	

Look at the following statements and decide how much you agree or disagree with them

	strongly agree	agree	disagree	strongly disagree
It's traditional to think of a certain person being keen on computers				
Computer enthusiasts are born not made				
Men are more likely to be keen on computers than women are				
Being a computer enthusiast is unlikely to alter in a person's lifetime				
Computer enthusiasts tend to be younger rather than older				
Using a computer can make you feel alienated towards it				
Using a computer can make you feel depressed				
If made to use a computer it is generally worthwhile				

Please select submit **to send your questionnaire or** reset **to clear the form and begin again.**

THE END

Thank you very much for your answers and your help.

If you wish to email any comments about this questionnaire then

please click here

University of Leicester School of Psychology

This questionnaire is anonymous and answers will be treated confidentially.

No email details are collected and no returns (unless requested by you in the comments section) will result.

Welcome

to all aged from 16 to 21

Please answer all questions by clicking on the answer most appropriate for yourself and then click the SUBMIT button below.

Do not spend too long on each answer and be as honest as possible.

First, please fill in the following details:

Place you are completing this questionnaire	
Identification code	
Identification number	
Your age	
Male or female	
How many sisters do you have?	
How many brothers do you have?	
Number of GCSE passes (grade C or above)	

In terms of 'A' levels or other qualifications please indicate the number you are taking of each subject

	not taking	one	two	three	four
Psychology					
English, Drama or literature based subject					
Maths, statistics etc.					
History, Geography or other humanities					
Business studies, Economics or financially based subject					
Biology, Chemistry, Physics or other pure science					
ICT, Computing or computer programming qualification					
French, German or other modern languages					
Art, Graphics, Photography or other art based subject					
Design, technical drawing or other technology related subject					
Health studies, dietician or other health related subject					
Other					

	yes	no
Do you have your own mobile phone with Internet access?		
Do you have a computer at home?		
If you have a computer is it in your bedroom or mainly yours?		
In the last month have you used a friend's computer?		

How often do you generally use a computer?

How many hours per week do you usually use a computer?

How often do you access the Internet?

How many hours per week do you usually use the Internet?

Indicate any or all of the things that you use regularly on the Internet

	yes	no
email		
computer games downloaded/played online		
chat rooms or message/discussion boards		
buying (shopping, downloading music, booking travel/entertainment etc.)		
information sources (sports, what's on, news, maps, travel information etc.)		
education (research for topic, courses available/online, online revision etc.)		

Rate the following uses of computers.

communication - eg. email, advertising, finding information etc.

neatness and presentation - eg. word processing, powerpoint etc.

entertainment - eg. computer games, music, animation, special effects etc.

convenience - eg,. online banking, shopping, spreadsheets for calculations etc.

calculation - eg. design software for building/manufacture/engineering etc.

reliability - eg. automated processes, traffic control, safety/reminder devices etc.

programmability - the user being able to define the computer's task by adapting, creating or using software for a specific customised purpose eg. website design, BASIC programming, SPSS syntax commands, spreadsheet formulae etc.

Record the option that best describes how you see computers?

They do as I command

They instruct me how, what and when to do things

They ask me to make choices

I think computers are …

Good

Bad

Good and bad

What percentage of the time do you think the user is in control of the computer?

What percentage of the time do you think the computer is in control?

Now, look at the pictures of the four computers, (A, B, C and D) below.

same choice of computer settings as for 10-11 year-old and 13-14 year-old questionnaires

Next, choose which of the four you would like to use most, second most, third most and least of all.

First choice computer to use

Second choice computer to use

Third choice computer to use

Last choice computer to use

Please choose ONE of the following six people that you think is a computer user

Emma	Someone's mum	Cynthia	Nathan	Someone's dad	Bob

I think the computer user is …

Considering your experiences at school indicate how true you think each of the following statements is as applied to yourself

same education LOC statements as in 13-14 year-olds' questionnaire

Click on the position between the two extremes you think most represents the way you feel generally whilst using a computer.

same semantic differential choices as in 13-14 year-olds' questionnaire

Considering your experiences using a computer indicate how true you think each of the following statements is as applied to yourself

same computing LOC statements as in 13-14 year-olds' questionnaire

Look at the following statements and decide how much you agree or disagree with them

	strongly agree	agree	disagree	strongly disagree
It's traditional to think of a certain person being keen on computers				
Computer enthusiasts are born not made				
Men are more likely to be keen on computers than women are				
Being a computer enthusiast is unlikely to alter in a person's lifetime				
Computer enthusiasts tend to be younger rather than older				
If made to use a computer it is generally worthwhile				

Please select submit **to send your questionnaire or** reset **to clear the form and begin again.**

Thank you very much for your answers and your help.

University of Leicester School of Psychology

This questionnaire is anonymous and answers will be treated confidentially.

No email returns (unless requested by you in the comments section) will result.

Welcome to

undergraduates aged less than 25

Please answer all questions by clicking on the answer most appropriate for yourself and then click the SUBMIT button below.

Do not spend too long on each answer and be as honest as possible.

First, please fill in the following details:

Place you are completing this questionnaire	
Identification code	
Identification number	
Your age	
Male or female	
How many sisters do you have?	
How many brothers do you have?	
Number of GCSE passes (grade C or above)	

In terms of 'A' levels or other qualifications please indicate the number you are have of each subject

	none	one	two	three	four
Psychology					
English, Drama or literature based subject					
Maths, statistics etc.					
History, Geography or other humanities					
Business studies, Economics or financially based subject					
Biology, Chemistry, Physics or other pure science					
ICT, Computing or computer programming qualification					
French, German or other modern languages					
Art, Graphics, Photography or other art based subject					
Design, CAD or any technology related subject					
Health studies, dietician or other health related subject					
Other					

What was your total UCAS 'A' level score?

Use the scoring system of A-grade counts for 10, B for 8, C for 6, D for 4 and an E for 2.

Rate the following uses of computers.

communication - eg. email, advertising, finding information etc.

neatness and presentation - eg. word processing, powerpoint etc.

entertainment - eg. computer games, music, animation, special effects etc.

convenience - eg,. online banking, shopping, spreadsheets for calculations etc.

calculation - eg. design software for building/manufacture/engineering etc.

reliability - eg. automated processes, traffic control, safety/reminder devices etc.

programmability - the user being able to define the computer's task by adapting, creating or using software for a specific customised purpose eg. website design, BASIC programming, SPSS syntax commands, spreadsheet formulae etc.

Record the option that best describes how you see computers?

They do as I command

They instruct me how, what and when to do things

They ask me to make choices

I think computers are …

Good

Bad

Good and bad

What percentage of the time do you think the user is in control of the computer?

What percentage of the time do you think the computer is in control?

Now, look at the pictures of the four computers, (A, B, C and D) below.

same choice of computer settings as for 10-11 year-old and 13-14 year-old questionnaires

Next, choose which of the four you would like to use most, second most, third most and least of all.

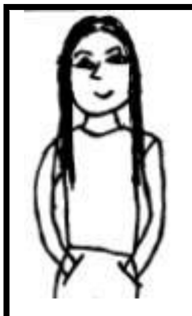
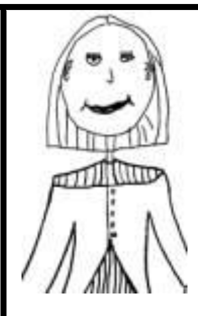
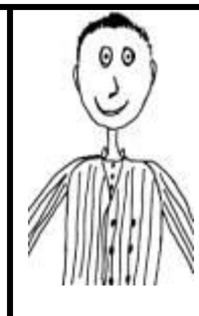
First choice computer to use

Second choice computer to use

Third choice computer to use

Last choice computer to use

Please choose ONE of the following six people that you think is a computer user

					
Emma	**Someone's mum**	**Cynthia**	**Nathan**	**Someone's dad**	**Bob**

I think the computer user is …

Considering your experiences at university indicate how true you think each of the following statements is as applied to yourself

I don't have the brains to do very well at university.

I have trouble working hard at university.

I can't stop myself from doing poorly at university.

I'm pretty lucky when it comes to getting good marks.

I can't get good marks, no matter what I do.

I think I'm pretty clever at university.

I'm just not able to get on with those teaching me.

I can't do well at university, even if I want to.

If I want to do well on my university work, I just need to try harder.

When I'm at university, I can work hard.

I don't know how to keep myself from getting bad

marks.	
If I'm not clever at a university subject, I won't do well at it.	
I am unlucky when it comes to university work.	
If I get good marks it's because of good luck.	
If I get bad marks, it's because I don't get along with those teaching me.	
If I decide to learn something hard, I can.	
When I do well at university, I can usually figure out why.	
If I get bad marks, it's because I don't try hard enough.	
I have to be clever to get good marks at university.	
I am able to get those teaching me to like me.	
I can do well in university if I want to.	
If I want to get good marks in a subject, I have to get along with those teaching me.	
If I don't get good marks, it's because of bad luck.	
I can get good marks in university.	

Click on the position between the two extremes you think most represents the way you feel generally whilst using a computer.

same semantic differential choices as in 13-14 year-olds' questionnaire

Considering your experiences using a computer indicate how true you think each of the following statements is as applied to yourself

same computing LOC statements as in 13-14 year-olds' questionnaire

Look at the following statements and decide how much you agree or disagree with them

	strongly agree	agree	disagree	strongly disagree
It's traditional to think of a certain person being keen on computers	○	○	○	○
Computer enthusiasts are born not made	○	○	○	○
Men are more likely to be keen on computers than women are	○	○	○	○
Being a computer enthusiast is unlikely to alter in a person's lifetime	○	○	○	○
Computer enthusiasts tend to be younger rather than older	○	○	○	○
Using a computer can make you feel alienated towards it	○	○	○	○
Using a computer can make you feel depressed	○	○	○	○
If made to use a computer it is generally worthwhile	○	○	○	○

Please select submit **to send your questionnaire or** reset **to clear the form and begin again.**

THE END

Thank you very much for your answers and your help.

If you wish to email any comments about this questionnaire then please click here

University of Leicester School of Psychology

This questionnaire is anonymous and answers will be treated confidentially.

No email details are collected and no returns (unless requested by you in the comments section) will result.

Welcome

to those aged over 21

Please answer all questions by clicking on the answer most appropriate for yourself and then click the SUBMIT button below.

Do not spend too long on each answer and be as honest as possible.

First, please fill in the following details:

Place you are completing this questionnaire	
Identification code	
Identification number	
Your age	
Male or female	
Highest Educational or Professional Qualification held	
What best describes your employment background?	

	yes	**no**
Do you have your own mobile phone with Internet access?		
Do you have a computer in your home?		
If you have a computer is it mainly yours?		

How often do you generally use a computer?	
How many hours per week do you usually use a computer?	
How often do you access the Internet?	
How many hours per week do you usually use the Internet?	

Indicate any or all of the things that you use regularly on the Internet

	yes	no
email		
computer games downloaded/played online		
chat rooms or message/discussion boards		
buying (shopping, downloading music, booking travel/entertainment etc.)		
information sources (sports, what's on, news, maps, travel information etc.)		
education (research for topic, courses available/online, online revision etc.)		

Rate the following uses of computers.

communication - eg. email, advertising, finding information etc.

neatness and presentation - eg. word processing, powerpoint etc.

entertainment - eg. computer games, music, animation, special effects etc.

convenience - eg,. online banking, shopping, spreadsheets for calculations etc.

calculation - eg. design software for building/manufacture/engineering etc.

reliability - eg. automated processes, traffic control, safety/reminder devices etc.

programmability - the user being able to define the computer's task by adapting, creating or using software for a specific customised purpose eg. website design, BASIC programming, SPSS syntax commands, spreadsheet formulae etc.

Record the option that best describes how you see computers?

They do as I command

They instruct me how, what and when to do things

They ask me to make choices

I think computers are …

Good

Bad

Good and bad

What percentage of the time do you think the user is in control of the computer?

What percentage of the time do you think the computer is in control?

Now, look at the pictures of the four computers, (A, B, C and D) below.

same choice of computer settings as for 10-11 year-old and 13-14 year-old questionnaires

Next, choose which of the four you would like to use most, second most, third most and least of all.

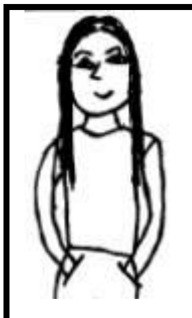
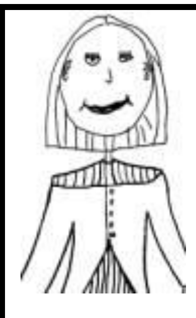
First choice computer to use

Second choice computer to use

Third choice computer to use

Last choice computer to use

Please choose ONE of the following six people that you think is a computer user

					
Emma	**Someone's mum**	**Cynthia**	**Nathan**	**Someone's dad**	**Bob**

I think the computer user is …

Considering your experiences in life indicate how true you think each of the following statements is as applied to yourself

I don't have the brains to do very well at work.

I have trouble putting effort in at work.

I can't stop myself from doing poorly at work.

I'm pretty lucky when it comes to getting on at work.

I can't succeed any better at work, no matter what I do.

I think I'm pretty clever at work.

I'm just not able to get on with my boss or those employing me.

I can't succeed well at work, even if I want to.

If I want to do succeed more at work, I just need to try harder.

When I'm at work, I can put the effort in.

I don't know how to keep myself from doing badly at work.

If I'm not clever at work, I won't do well.

I am unlucky when it comes to work.

If I do well at work it's because of good luck.

If I don’t succeed at something it’s because I don’t get on with those telling me to do it.

If I decide to learn something hard, I can.

When I do well at work, I can usually figure out why.	
If I don't succeed at work, it's because I don't try hard enough.	
I have to be clever to get on at work.	
I am able to get my boss or those employing me to like me.	
I can do well at work if I want to.	
If I want to succeed at something, I have to get along with those telling me to do it.	
If I don't do well at work, it's because of bad luck.	
I can be successful at work.	

Click on the position between the two extremes you think most represents the way you feel generally whilst using a computer.

same semantic differential choices as in 13-14 year-olds' questionnaire

Considering your experiences using a computer indicate how true you think each of the following statements is as applied to yourself

same computing LOC statements as in 13-14 year-olds' questionnaire

Finally, look at the following statements and decide how much you agree or disagree with them

	strongly agree	**agree**	**disagree**	**strongly disagree**
It's traditional to think of a certain person being keen on computers				
Computer enthusiasts are born not made				
Men are more likely to be keen on computers than women are				
Being a computer enthusiast is unlikely to alter in a person's lifetime				

Computer enthusiasts tend to be younger rather than older	○	○	○	○
If made to use a computer it is generally worthwhile	○	○	○	○

Please select submit **to send your questionnaire or** reset **to clear the form and begin again.**

THE END

Thank you very much for your answers and your help.

If you wish to email any comments about this questionnaire then please click here

Appendix B-2

Educational Attainment Data for each Age Group

Number of GCSE's being taken† or obtained

	Mean (*SD*)			Mean (*SD*)	
	men	women	*t*-test *p*	all	*N*
13-14 year-olds†	8.45 (3.09)	8.79 (2.41)	0.65	8.61 (2.78)	61
16-18 year-olds	7.52 (3.58)	8.70 (3.28)	0.08	8.15 (3.46)	107
Undergraduates	9.88 (1.31)	9.92 (1.69)	0.88	9.92 (1.64)	212

Total Number of 'A' levels being taken† or obtained

	Mean (*SD*)			Mean (*SD*)	
	men	women	*t*-test *p*	all	*N*
16-18 year-olds†	2.86 (1.32)	2.91 (1.38)	0.84	2.89 (1.35)	105
Undergraduates	3.67 (1.02)	3.58 (0.93)	0.62	3.59 (0.95)	184

Undergraduates' university entrance qualifications

	Mean (*SD*)			Mean (*SD*)	
	men	women	*t*-test *p*	all	*N*
UCAS points§	28.36 (4.70)	27.81 (5.66)	0.60	27.89 (5.51)	208

§ UCAS points calculated as grade A at 'A' level equivalent to 10 points; grade B, 8 points; grade C, 6 points; grade D, 4 points; grade E, 2 points

Adult Highest level of Qualification

	Proportion (%) of participants				
	men	women	all	*p* for χ^2	*N*
no exams passed	2.9	1.9	2.3	1.0	2
a few GCSE/'O' level passes	5.9	7.5	6.9	0.41	6
several GCSE/'O' level passes	17.6	20.8	19.5	0.23	17
'A' level passes	8.8	13.2	11.5	0.21	10
Degree/HND or equivalent	35.3	28.3	31.0	0.56	27
Higher degree or professional qualification	29.4	28.3	28.7	0.32	25

Generation of category for all participants to be relatively above or below average in terms of educational attainment for their age group

Age group	Criterion for categorisation as below average	*N* (%) below average	*N* (%) average or above average	Mann-Whitney tests for difference in gender *z*	*p*
10-11 year-olds	n/a	-	-	-	
13-14 year-olds	Taking < 9 GCSE's	27 (44.3)	34 (55.7)	-0.2	0.84
16-18 year-olds	Having < 9 GCSE's	48 (44.9)	59 (55.1)	-0.6	0.54
Undergraduates	Having < 28 UCAS points	92 (44.2)	116 (55.8)	-0.5	0.59
Adults aged 21-25	Highest qualification = good GCSE's	6 (54.5)	5 (45.5)	1.5	0.25
Adults aged 26-35	Highest qualification = 'A' levels	12 (48.0)	13 (52.0)	-1.4	0.15
Adults aged 36-45	Highest qualification = first degree	11 (52.4)	10 (47.6)	-1.5	0.13
Adults aged 46-55	Highest qualification = first degree	11 (52.4)	10 (47.6)	0.5	0.54
Adults aged 56-65	Highest qualification = good GCSE's	4 (50.0)	4 (50.0)	-0.7	0.50
Adults aged 65 +	n/a	-	-	-	

Appendix B-3

Coding strategies and results in terms of science vs. non-science subject choices

10-11 year-old age group Favourite Subject

		Proportions (%) of participants		
Drop-down menu choice	Coding	boys	girls	all
Art	Non-science	17.6	34.8	26.2
Computing	Science	13.2	2.2	7.7
Design Technology	Science	5.5	9.8	7.7
English	Non-science	-	1.1	0.5
French	Neutral	-	3.3	1.6
History	Neutral	11.0	2.2	6.6
Maths	Science	7.7	5.5	6.6
Music	Neutral	3.3	10.9	7.1
PE	Neutral	35.2	22.8	29.0
Science	Science	4.4	6.5	5.5

13-14 year-old age group GCSE Choices

Drop-down menu choice	Coding
English, Drama or literature based subject	Non-science
Maths, statistics etc.	Science
History, Geography or other humanities	Neutral
Business studies, Economics or financially based subject	Neutral
Biology, Chemistry, Physics, General Science or other pure science	Science
ICT, Computing, Systems & Control or computer programming qualification	Science
French, German or other modern languages	Neutral
Art, Graphics, Photography, Music or other art based subject	Non-science
Design, Technical Drawing, Resistant Materials or other technology related subject	Science
Other	Neutral

Results of 13-14 year-olds: Number of science/neutral/non-science GCSE's

	Mean (*SD*)			Mean (*SD*)	
	men	women	*t*-test *p*	all	*N*
Science GCSE's	4.58 (1.71)	4.32 (1.81)	0.58	4.46 (1.75)	105
Neutral GCSE's	2.09 (1.26)	2.00 (1.12)	0.77	2.05 (1.19)	105
Non-science GCSE's	1.79 (1.14)	2.46 (1.14)	0.02	2.10 (1.18)	105

16-18 year old and undergraduate groups 'A' level Choices

Drop-down menu choice	Coding
Psychology	Neutral
English, Drama or literature based subject	Non-science
Maths, statistics etc.	Science
History, Geography or other humanities	Neutral
Business studies, Economics or financially based subject	Neutral
Biology, Chemistry, Physics or other pure science	Science
ICT, Computing or computer programming qualification	Science
French, German or other modern languages	Neutral
Art, Graphics, Photography or other art based subject	Non-science
Design, technical drawing or other technology related subject	Science
Health studies, dietician or other health related subject	Neutral
Other	Neutral

16-18 year-olds and Undergraduates: Number of science/neutral/non-science 'A' levels

	Mean (*SD*) men	Mean (*SD*) women	*t*-test *p*	Mean (*SD*) all	*N*
16-18 year olds					
Science 'A' levels	2.12 (1.25)	0.93 (0.95)	< 0.001	1.49 (1.25)	105
Neutral 'A' levels	0.65 (0.95)	1.39 (1.12)	< 0.001	1.05 (1.10)	105
Non-science 'A' levels	0.08 (0.28)	0.59 (0.73)	< 0.001	0.35 (0.62)	105
Undergraduates					
Science 'A' levels	1.33 (0.96)	0.97 (1.00)	0.06	1.03 (1.00)	184
Neutral 'A' levels	1.67 (0.82)	1.86 (0.89)	0.25	1.83 (0.88)	184
Non-science 'A' levels	0.67 (0.82)	0.75 (0.74)	0.57	0.73 (0.75)	184

Proportions of participants who favour science, neutral or non-science subjects

		10-11 year-olds		13-14 year-olds		16-18 year-olds		under-graduates	
science		27.8		8.0		59.0		42.9	
neutral		45.0		26.7		30.5		26.6	
non-science		27.2		65.3		10.5		30.4	
		m	f	m	f	m	f	m	f
science		31.5	24.2	2.3	15.6	83.7	37.5	48.5	41.7
neutral		50.6	39.6	30.2	21.9	16.3	42.9	36.4	24.5
non-science		18.0	36.3	67.4	62.5	0.0	19.6	15.2	33.8
χ^2 for gender	χ^2	7.60		4.61		25.10		4.81	
	Φ	0.21		0.25		0.49		0.16	
	p	< 0.05		0.10		< 0.001		0.09	

Adult age group occupations

	Proportions (%) of participants		
Drop-down menu choice	men	women	all
Administration	12.1	15.4	14.1
Agriculture or animal husbandry	-	-	-
Art, craft or design	-	1.9	1.2
Building and construction	-	1.9	1.2
Caring for others	-	1.9	1.2
Catering or food	3.0	1.9	2.4
Education – student	3.0	5.8	4.7
Education - teacher, lecturer, librarian	9.1	25.0	18.8
Engineering or technical design	3.0	-	1.2
Entertainment	6.1	1.9	3.5
Fashion or beauty	3.0	-	1.2
Finance or insurance	6.1	7.7	7.1
Hotel, retail, commerce or trade	3.0	-	1.2
ICT or computing in any form	18.2	3.8	9.4
Law or legal profession	3.0	1.9	2.4
Management	6.1	3.8	4.7
Manufacturing	3.0	1.9	2.4
Marketing/advertising	-	-	-
Medical or health care	-	11.5	7.1
Politics	-	-	-
Public Services	12.1	1.9	5.9
The Services - fire, police, army etc	-	-	-
Transport - driving, maintenance or management	-	1.9	1.2
None of the above	9.1	9.6	9.4

Appendix B-4

Computer Use

Proportions of participants who have access to a computer at home

	10-11 year-olds		13-14 year-olds		16-18 year-olds		under-graduates		adults	
has pc at home	85.2		93.3		100.0		100.0		94.3	
	m	f	m	f	m	f	m	f	m	f
has pc at home	80.2	90.2	93.0	93.8	100	100	100	100	100	90.6
p value of χ^2 for gender	< 0.05		0.64		1.00		1.00		0.08	

Proportions of participants who have access to their own computer`

	10-11 year-olds		13-14 year-olds		16-18 year-olds		under-graduates		adults	
has own pc	35.2		52.0		57.4		82.6		70.6	
	m	f	m	f	m	f	m	f	m	f
has own pc	32.2	38.2	55.8	46.9	68.0	48.3	85.3	82.2	94.1	54.9
p value of χ^2 for gender	0.25		0.30		< 0.05		0.43		<0.001	
N	90	89	41	32	50	58	34	184	34	51

Proportions of participants who have a mobile phone with internet access

	13-14 year-olds		16-18 year-olds		under-graduates		adults	
has internet on phone	61.3		74.1		74.8		55.2	
	m	f	m	f	m	f	m	f
has own pc	58.1	65.6	68.0	79.3	79.4	73.9	50.0	58.5
p value of χ^2 for gender	0.51		0.18		0.50		0.44	
N	43	34	50	58	34	184	34	53

Proportion of participants (%) with each frequency of use of a computer

	13-14 year-olds	16-18 year-olds	under-graduates	adults
once a month	2.7	0.0	0.0	0.0
once a week	4.0	4.6	0.5	0.0
2-3 times a week	10.7	9.3	3.2	8.1
most days	33.3	19.4	19.2	22.1
every day	17.3	18.5	12.3	5.8
twice a day	8.0	13.9	18.3	4.7
over twice a day	24.0	34.3	46.6	59.3

Proportion of participants (%) with each frequency of use of a computer by gender

	13-14 year-olds		16-18 year-olds		under-graduates		adults	
	m	f	m	f	m	f	m	f
once a month	2.3	3.1	2.0	6.9	-	-	-	-
once a week	4.7	3.1	4.0	13.8	-	0.5	-	-
2-3 times a week	4.7	18.8	18.0	20.7	2.9	3.2	5.9	9.6
most days	34.9	31.3	12.0	24.1	8.8	21.1	20.6	23.1
every day	14.0	21.9	16.0	12.1	2.9	14.1	-	9.6
twice a day	9.3	6.3	48.0	22.4	14.7	18.9	5.9	3.8
over twice a day	30.2	15.6	2.0	6.9	70.6	42.2	67.6	53.8
Median value	every day	most days	twice a day	every day	over twice a day	twice a day	over twice a day	over twice a day
p value from one-way ANOVA gender main effect	0.14		< 0.01		< 0.05		0.24	

Proportion of participants (%) declaring each level of number of hours of computer use

	13-14 year-olds	16-18 year-olds	under-graduates	adults
< 1 hour/week	13.3	1.9	0.5	-
1-5 hours/week	28.0	17.8	14.2	15.1
5-10 hours/week	20.0	21.5	22.4	15.1
10-15 hours/week	12.0	17.8	21.0	5.8
15-25 hours/week	8.0	13.1	16.9	15.1
25-40 hours/week	8.0	7.5	18.3	29.1
> 40 hours/week	10.7	20.6	6.8	19.8

Proportion of participants (%) and level of computer use by gender

	13-14 year-olds		16-18 year-olds		under-graduates		adults	
	m	f	m	f	m	f	m	f
< 1 hour/week	9.3	18.8	-	3.5	-	0.5	-	-
1-5 hours/week	18.6	40.6	14.0	21.1	8.8	15.1	14.7	15.4
5-10 hours/week	23.3	15.6	10.0	31.6	26.5	21.6	11.8	17.3
10-15 hours/week	16.3	6.3	16.0	19.3	5.9	23.8	2.9	7.7
15-25 hours/week	7.0	9.4	18.0	8.8	11.8	17.8	11.8	17.3
25-40 hours/week	9.3	6.3	10.0	5.3	29.4	16.2	23.5	32.7
> 40 hours/week	16.3	3.1	32.0	10.5	17.6	4.9	35.3	9.6
Median value	5-10 hours/ week	1-5 hours/ week	15-25 hours/ week	5-10 hours/ week	15-25 hours/ week	10-15 hours/ week	25-40 hours/ week	15-25 hours/ week
p value from one-way ANOVA gender main effect	< 0.05		< 0.001		< 0.05		0.12	

Responses to following section of questionnaires:

Indicate any or all of the things that you use regularly on the Internet

	yes	no
email	○	○
computer games downloaded/played online	○	○
chat rooms or message/discussion boards	○	○
buying (shopping, downloading music, booking travel/entertainment etc.)	○	○
information sources (sports, what's on, news, maps, travel information etc.)	○	○
education (research for topic, courses available/online, online revision etc.)		

Uses of computers: proportions based on gender and overall of making use of various computer functions

	Proportion (%) of participants			p value of χ^2 for gender
	all	male	female	
uses email	95.4	91.6	97.2	< 0.01
plays games	36.5	52.9	28.3	< 0.001
chats online	50.5	56.8	47.5	0.06
buys online	63.2	64.6	62.6	0.67
sources info online	80.5	84.5	78.6	0.13
uses www for education	86.7	77.1	91.4	< 0.001

Uses of computers: proportions for each age group making use of various functions

	13-14 year-olds	16-18 year-olds	under-graduates	adults	p value of χ^2 for age group
uses email	83.3	92.3	100.0	97.7	< 0.001
plays games	80.8	58.3	19.0	14.5	< 0.001
chats online	55.6	57.7	56.8	20.7	< 0.001
buys online	39.7	55.8	70.2	75.0	< 0.001
sources info online	71.8	70.8	84.7	89.4	< 0.01
uses www for education	70.8	78.5	98.6	80.2	< 0.001

Uses of computers: proportions for each age group and gender making use of various functions

	13-14 year-olds		p value of χ^2 for gender	16-18 year-olds		p value of χ^2 for gender
	boys	girls		men	women	
uses email	77.5	90.6	0.14	91.3	93.1	0.73
plays games	90.2	68.8	< 0.05	66.0	51.8	0.15
chats online	56.1	54.8	0.92	68.1	49.1	0.05
buys online	45.2	32.3	0.27	61.2	50.9	0.29
sources info online	85.0	54.8	< 0.01	75.0	67.2	0.25
uses www for education	67.5	75.0	0.49	75.5	81.0	0.45

Uses of computers: proportions for each age group and gender making use of various functions

	undergraduates		p value of χ^2 for gender	adults		p value of χ^2 for gender
	men	women		men	women	
uses email	100.0	100.0	1.00	100.0	99.2	0.25
plays games	26.5	17.6	0.23	15.2	14.0	0.89
chats online	67.6	54.7	0.17	30.3	14.3	0.08
buys online	73.5	69.6	0.65	84.8	68.6	0.10
sources info online	91.2	83.4	0.25	90.9	88.5	0.72
uses www for education	100.0	98.4	0.45	67.6	88.5	0.02†

† entire adult sample- treating adult sample without those engaged in education (teachers/students) gave a p value of 0.11

Responses to following section of questionnaires:

Rate the following uses of computers.

communication - e.g. email, advertising, finding information etc.

neatness and presentation - e.g. word processing, powerpoint etc

entertainment - e.g. computer games, music, animation, special effects etc.

convenience - e.g. online banking, shopping, spreadsheets for calculations etc.

calculation - e.g. design software for building/manufacture/engineering etc.

reliability - e.g. automated processes, traffic control, safety/reminder devices etc.

programmability - the user being able to define the computer's task by adapting, creating or using software for a specific customised purpose e.g. website design, BASIC programming, SPSS syntax commands, spreadsheet formulae etc.

Responses available from drop-down menu (value ascribed to that response):

the most important use of all (1), extremely important use (2), very important use (3), fairly important use (4), occasionally important use (5), rarely important use (6), least important use of all (7)

Ratings of various uses of computers in terms of usefulness: mean value of responses on a 7-point Likert scale based on gender and overall

	Median	Mode	Mean Rating (*SD*)			*p* value from 1-way ANOVA's for effect of sex
	all	all	all	male	female	
communication	2	2	2.35 (1.21)	2.60 (1.39)	2.22 (1.09)	0.18
neatness	3	2	2.80 (1.28)	3.00 (1.43)	2.70 (1.19)	0.13
entertainment	4	4	4.14 (1.62)	3.68 (1.70)	4.37 (1.53)	< 0.01
convenience	4	4	3.83 (1.51)	3.74 (1.57)	3.87 (1.48)	< 0.05
calculation	4	3	4.32 (1.76)	4.18 (1.79)	4.38 (1.74)	0.10
reliability	4	4	3.99 (1.75)	3.76 (1.71)	4.10 (1.76)	< 0.05
programmability	4	3	3.90 (1.69)	3.80 (1.80)	3.95 (1.64)	< 0.05

Ratings of various uses of computers: mean value of responses on a 7-point Likert scale based on age group

	13-14 year-olds	16-18 year-olds	under-graduates	adults	*p* value from 1-way ANOVA's for effect of age
communication	3.14 (1.50)	2.71 (1.43)	2.05 (0.89)	2.00 (0.89)	< 0.001
neatness	3.03 (1.57)	3.08 (1.45)	2.64 (1.12)	2.68 (1.08)	0.12
entertainment	3.23 (1.94)	3.81 (1.60)	4.22 (1.31)	5.08 (1.53)	< 0.001
convenience	4.42 (1.94)	4.22 (1.49)	3.64 (1.30)	3.34 (1.38)	< 0.001
calculation	4.15 (1.92)	4.55 (1.63)	4.26 (1.65)	4.31 (2.02)	0.60
reliability	3.94 (1.83)	3.98 (1.73)	4.08 (1.69)	3.83 (1.86)	0.52
programmability	3.88 (1.88)	4.20 (1.72)	3.62 (1.44)	4.27 (1.98)	0.24

Ratings of various uses of computers: mean value of responses on a 7-point Likert scale for each age group and gender

	13-14 year-olds		*p* value of t-test for gender	16-18 year-olds		*p* value of t-test for gender
	boys	girls		men	women	
communication	3.32 (1.59)	2.90 (1.37)	0.25	2.67 (1.49)	2.74 (1.38)	0.82
neatness	3.15 (1.66)	2.87 (1.46)	0.46	3.02 (1.53)	3.14 (1.38)	0.67
entertainment	3.13 (1.96)	3.35 (1.92)	0.62	3.47 (1.56)	4.11 (1.59)	< 0.05
convenience	4.15 (1.93)	4.77 (1.93)	0.18	3.94 (1.49)	4.46 (1.46)	0.08
calculation	3.83 (2.00)	4.58 (1.75)	0.10	4.39 (1.62)	4.68 (1.65)	0.35
reliability	3.73 (1.63)	4.23 (2.04)	0.26	3.80 (1.70)	4.14 (1.76)	0.31
programmability	3.51 (1.68)	4.37 (2.03)	0.06	3.71 (1.81)	4.61 (1.53)	< 0.01

Ratings of various uses of computers: mean value of responses on a 7-point Likert scale for each age group and gender

	undergraduates		*p* value of t-test for gender	adults		*p* value of t-test for gender
	men	women		men	women	
communication	2.09 (0.93)	2.04 (0.88)	0.79	2.15 (0.96)	1.91 (0.84)	0.22
neatness	2.94 (1.41)	2.58 (1.06)	0.09	2.85 (0.96)	2.57 (1.15)	0.23
entertainment	3.50 (1.21)	4.36 (1.29)	< 0.001	4.79 (1.51)	5.26 (1.53)	0.17
convenience	3.47 (1.42)	3.68 (1.27)	0.40	3.24 (1.18)	3.42 (1.50)	0.56
calculation	4.35 (1.69)	4.24 (1.65)	0.73	4.15 (1.89)	4.42 (2.13)	0.55
reliability	4.18 (1.70)	4.06 (1.69)	0.71	3.35 (1.79)	4.13 (1.85)	0.06
programmability	4.06 (1.69)	3.54 (1.38)	< 0.05	4.00 (2.03)	4.44 (1.95)	0.32

Appendix B-5

Locus of Control

Simple LOC measure: proportions based on gender for various LOC

LOC		men	women	all	*N*
with user		58.6	49.4	52.8	348
shared		34.4	33.5	33.8	223
with computer		7.0	17.1	13.4	88
χ^2 for 2-way LOC of user vs. shared or with computer	$\chi^2(1)$	7.23	0.06	2.08	$\Sigma = 658$
	p	< 0.01	0.81	0.15	

Simple LOC measure: proportions for each age group for various LOC

LOC		10-11 year-olds		13-14 year-olds		16-18 year-olds		under-graduates		adults	
with user		25.7		60.6		62.9		58.1		77.0	
shared		69.8		26.8		17.1		22.1		14.9	
with computer		4.5		12.7		20.0		19.8		8.0	
χ^2 test for 2-way LOC of user vs. other	$\chi^2(1)$	1.75		0.45		3.83		5.00		6.33	
	p	0.12		0.33		< 0.05		< 0.05		< 0.05	
This Chapter's results		m	f	m	f	m	f	m	f	m	f
with user		30	21	64	56	73	54	76	55	91	68
shared		66	74	21	34	21	14	15	23	6	21
with computer		4	5	15	9	6	32	9	22	3	11
Chapter 3 results		m	f			m	f				
with user		20	12			77	60				
shared		65	80			16	24				
with computer		14	7			7	16				

Spearman correlations between simple LOC measure and %time that user or %time that computer is in control

	Correlation with simple LOC measure		
	all (*N* = 475)	male participants (*N* = 151)	female participants (*N* = 324)
% user is in control	-0.16**	-0.02	-0.23**
% computer is in control	0.15**	0.10	0.19**

*** indicates significant at p < 0.01 level*

Mean values (SD) for %time that user or %time that computer is in control

	all	male participants	female participants
% user is in control	73.5 (18.2)	72.1 (21.2)	74.2 (16.6)
% computer is in control	28.9 (22.6)	29.6 (24.3)	28.5 (21.7)

	t-test of gender difference
% user is in control	*t*(482) = -1.07, *p* = 0.29
% computer is in control	*t*(479) = 0.48, *p* = 0.63

	Mean (*SD*) values by age-group and gender							
	13-14 year-olds		16-18 year-olds		under-graduates		adults	
% user is in control	73.6		68.5		74.5		77.0	
% computer is in control	38.0		31.7		26.7		23.1	
	m	f	m	f	m	f	m	f
% user is in control	71.2	76.6	69.8	67.4	72.2	75.0	76.5	77.4
% computer is in control	35.9	40.6	29.8	33.3	30.3	26.1	21.1	24.4

	t-tests of gender difference (*all t- tests gave p* > 0.10			
% user is in control	*t*(71) = -1.02	*t*(105) = 0.58	*t*(215) = -0.97	*t*(85) = -0.25
% computer is in control	*t*(71) = -0.63	*t*(104) = -0.80	*t*(214) = 1.23	*t*(84) = -0.66

Considering your experiences at university indicate how true you think each of the following statements is as applied to yourself

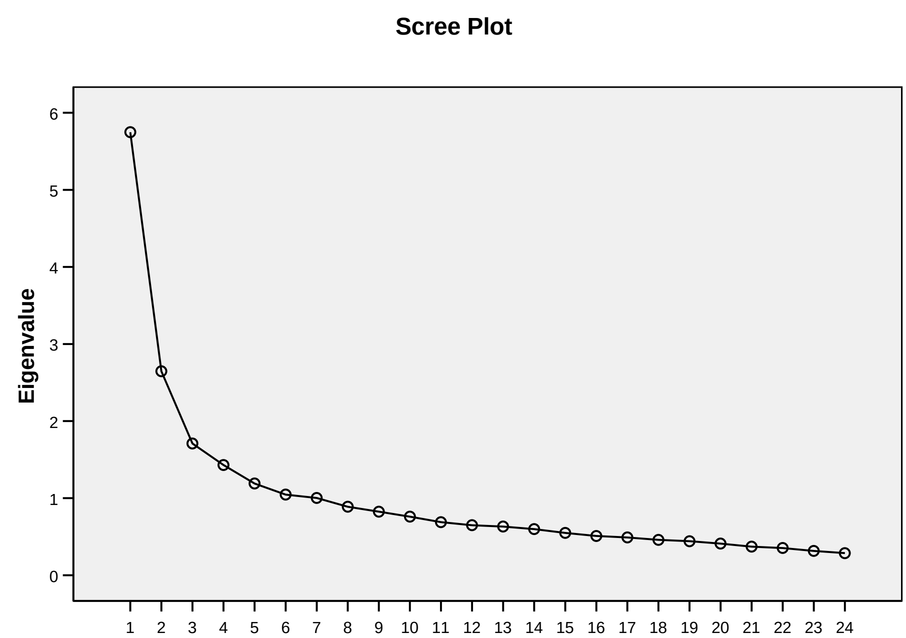
I don't have the brains to do very well at university.	very true for me
I have trouble working hard at university.	true for me
I can't stop myself from doing poorly at university.	not true for me
I'm pretty lucky when it comes to getting good marks.	not at all true for me
I can't get good marks, no matter what I do.	

More complex LOC scale derived from 24 questions (first 5 shown above) with 4-point Likert scale options (shown above) as response. A value of 4 was assigned for a response of 'very true for me' through to 1 for 'not at all true of me'. Two versions: one based on the Skinner, Zimmer-Gembeck & Connell (1998) control scale for life and then adapted to the specific domain of computing. Equivalent questions to reflect same areas of control: LOC (internal/external); strategy beliefs; capacity beliefs; belief around others; luck and ability.

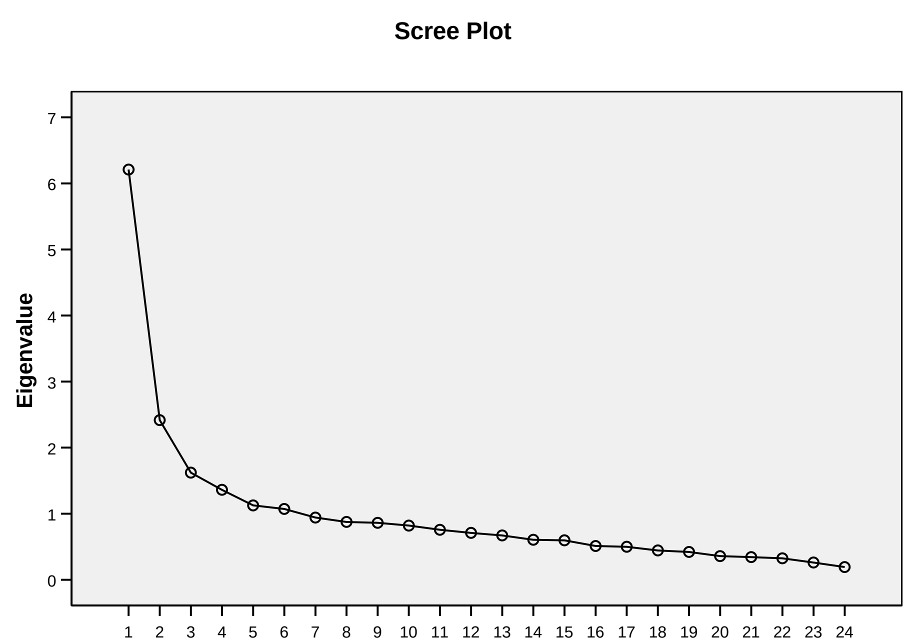
Summary of approach to Principal Components Analysis taken:

Factor analysis followed by inspection of the scree plot and Horn's parallel analysis against random generated eigenvalues for the same number of inputs to the scale and degrees of freedom. Subsequent reliability scale analyses to validate the sub-scales derived and used elsewhere for analysis.

Scree plots for work/education and computer LOC scales



Work/education LOC: Principal Component Analysis - Scree Plot indicating 4 major factors accounting for 48% of the variance



Computer LOC: Principal Component Analysis - Scree Plot indicating 4 major factors accounting for 48% of the variance

LOC scales derived from life scales - 48.1% variance accounted by 4 factors

Factor analysis of LOC life scale: Principal components analysis based on 75 participants from each age group to give sub-scales

Variable	Code from Skinner et al (1998)	Question on life LOC	-ve on Factor 1 / +ve on Factor 1	Factor 2	-ve on Factor 3 / +ve on Factor 3	-ve on Factor 4 / +ve on Factor 4
Q1life	ASYAN01	don't have the brains	.66			.32
Q2life	ASYEN03	trouble putting effort in	.68			
Q3life	ASCNN02	can't stop doing poorly	.64			
Q4life	ASYLP02	lucky			.30	.37
Q5life	ASCNN01	can't succeed, no matter	.53			.42
Q6life	ASYAP01	pretty clever	-.33	.44	.41	
Q7life	ASYON03	not able to get on with boss	.58			-.44
Q8life	ASCNN03	can't succeed, even if want to	.73			
Q9life	ASSEP02	succeed more, just need to try harder		.38	-.35	
Q10life	ASYEP01	when … can put the effort in	-.42	.32		
Q11life	ASSUN02	don't know how from doing badly	.66			
Q12life	ASSAN03	if not clever, won't do well	.45			-.40
Q13life	ASYLN01	unlucky	.71			
Q14life	ASSLP03	do well, good luck	.54			
Q15life	ASSON03	don’t succeed as don’t get on with others	.51		.53	
Q16life	ASCNP01	if decide to learn, I can	-.52	.54		
Q17life	ASSUP01	when do well, usually figure out why	-.46	.41	.33	
Q18life	ASSEN02	don't succeed, because don't try enough		.55	-.44	
Q19life	ASSAP01	have to be clever to get on		.34		-.36
Q20life	ASYOP01	can get my boss to like me	-.39	.50		.54
Q21life	ASCNP02	can do well if want to	-.40	.55		
Q22life	ASSOP03	to succeed, have to get along with others		.40	.46	
Q23life	ASSLN02	if don't do well, bad luck	.50		.32	
Q24life	ASCNP03	can be successful at work	-.39	.43		

LOC work/education Factors sub-scale			Variable name
External control factors (12 questions loading on +ve Factor 1)	Negative factors on personal LOC (excuses)	don't have the brains	Q1life
		trouble putting effort in	Q2life
		can't stop doing poorly	Q3life
		can't succeed, no matter	Q5life
		not able to get on with boss	Q7life
		can't succeed, even if want to	Q8life
		don't know how from doing badly	Q11life
		if not clever, won't do well	Q12life
		unlucky	Q13life
		do well, good luck	Q14life
		don't succeed as don't get on with others	Q15life
		if don't do well, bad luck	Q23life
Internal control factors (7 questions loading on -ve Factor 1)	Positive factors on personal LOC (self)	pretty clever	Q6life
		when … can put the effort in	Q10life
		if decide to learn, can	Q16life
		when do well, usually figure out why	Q17life
		can get boss to like me	Q20life
		can do well if want to	Q21life
		can be successful at work	Q24life
Potential to succeed (11 questions loading on Factor 2)	Belief in extra personal potential, strategies and effort available	pretty clever	Q6life
		succeed more, just need to try harder	Q9life
		when … can put the effort in	Q10life
		if decide to learn, I can	Q16life
		when do well, usually figure out why	Q17life
		don't succeed, because don't try enough	Q18life
		have to be clever to get on	Q19life
		can get my boss to like me	Q20life
		can do well if want to	Q21life
		to succeed, have to get along with others	Q22life
		can be successful at work	Q24life
Luck and others (6 questions loading on +ve Factor 3)	Belief in luck or others' influence on success	lucky	Q4life
		pretty clever	Q6life
		don't succeed as don't get on with others	Q15life
		when do well, usually figure out why	Q17life
		to succeed, have to get along with others	Q22life
		if don't do well, bad luck	Q23life
Motivation (2 questions loading on -ve Factor 3)	Belief in personal effort for success	succeed more, just need to try harder	Q9life
		don't succeed, because don't try enough	Q18life

Self-confidence (4 questions loading on +ve Factor 4)	Lack of self-belief and autonomy	don't have the brains lucky can't succeed, no matter can get my boss to like me	Q1life Q4life Q5life Q20life
Self-confidence (3 questions loading on -ve Factor 4)	Self-belief and autonomy	not able to get on with boss if not clever, won't do well have to be clever to get on	Q7life Q12life Q10life

Five factors of LOC for general (work) LOC:

Overall locus of control = ***Internal control - External control***

External control = (Q1life + Q2life + Q3life + Q5life + Q7life + Q8life + Q11life + Q12life + Q13life + Q14life + Q15life + Q23life) / 12

Internal control = (Q6life + Q10life + Q16life + Q17life + Q20life + Q21life + Q24life) / 7

Potential to succeed = (Q6life + Q9life + Q10life + Q16life + Q17life + Q18life + Q19life + Q20life + Q21life + Q22life + Q24life) / 11

Luck and others = (Q4life + Q6life + Q15life + Q17life + Q22life + Q23life) / 6

Motivation = 4 - ((Q9life + Q18life) / 2)

Self-confidence = (Q1life + Q4life + Q5life + Q20life) + ((4-Q7life) + (4-Q12life) + (4-Q19life)) / 7

LOC scales derived from computer scales - 48.4% variance accounted by 4 factors

Factor analysis of LOC life scale: Principal components analysis based on 75 participants from each age group to give sub-scales

Variable	Question on life LOC	-ve on Factor 1 +ve on Factor 1	Factor 2	-ve on Factor 3 +ve on Factor 3	-ve on Factor 4 +ve on Factor 4
Q1comp	not clever enough to use computers well	0.72			
Q2comp	trouble applying self to use computers	0.67		-0.36	
Q3comp	can't stop being useless with computers	0.77			
Q4comp	pretty lucky when using computers			0.68	
Q5comp	computer seems to work, no matter		0.55	0.38	
Q6comp	got the ability to be good at computing	-0.66			-0.30
Q7comp	ICT expert(s) and I don't get on	0.42		0.38	
Q8comp	can't get computer to work, even if want	0.63			-0.57
Q9comp	if want to be better, just try harder				
Q10comp	if computing, work hard and concentrate	-0.35	0.52		
Q11comp	don't know to stop them going wrong	0.49		-0.39	
Q12comp	not clever enough	0.64			0.31
Q13comp	unlucky	0.65			
Q14comp	if works, it's because of good luck	0.55			
Q15comp	if no good, because I don't get along with those teaching me	0.60		0.31	
Q16comp	if decided to learn computing, could	-0.54	0.40	-0.33	
Q17comp	if successful**,** can usually work out why	-0.54	0.31		-0.60
Q18comp	if can't get a computer to do what want, because don't try hard enough		0.48		
Q19comp	need to be clever to do what I want		0.42		0.44
Q20comp	able to get teachers of ICT to like me		0.54		
Q21comp	can be very good if I want to be	-0.57	0.37		
Q22comp	if want success, have to get along with teachers		0.48		

Q23comp	if computer not working, because of bad luck	0.56
Q24comp	can use a computer well	-0.64

LOC Computer Factors sub-scale			Variable name
External control factors (11 questions loading on +ve Factor 1)	Negative factors on personal LOC (excuses)	not clever enough to use computers well	Q1comp
		trouble applying self to use computers	Q2comp
		can't stop being useless with computers	Q3comp
		ICT expert(s) and I don't get on	Q7comp
		can't get computer to work, even if want	Q8comp
		don't know to stop them going wrong	Q11comp
		not clever enough	Q12comp
		unlucky	Q13comp
		if works, it's because of good luck	Q14comp
		if no good, because I don't get along with those teaching me	Q15comp
		if computer not working, because of bad luck	Q23comp
Internal control factors (6 questions loading on -ve Factor 1)	Positive factors on personal LOC (self)	got the ability to be good at computing	Q6comp
		if computing, work hard and concentrate	Q10comp
		if decided to learn computing, could	Q16comp
		if successful, can usually work out why	Q17comp
		can be very good if I want to be	Q21comp
		can use a computer well	Q24comp
Potential to succeed (9 questions loading on Factor 2)	Belief in extra personal potential, strategies and effort available	computer seems to work, no matter	Q5comp
		if computing, work hard and concentrate	Q10comp
		if decided to learn computing, could	Q16comp
		if successful, can usually work out why	Q17comp
		if can't get a computer to do what want, because don't try hard enough	Q18comp
		need to be clever to do what I want	Q19comp
		able to get teachers of ICT to like me	Q20comp
		can be very good if I want to be	Q21comp
		if want success, have to get along with teachers	Q22comp
Luck and others (4 questions loading on +ve Factor 3)	Belief in luck or others' influence on success	pretty lucky when using computers	Q4comp
		computer seems to work, no matter	Q5comp
		ICT expert(s) and I don't get on	Q7comp
		if I'm no good, it's because I don't get along with those teaching me	Q15comp
Motivation (2 questions loading on -ve Factor 3)	Belief in personal effort for success	trouble applying self to use computers	Q2comp
		don't know to stop them going wrong	Q11comp

Self-confidence (2 questions loading on +ve Factor 4)	Lack of self-belief	not clever enough need to be clever to do what I want	Q12comp Q14comp
Self-confidence (2 questions loading on -ve Factor 4)	Self-belief and autonomy	got the ability to be good at computing if successful, can usually work out why	Q6comp Q17comp

Five factors of LOC for computer LOC:

Overall locus of control = ***Internal control - External control***

External control = (Q1comp + Q2comp + Q3comp + Q7comp + Q8comp + Q11comp + Q12comp + Q13comp + Q14comp + Q15comp + Q23comp) / 11

Internal control = (Q6comp + Q10comp + Q16comp + Q17comp + Q21comp + Q24comp) / 6

Potential to succeed = (Q5comp + Q10comp + Q16comp + Q17comp + Q18comp + Q19comp + Q20comp + Q21comp + Q22comp) / 9

Luck and others = (Q4comp + Q5comp + Q7comp + Q15comp) / 4

Motivation = 4 – ((Q2comp + Q11comp) / 2)

Self-confidence = ((Q6comp + Q17comp) + ((4-Q12comp) + (4-Q14comp))) / 4

SPSS Syntax commands to generate LOC sub-scales

```
RELIABILITY
 /VARIABLES=Q1life Q2life Q3life Q5life Q7life Q8life Q11life Q12life
 Q13life Q14life Q15life Q23life
 /SCALE('ALL VARIABLES')  ALL/MODEL=ALPHA
 /STATISTICS=SCALE
 /SUMMARY=TOTAL .
RELIABILITY
 /VARIABLES=Q6life Q10life Q16life Q17life Q20life Q21life Q24life
 /SCALE('ALL VARIABLES')  ALL/MODEL=ALPHA
 /STATISTICS=SCALE
 /SUMMARY=TOTAL .
RELIABILITY
 /VARIABLES=Q6life Q9life Q10life Q16life Q17life Q18life Q19life Q20life
 Q21life Q22life Q24life
 /SCALE('ALL VARIABLES')  ALL/MODEL=ALPHA
 /STATISTICS=SCALE
 /SUMMARY=TOTAL .
RELIABILITY
 /VARIABLES=Q4life Q6life Q15life Q17life Q22life Q23life
 /SCALE('ALL VARIABLES')  ALL/MODEL=ALPHA
 /STATISTICS=SCALE
 /SUMMARY=TOTAL .
RELIABILITY
 /VARIABLES=Q9life Q18life
 /SCALE('ALL VARIABLES')  ALL/MODEL=ALPHA
 /STATISTICS=SCALE
 /SUMMARY=TOTAL .
RELIABILITY
 /VARIABLES=Q1life Q4life Q5life Q20life
 /SCALE('ALL VARIABLES')  ALL/MODEL=ALPHA
 /STATISTICS=SCALE
 /SUMMARY=TOTAL .
RELIABILITY
 /VARIABLES=Q7life Q12life Q19life
 /SCALE('ALL VARIABLES')  ALL/MODEL=ALPHA
 /STATISTICS=SCALE
 /SUMMARY=TOTAL .
RELIABILITY
 /VARIABLES=Q1comp Q2comp Q3comp Q7comp Q8comp Q11comp Q12comp
 Q13comp Q14comp Q15comp Q23comp
 /SCALE('ALL VARIABLES')  ALL/MODEL=ALPHA
 /STATISTICS=SCALE
 /SUMMARY=TOTAL .
RELIABILITY
 /VARIABLES=Q6comp Q10comp Q16comp Q17comp Q21comp Q24comp
 /SCALE('ALL VARIABLES')  ALL/MODEL=ALPHA
 /STATISTICS=SCALE
 /SUMMARY=TOTAL .
RELIABILITY
 /VARIABLES=Q5comp Q10comp Q16comp Q17comp Q18comp Q19comp Q20comp
 Q21comp Q22comp
 /SCALE('ALL VARIABLES')  ALL/MODEL=ALPHA
 /STATISTICS=SCALE
 /SUMMARY=TOTAL .
```

```
RELIABILITY
  /VARIABLES=Q4comp Q5comp Q7comp Q15comp
  /SCALE('ALL VARIABLES')  ALL/MODEL=ALPHA
  /STATISTICS=SCALE
  /SUMMARY=TOTAL .
RELIABILITY
  /VARIABLES=Q2comp Q11comp
  /SCALE('ALL VARIABLES')  ALL/MODEL=ALPHA
  /STATISTICS=SCALE
  /SUMMARY=TOTAL .
RELIABILITY
  /VARIABLES=Q12comp Q14comp
  /SCALE('ALL VARIABLES')  ALL/MODEL=ALPHA
  /STATISTICS=SCALE
  /SUMMARY=TOTAL .
RELIABILITY
  /VARIABLES=Q6comp Q17comp
  /SCALE('ALL VARIABLES')  ALL/MODEL=ALPHA
  /STATISTICS=SCALE
  /SUMMARY=TOTAL .
COMPUTE posloc = (Q1life + Q2life + Q3life + Q5life + Q7life + Q8life +
  Q11life  + Q12life  + Q13life + Q14life + Q15life + Q23life) / 12 .
EXECUTE .
COMPUTE negloc = (Q6life + Q10life + Q16life + Q17life + Q20life + Q21life +
  Q24life) / 7 .
EXECUTE .
COMPUTE potloc = (Q6life + Q9life + Q10life + Q16life + Q17life + Q18life +
  Q19life  + Q20life  + Q21life + Q22life + Q24life) / 11 .
EXECUTE .
COMPUTE luckloc = (Q4life + Q6life + Q15life + Q17life + Q22life + Q23life) / 6 .
EXECUTE .
COMPUTE motloc = 4 – ((Q9life + Q18life)) / 2 .
EXECUTE .
COMPUTE selfloc = ((Q1life + Q4life + Q5life + Q20life) + (4-Q7life + 4-Q12life +
  4-Q19life)) /7 .
EXECUTE .
COMPUTE overloc = 2 - posloc/2  +  negloc/2 .
EXECUTE .
COMPUTE cposloc = (Q1comp + Q2comp + Q3comp + Q7comp + Q8comp +
  Q11comp  + Q12comp  + Q13comp + Q14comp + Q15comp + Q23comp) / 11 .
EXECUTE .
COMPUTE cnegloc = (Q6comp + Q10comp + Q16comp + Q17comp + Q21comp +
  Q24comp) / 6 .
EXECUTE .
COMPUTE cpotloc = (Q5comp + Q10comp + Q16comp + Q17comp + Q18comp +
  Q19comp  + Q20comp  + Q21comp + Q22comp) / 9 .
EXECUTE .
COMPUTE cluckloc = (Q4comp + Q5comp + Q7comp + Q15comp) / 4 .
EXECUTE .
COMPUTE cmotloc = 4 – ((Q2comp + Q11comp)) / 2 .
EXECUTE .
COMPUTE cselfloc = ((Q6comp + Q17comp) + (4-Q12comp + 4-Q14comp)) / 4 .
EXECUTE .
COMPUTE coverloc = 2 - cposloc/2  +  cnegloc/2 .
EXECUTE .
```

Reliability Analyses of LOC scales

Cronbach's alpha for each sub-scale across all participants (beyond 75 used to generate the sub-scales) for LOC based around school/university/work

	all	13-14 year-olds	16-18 year-olds	under-graduates	adults	males	females
External LOC	0.84	0.87	0.84	0.82	0.86	0.87	0.82
Internal LOC	0.73	0.77	0.72	0.71	0.74	0.78	0.69
Potential belief	0.64	0.76	0.63	0.56	0.53	0.70	0.58
Luck belief	0.42	0.64	0.35	0.18	0.21	0.50	0.34
Motivation	0.57	0.53	0.43	0.59	0.45	0.63	0.51
Negative self confidence		0.44	0.00	0.09	0.20	0.32	0.01
Positive self confidence		0.36	0.40	0.16	0.28	0.35	0.25

Cronbach's alpha for each sub-scale across all participants (beyond 75 used to generate the sub-scales) for LOC based around computers

	all	13-14 year-olds	16-18 year-olds	under-graduates	adults	males	females
External LOC	0.87	0.87	0.87	0.87	0.84	0.86	0.86
Internal LOC	0.74	0.77	0.71	0.70	0.79	0.76	0.71
Potential belief	0.57	0.63	0.68	0.38	0.67	0.60	0.56
Luck belief	0.40	0.60	0.41	0.14	0.40	0.40	0.41
Motivation	0.66	0.59	0.61	0.71	0.60	0.58	0.68
Negative self confidence	0.54	0.55	0.50	0.59	0.34	0.40	0.61
Positive self confidence	0.53	0.53	0.57	0.52	0.40	0.55	0.50

Results of LOC scales

Mean values (SD) for each sub-scale across all participants – life LOC

	all	13-14 year-olds	16-18 year-olds	under-graduates	adults
Overall LOC	2.58 (0.36)	2.55 (0.41)	2.60 (0.39)	2.54 (0.32)	2.67 (0.33)
Potential belief	2.93 (0.33)	2.90 (0.49)	2.94 (0.32)	2.95 (0.26)	2.90 (0.26)
Luck belief	2.41 (0.35)	2.47 (0.54)	2.41 (0.34)	2.35 (0.26)	2.47 (0.27)
Motivation	1.07 (0.67)	1.26 (0.81)	0.96 (0.58)	0.87 (0.59)	1.44 (0.59)
Self-confidence	2.02 (0.28)	1.94 (0.41)	2.01 (0.28)	2.04 (0.20)	2.07 (0.26)

Mean values (SD) for each sub-scale across all participants – computer LOC

	all	13-14 year-olds	16-18 year-olds	under-graduates	adults
Overall LOC	2.56 (0.41)	2.53 (0.51)	2.64 (0.41)	2.48 (0.38)	2.64 (0.36)
Potential belief	2.66 (0.34)	2.70 (0.45)	2.60 (0.39)	2.67 (0.27)	2.70 (0.34)
Luck belief	2.14 (0.44)	2.32 (0.65)	2.08 (0.47)	2.15 (0.34)	2.05 (0.39)
Motivation	1.77 (0.70)	1.96 (0.75)	1.96 (0.65)	1.62 (0.70)	1.80 (0.65)
Self-confidence	2.50 (0.49)	2.48 (0.59)	2.63 (0.50)	2.40 (0.46)	2.62 (0.39)

Correlations for each LOC sub-scale across all participants – life vs. computer

	Life LOC				
Computer LOC	Overall LOC	Potential belief	Luck belief	Motivation	Self-confidence
Overall LOC	0.40**	0.27**	-0.07	-0.03	-0.03
Potential belief	0.13**	0.30**	0.14**	-0.17**	0.02
Luck belief	-0.26**	0.02	0.27**	-0.12**	0.00
Motivation	0.28**	0.11*	-0.10	0.02	0.00
Self-confidence	0.28**	0.20**	-0.06	-0.01	-0.09

Results of 2-way ANOVA's for gender and age-group on life and computer LOC sub-scales

	2-way ANOVA results						
		Main effect of gender		Main effect of age-group		Interaction between gender and age	
	n	F(1,n)	*p*	F(3,n)	*p*	F(3,n)	*p*
Life LOC							
Overall LOC	421	0.97	0.33	1.77	0.15	1.23	0.30
Potential belief	395	0.24	0.62	0.62	0.60	1.85	0.14
Luck belief	422	0.04	0.84	1.96	0.12	1.10	0.35
Motivation	452	0.01	0.91	13.91	< 0.001	0.47	0.71
Self-confidence	422	4.33	< 0.05	2.20	0.09	1.50	0.21
Computer LOC							
Overall LOC	460	4.98	< 0.05	2.68	< 0.05	0.41	0.75
Potential belief	424	2.14	0.15	1.65	0.18	4.23	< 0.01
Luck belief	461	1.84	0.18	5.30	< 0.01	1.95	0.12
Motivation	424	6.81	< 0.01	3.03	< 0.05	0.24	0.87
Self-confidence	457	6.75	< 0.01	4.69	< 0.01	0.34	0.80

Question by Question Responses for LOC questions in Work/Education and Computing Contexts

Question number	Proportion (%) of participants choosing each response										Paired t-test results
	Work/education context					Computing context					
	Mean value	not at all true	not true	true for me	very true	Mean value	not at all true	not true	true for me	very true	
1	1.71	41.1	49.5	6.6	2.8	1.77	36.1	53.4	7.9	2.6	-1.12
2	2.13	22.5	48.6	22.3	6.6	2.07	24.1	49.0	22.6	4.3	1.69
3	1.67	41.8	51.2	5.2	1.9	1.74	34.6	57.6	6.5	1.3	-1.67
4	2.56	7.0	37.6	47.4	8.0	2.47	11.3	38.1	43.5	7.1	2.03*
5	1.79	32.4	58.2	7.0	2.3	2.46	8.2	44.1	41.0	6.7	-14.00**
6	2.74	3.3	27.5	61.0	8.2	3.05	2.4	13.4	61.3	22.9	-8.08**
7	1.85	32.2	54.9	8.5	4.5	1.87	30.7	55.6	9.3	4.3	-1.26
8	1.69	39.9	53.5	4.5	2.1	1.74	36.7	54.4	7.3	1.5	-0.95
9	2.97	5.2	16.9	54.0	23.9	2.65	8.4	26.8	55.7	9.1	7.21**
10	3.03	2.3	14.3	61.5	21.8	2.81	3.7	25.4	57.2	13.7	5.00**
11	1.83	28.7	61.9	7.5	1.9	2.39	13.0	44.9	32.5	9.5	-10.57**
12	2.35	11.6	49.5	31.6	7.3	1.98	24.9	55.1	16.7	3.3	7.28**

table continued on next page

Question by Question Responses for LOC questions in Work/Education and Computing Contexts (continued)

Question number	Proportion (%) of participants choosing each response										Paired t-test results
	Work/education context					Computing context					
	Mean value	not at all true	not true	true for me	very true	Mean value	not at all true	not true	true for me	very true	
13	1.92	20.0	69.9	8.0	2.1	1.99	22.6	58.9	15.0	3.5	-1.38
14	2.01	19.3	63.3	14.1	3.3	1.97	21.5	60.7	16.7	1.1	1.24
15	1.90	27.8	57.6	11.3	3.3	1.76	34.7	56.0	7.6	1.7	2.74**
16	3.26	1.9	5.6	57.4	35.1	3.15	3.0	5.7	64.3	27.0	2.54*
17	3.03	1.9	11.3	68.7	18.1	2.92	3.3	17.7	62.9	16.2	2.38*
18	2.89	6.8	18.4	53.8	21.0	2.40	10.4	46.5	36.1	7.0	9.88**
19	2.61	5.0	36.8	50.9	7.3	2.22	12.4	57.2	26.0	4.4	8.04**
20	2.89	3.5	15.3	70.1	11.1	2.75	5.9	21.8	64.0	8.3	4.42**
21	3.25	2.8	5.2	55.7	36.3	3.08	2.6	10.7	62.7	24.0	3.67**
22	2.37	10.4	50.0	31.6	8.0	2.23	16.1	50.1	28.8	5.0	2.98**
23	1.86	25.1	65.9	6.9	2.1	1.96	21.4	62.7	14.2	1.7	-2.47*
24	3.19	4.5	4.0	59.1	32.4	3.20	3.2	9.0	52.0	35.8	0.17

Questions that demonstrate largest difference in response between life and computing contexts

	Work/education LOC question	Computing LOC equivalent
5	I can't get good marks, no matter what I do.	The computer seems to work anyway, no matter what I do.
6	I think I'm pretty clever at university.	I think I've got the ability to be good at using computers.
9	If I want to do well on my university work, I just need to try harder.	If I want to use computers better, I just need to try harder.
10	When I'm at university, I can work hard.	When I'm using a computer I work hard and concentrate.
11	I don't know how to keep myself from getting bad marks.	I don't usually know how to prevent computers going wrong.
12	If I'm not clever at a university subject, I won't do well at it.	I'm not clever enough with computers to use them well.
18	If I get bad marks, it's because I don't try hard enough.	If I can't get a computer to do what I want, it's because I don't try hard enough.
19	I have to be clever to get good marks at university.	I need to be clever to get a computer to do what I want.

N.B. Question 5 presented non-equivalent wording so cannot be regarded as fully compatible between the LOC contexts**.** All other items are more consistent across the versions. This does not affect the sub-scales as they are independent of this cross-version comparison.

Spearman Correlation coefficients from correlation analysis between subscales of overall LOC and other variables

	Work/education LOC	Computer LOC
Simple LOC measure	-0.05	-0.29**
% of time user is in control	0.13*	0.16**
% of time computer is in control	-0.15**	-0.12*
Age group	0.07	0.02
Gender	0.03	-0.14**
Number of GCSE's being taken (13-14 year-olds)	0.04	-0.39**
Number of GCSE's obtained (16-18 year-olds)	-0.03	-0.16
Number of 'A' levels being taken (16-18 year-olds)	0.22	0.03
Number of 'A' levels obtained (undergraduates)	0.16	0.11
UCAS points (undergraduates)	0.15	0.00
Adult's level of education	-0.03	0.05
Preference for non-science subjects (16-18 year-olds and undergraduates only)	0.02	-0.17*
Ownership of computer by the participant	0.05	0.15**
Frequency of access to computers	0.08	0.28**
Number of hours per week of computer use	0.02	0.27**

Appendix B-6

Emotion during computing use

Simple affect measure: proportions based on gender for various opinions of computers

Computers are …	men	women	all	N
Good	67.9	53.6	58.9	392
Good and Bad	30.5	45.7	40.0	266
Bad	1.6	0.7	1.1	7
χ^2, p for Good vs. Good and Bad	24.13 < 0.001	2.64 0.10	24.13 p< 0.01	658

Simple affect measure: proportions for each age group for various opinions on computers

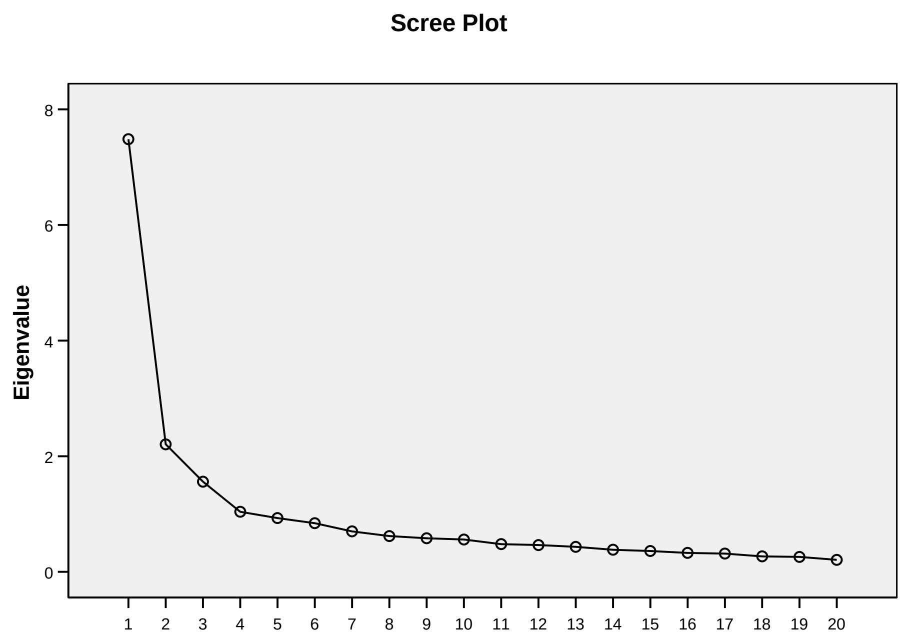
Computers are …		10-11 year-olds	13-14 year-olds	16-18 year-olds	under-graduates	adults
Good		77.3	54.1	52.3	50.9	52.9
Good and Bad		20.4	41.9	47.7	49.1	47.1
Bad		2.2	4.1	0.0	0.0	0.0
χ^2 test for Good vs. Good and Bad	χ^2 value	59.94	1.14	0.23	0.07	0.29
	p value	< 0.001	0.29	0.63	0.79	0.59

Simple affect measure: mean values based on age group for various opinions on computers

		10-11 year-olds	13-14 year-olds	16-18 year-olds	under-graduates	adults
Mean value of opinion		1.25	1.50	1.48	1.49	1.47
Kruskal Wallis for age groups	10-11 to 13-14	χ^2 (1)= 13.42 p < 0.001				
	13-14 to adults		χ^2 (3) = 0.13 p = 0.99			

Results of emotion questions for participants – mean values (SD) and t-test on gender (1 indicates closest to first emotion; 6 indicates closer to opposing emotion; 3.5 neutral)

Questionnaire choice	overall	males	females	t-test for gender		
				t	*N*	*p*
Alienated v engaged	4.57 (1.05)	4.59 (1.22)	4.56 (0.96)	0.30	462	.77
Comforted v depressed	2.77 (1.02)	2.59 (1.14)	2.86 (0.95)	-2.50	468	< 0.05
Frustrated v unperturbed	3.84 (1.22)	3.96 (1.30)	3.78 (1.17)	1.47	463	.14
Heartened v irritated	3.33 (1.06)	3.20 (1.17)	3.39 (1.01)	-1.81	458	.07
Aggravated v relaxed	4.25 (1.12)	4.45 (1.23)	4.16 (1.05)	2.46	462	< 0.05
Calm v angry	2.73 (1.19)	2.64 (1.41)	2.78 (1.08)	-1.08	465	.28
Bored v excited	3.85 (1.14)	4.08 (1.25)	3.74 (1.07)	3.05	467	< 0.01
Interested v tedium	2.68 (1.14)	2.57 (1.28)	2.72 (1.06)	-1.28	463	.20
Fed up v content	4.14 (1.12)	4.23 (1.25)	4.09 (1.04)	1.19	463	.24
Impatient v patient	3.52 (1.40)	3.55 (1.44)	3.50 (1.39)	0.34	462	.74
Stress v at ease	4.11 (1.17)	4.33 (1.29)	4.01 (1.09)	2.63	459	< 0.01
Satisfied v thwarted	2.85 (1.03)	2.75 (1.17)	2.90 (0.96)	-1.35	459	.18
Encouraged v discouraged	2.87 (1.02)	2.83 (1.15)	2.90 (0.96)	-0.59	461	.56
Upset v pleased	4.43 (0.95)	4.46 (1.11)	4.41 (0.87)	0.42	463	.68
Useful v useless	2.58 (1.13)	2.59 (1.35)	2.58 (1.01)	0.14	466	.89
Empowered v humiliated	2.73 (0.98)	2.68 (1.18)	2.76 (0.87)	-0.71	455	.48
Neutral v animated	3.32 (1.28)	3.61 (1.48)	3.18 (1.15)	3.09	457	< 0.01
Indifferent v wound up	2.98 (1.12)	3.07 (1.23)	2.93 (1.06)	1.21	449	.23
Emotional v unaffected	4.29 (1.22)	4.29 (1.26)	4.30 (1.20)	-0.09	457	.93
Detached v absorbed	4.13 (1.17)	4.10 (1.26)	4.14 (1.12)	-0.34	450	.74



Scree Plot from Principal Component Analysis of 20 questions on emotions felt during computer use – 4 factors identified to cover 56% of variance

SPSS output of Total Variance Explained across 20 degrees of freedom - first 4 factors

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.484	37.422	37.422	7.484	37.422	37.422
2	2.205	11.027	48.449	2.205	11.027	48.449
3	1.559	7.795	56.244	1.559	7.795	56.244
4	1.038	5.189	61.433	1.038	5.189	61.433
5	.929	4.645	66.078			
6	.841	4.206	70.284			
7	.699	3.497	73.781			
8	.618	3.091	76.872			
9	.580	2.902	79.774			
10	.559	2.793	82.567			
11	.479	2.393	84.959			
12	.463	2.313	87.273			
13	.432	2.158	89.430			
14	.381	1.906	91.337			
15	.359	1.795	93.131			
16	.327	1.634	94.765			
17	.315	1.577	96.343			
18	.267	1.335	97.678			
19	.257	1.287	98.965			
20	.207	1.035	100.000			

Factor analysis of affect scale: Principal components analysis based on 75 participants from each age group to generate sub-scales of emotion

Questionnaire choice	-ve on Factor 1 +ve on Factor 1	Factor 2	-ve on Factor 3 +ve on Factor 3	Factor 4
Alienated v engaged	-0.58			0.40
Comforted v depressed	0.65			
Frustrated v unperturbed	-0.65		0.36	
Heartened v irritated	0.71			
Aggravated v relaxed	-0.73			
Calm v angry	0.74			
Bored v excited	-0.53	0.34		
Interested v tedium	0.63		0.34	
Fed up v content	-0.67	0.35		
Impatient v patient	-0.47	0.51		
Stress v at ease	-0.70	0.38		
Satisfied v thwarted	0.72			
Encouraged v discouraged	0.71	0.35		
Upset v pleased	-0.66			
Useful v useless	0.71	0.37		
Empowered v humiliated	0.64	0.49		
Neutral v animated		0.58	-0.48	
Indifferent v wound up	0.45	0.36	-0.36	
Emotional v unaffected			0.70	0.33
Detached v absorbed	-0.50			0.55

Emotion sub-scale			Variable name
Positive emotion (9 questions loading on +ve Factor 1)	Positive factors	Alienated v engaged Frustrated v unperturbed Aggravated v relaxed Bored v excited Fed up v content Impatient v patient Stress v at ease Upset v pleased Detached v absorbed	Affect1 Affect3 Affect5 Affect7 Affect9 Affect10 Affect11 Affect14 Affect20
Negative emotion (9 questions loading on -ve Factor 1)	Negative factors	Comforted v depressed Heartened v irritated Calm v angry Interested v tedium Satisfied v thwarted Encouraged v discouraged Useful v useless Empowered v humiliated Indifferent v wound up	Affect2 Affect4 Affect6 Affect8 Affect12 Affect13 Affect15 Affect16 Affect18
Level of engagement (5 questions loading on Factor 2 and -ve Factor 3)	Increase in sensation of level of engagement or excitement	Bored v excited Fed up v content Impatient v patient Stress v at ease Neutral v animated Encouraged v discouraged Useful v useless Empowered v humiliated Indifferent v wound up	Affect7 Affect9 Affect10 Affect11 Affect17 -Affect13 -Affect15 -Affect16 -Affect18
Emotionality of computer use (9 questions loading on Factor 4 and +ve Factor 3)	Relief from emotional discomfort	Alienated v engaged Frustrated v unperturbed Aggravated v relaxed Interested v tedium Fed up v content Stress v at ease Upset v pleased Emotional v unaffected Detached v absorbed	Affect1 Affect3 Affect5 Affect8 Affect9 Affect11 Affect14 Affect19 Affect20

```
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  /STATISTICS=SCALE
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EXECUTE .
COMPUTE negemo = (affect2 + affect4 + affect6 + affect8 + affect12 + affect13 +
  affect15 + affect16 + affect18) / 9 .
EXECUTE .
COMPUTE engemo = (affect7 + affect9 + affect10 + affect11 + affect17 - affect13 -
  affect15 - affect16 - affect18) / 9 .
EXECUTE .
COMPUTE emoemo = (affect1 + affect3 + affect5 + affect8 + affect9 + affect11 +
  affect14 + affect19 + affect20) / 9 .
EXECUTE .
```

Four factors of emotion (range: 1-6 in line with initial questionnaire data):

Positive emotion = (affect1 + affect3 + affect5 + affect7 + affect9 + affect10 + affect11 + affect14 + affect 20) / 9

Negative emotion = (affect2 + affect4 + affect6 + affect8 + affect12 + affect13 + affect15 + affect 16 + affect18) / 9

Level of engagement = (affect7 + affect9 + affect10 + affect11 + affect17 + (6-affect13) + (6-affect 15) + (6-affect16) + (6-affect18)) / 9

Level of emotionality = (affect1 + affect3 + affect5 + affect8 + affect9 + affect11 + affect14 + affect 19 + affect 20) / 9

Chronbach's alpha for each sub-scale across all participants (beyond 75 used to generate the sub-scales)

	all	13-14 year-olds	16-18 year-olds	under-graduates	adults
Positive emotion	0.87	0.85	0.87	0.88	0.88
Negative emotion	0.89	0.91	0.88	0.87	0.91
Level of engagement	0.79	0.66	0.80	0.82	0.78
Level of emotionality	0.84	0.82	0.79	0.87	0.84

Mean values (SD) for each sub-scale across all participants

	all	13-14 year-olds	16-18 year-olds	under-graduates	adults
Positive emotion	4.09 (0.79)	4.17 (0.85)	4.07 (0.83)	3.99 (0.78)	4.33 (0.69)
Negative emotion	2.88 (0.77)	3.00 (1.03)	2.76 (0.78)	2.92 (0.69)	2.83 (0.76)
Level of engagement	3.43 (0.57)	3.49 (0.58)	3.48 (0.60)	3.34 (0.58)	3.57 (0.48)
Level of emotionality	4.05 (0.63)	4.14 (0.76)	3.96 (0.62)	3.98 (0.61)	4.27 (0.55)

Mean values (SD) for each sub-scale across all participants

		all		13-14 year-olds		16-18 year-olds		under-graduates		adults	
		m	f	m	f	m	f	m	f	m	f
Positive emotion		4.17 (0.89)	4.05 (0.74)	4.32 (0.92)	3.93 (0.68)	4.08 (0.94)	4.07 (0.73)	4.02 (0.87)	3.98 (0.76)	4.35 (0.78)	4.31 (0.64)
values for gender t-test	*t*	1.42		1.58		0.04		0.22		0.23	
	p	0.16		0.12		0.97		0.82		0.82	
	N	435		45		93		211		80	
Negative emotion		2.82 (0.92)	2.91 (0.69)	2.79 (1.17)	3.31 (0.69)	2.77 (0.89)	2.75 (0.67)	2.79 (0.79)	2.94 (0.67)	2.94 (0.88)	2.76 (0.68)
values for gender t-test	*t*	-1.00		-1.77		0.14		-1.18		1.04	
	p	0.32		0.08		0.89		0.24		0.30	
	N	431		47		90		209		79	
Level of engagement		3.52 (0.61)	3.39 (0.54)	3.61 (0.65)	3.31 (0.40)	3.52 (0.64)	3.44 (0.56)	3.39 (0.65)	3.33 (0.57)	3.59 (0.49)	3.56 (0.47)
values for gender t-test	*t*	2.38		2.07		0.71		0.48		0.33	
	p	< 0.05		< 0.05		0.48		0.66		0.75	
	N	440		48		96		211		79	
Level of emotionality		4.08 (0.71)	4.03 (0.59)	4.22 (0.81)	4.02 (0.65)	3.93 (0.69)	3.99 (0.55)	4.03 (0.67)	3.97 (0.60)	4.24 (0.63)	4.29 (0.50)
values for gender t-test	*t*	0.78		0.89		-0.47		0.48		-0.36	
	p	0.44		0.38		0.64		0.64		0.72	
	N	436		46		92		212		80	

Correlations with other variables

Simple measure of opinion of computers correlations with educational attainment

	Opinion of computers	Gender	Number GCSE's	Number A levels	UCAS points	Adult's level
Opinion of computers	-	-0.07	-0.01	0.01	-0.05	-0.02
Positive emotion	-0.19**	-0.07	-0.12*	-0.12*	-0.12*	-0.08
Negative emotion	0.23**	-0.06	0.07	0.03	0.02	-0.08
Level of engagement	-0.20**	-0.11*	-0.03	-0.05	-0.07	0.01
Level of emotionality	-0.20**	-0.08	-0.16**	-0.12*	-0.14**	-0.08
Chapter 3 paper questionnaire coding of emotions	-	0.15*	-0.07	-	-	-

Computer Use and science vs. non-science basis of study

	Ownership of computer by the participant	Frequency of access to computers	Number of hours per week of computer use	Preference for non-science subjects
Opinion of computers	0.00	-0.13**	-0.13**	0.01
Positive emotion	0.14**	0.16**	0.20**	0.02
Negative emotion	-0.14**	-0.20**	-0.20**	0.05
Level of engagement	0.15**	0.13**	0.19**	-0.05
Level of emotionality	0.11*	0.15**	0.17**	0.04
Chapter 3 paper questionnaire coding of emotions	-	-	0.20**	0.19**

Correlations with other variables (continued)

Computer LOC and % of time user or %of time computer is in control

	Simple LOC measure	% of time user is in control	% of time computer is in control	Computer LOC subscale of Overall LOC
Opinion of computers	-0.04	-0.15**	0.11*	-0.18**
Positive emotion	-0.17**	0.05	-0.09	0.50**
Negative emotion	0.15**	-0.18**	0.09	-0.53**
Level of engagement	-0.19**	0.10**	-0.10*	0.49**
Level of emotionality	-0.18	0.00	-0.08	0.41**
Chapter 3 paper questionnaire coding of emotions	0.24**	0.23**	-0.27**	-

Appendix B-7

Computer Settings

Proportions of participants (%) who chose particular computer settings as last choice

	10-11 year-olds	13-14 year-olds	16-18 year-olds	under-graduates	adults
Computer setting A	33.3	42.5	28.3	10.0	13.8
Computer setting B	24.3	19.2	11.3	8.7	1.1
Computer setting C	11.9	9.6	4.7	2.7	1.1
Computer setting D	30.5	28.8	55.7	78.5	83.9

Proportions of participants (%) who chose particular computer settings as last choice by gender

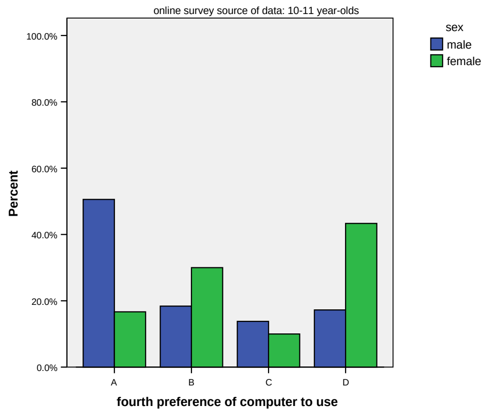
	10-11 year-olds		13-14 year-olds		16-18 year-olds		under-graduates		adults	
	m	f	m	f	m	f	m	f	m	f
Computer setting A	50.6	16.7	48.8	34.4	42.9	15.8	29.4	6.5	17.6	11.3
Computer setting B	18.4	30.0	14.6	25.0	14.3	8.8	5.9	9.2	0.0	1.9
Computer setting C	13.8	10.0	12.2	6.3	4.1	5.3	5.9	2.2	2.9	0.0
Computer setting D	17.2	43.3	24.4	34.4	38.8	70.2	58.8	82.2	79.4	86.8
p value of χ^2 for gender	< 0.001		0.37		< 0.01		< 0.001		0.40	

Proportions of participants (%) who chose particular computer settings as first choice

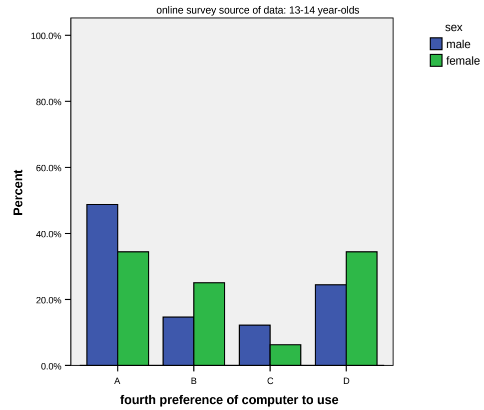
	10-11 year-olds	13-14 year-olds	16-18 year-olds	under-graduates	adults
Computer setting A	5.5	2.7	7.5	18.3	9.2
Computer setting B	23.1	30.1	48.6	25.6	41.4
Computer setting C	17.6	15.1	29.0	51.6	48.3
Computer setting D	53.8	52.1	15.0	4.6	1.1

Proportions of participants (%) who chose particular computer settings as first choice

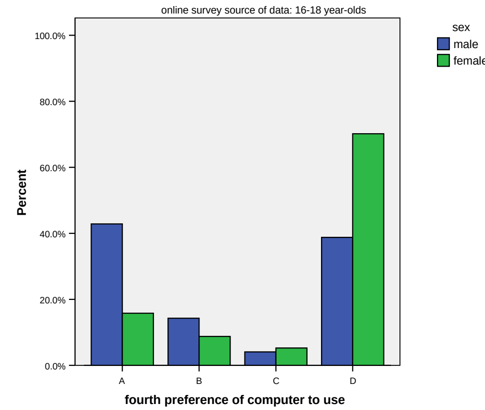
	10-11 year-olds		13-14 year-olds		16-18 year-olds		under-graduates		adults	
	m	f	m	f	m	f	m	f	m	f
Computer setting A	2.2	8.7	2.4	3.1	6.1	8.6	5.9	20.5	5.9	11.3
Computer setting B	13.3	32.6	17.1	46.9	42.9	53.4	35.3	23.8	41.2	41.5
Computer setting C	14.4	20.7	17.1	12.5	26.5	31.0	47.1	52.4	52.9	45.3
Computer setting D	70.0	38.0	63.4	37.5	24.5	6.9	11.8	3.2	0.0	1.9
p value of χ^2 for gender	< 0.001		< 0.05		0.09		< 0.05		0.67	



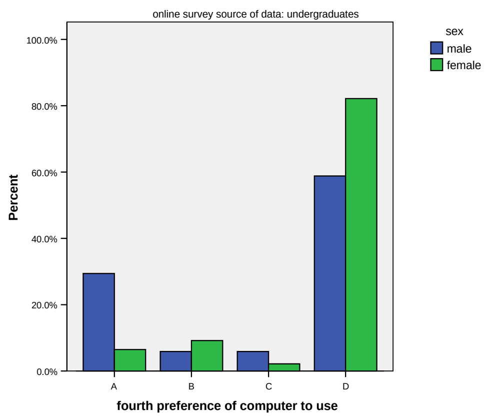
Proportions (%) of each gender of 10-11 year olds choosing A, B, C or D as last preference.



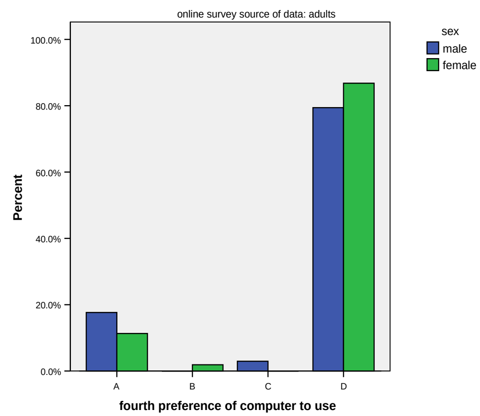
Proportions (%) of each gender of 13-14 year olds choosing A, B, C or D as last preference.



Proportions (%) of each gender of 16-18 year olds choosing A, B, C or D as last preference.

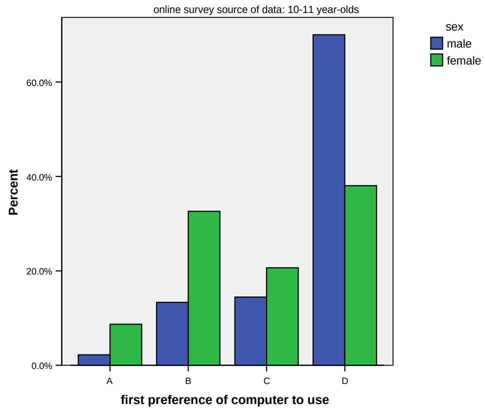


Proportions (%) of each gender of undergraduates choosing A, B, C or D as last preference.

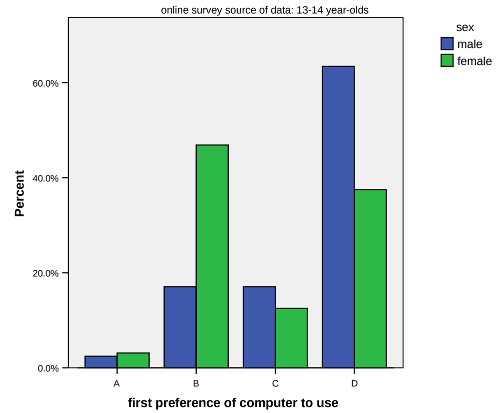


Proportions (%) of each gender of adults choosing A, B, C or D as last preference.

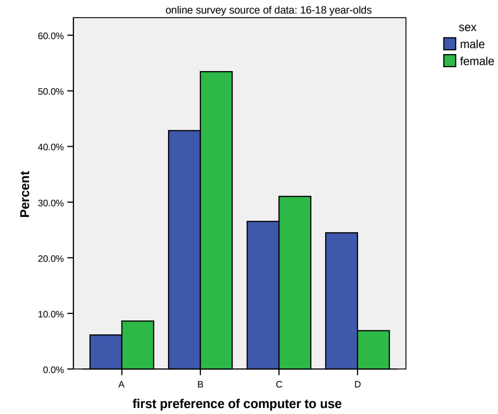
Graphs of least preferred computer setting:
Each graph represents each age group with proportions (%) of each gender choosing A, B, C or D.



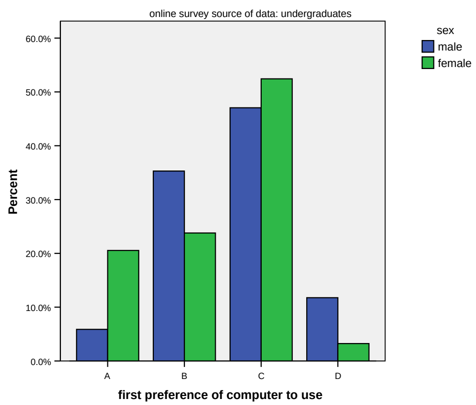
Proportions (%) of each gender of 10-11 year olds choosing A, B, C or D as first preference.



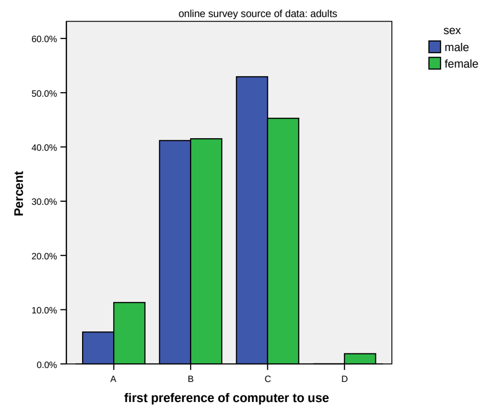
Proportions (%) of each gender of 13-14 year olds choosing A, B, C or D as first preference.



Proportions (%) of each gender of 16-18 year olds choosing A, B, C or D as first preference.



Proportions (%) of each gender of undergraduates choosing A, B, C or D as first preference.



Proportions (%) of each gender of adults choosing A, B, C or D as first preference.

Graphs of most preferred computer setting:
Each graph represents each age group with proportions (%) of each gender choosing A, B, C or D.

Mean ratings (SD) of participants for each computer setting by age group and gender

	10-11 year-olds		13-14 year-olds		16-18 year-olds		under-graduates		adults	
Computer setting A	3.0 (0.9)		3.3 (0.8)		2.9 (0.9)		2.6 (0.9)		2.8 (0.8)	
	m	f	m	f	m	f	m	f	m	f
	3.3 (0.8)	2.7 (0.9)	3.5 (0.6)	3.0 (0.9)	3.2 (0.9)	2.7 (0.8)	3.0 (0.8)	2.5 (0.9)	3.0 (0.7)	2.7 (0.8)
p value of t-test for gender	< 0.001		< 0.05		< 0.01		< 0.01		0.09	
Chapter 3 data	3.2	2.6			3.4	2.5				
Computer setting B	2.5 (1.1)		2.3 (1.1)		1.9 (1.0)		2.2 (0.9)		1.8 (0.8)	
	m	f	m	f	m	f	m	f	m	f
	2.7 (0.9)	2.4 (1.3)	2.4 (1.0)	2.3 (1.3)	2.1 (1.1)	1.8 (1.0)	2.0 (0.9)	2.2 (0.9)	1.7 (0.7)	1.8 (0.8)
p value of t-test for gender	0.16		0.72		0.18		0.18		0.62	
Chapter 3 data	2.9	2.8			2.1	2.4				
Computer setting C	2.4 (0.9)		2.3 (0.9)		2.0 (0.8)		1.7 (0.8)		1.7 (0.7)	
	m	f	m	f	m	f	m	f	m	f
	2.4 (0.9)	2.4 (0.9)	2.3 (0.9)	2.3 (0.8)	2.0 (0.8)	2.0 (0.9)	1.8 (0.9)	1.7 (0.8)	1.6 (0.7)	1.7 (0.7)
p value of t-test for gender	0.80		0.88		0.99		0.37		0.27	
Chapter 3 data	2.4	2.1			2.1	1.7				
Computer setting D	2.2 (1.4)		2.2 (1.3)		3.2 (1.1)		3.7 (0.8)		3.8 (0.5)	
	m	f	m	f	m	f	m	f	m	f
	1.7 (1.2)	2.6 (1.4)	2.1 (1.3)	2.5 (1.3)	2.8 (1.2)	3.5 (0.9)	3.2 (1.1)	3.7 (0.7)	3.8 (0.5)	3.8 (0.6)
p value of t-test for gender	< 0.001		0.16		< 0.001		< 0.001		0.84	
Chapter 3 data	1.6	2.4			2.4	3.3				

Correlations with other variables

Choice of computer setting correlations with educational attainment and science vs. non-science basis of study

	Score for A	Score for B	Score for C	Score for D
Number of GCSE's being taken/obtained	-0.13*	-0.03	-0.10	0.21**
Number of 'A' levels being taken/obtained	-0.07	0.05	-0.14*	0.13*
UCAS points obtained by undergraduates	-0.05	0.06	0.06	-0.08
Adult's highest level of educational attainment	0.02	0.02	-0.12	0.16
Preference for non-science subjects	-0.01	0.05	0.01	-0.04

Choice of computer setting correlations with computer use

	Score for A	Score for B	Score for C	Score for D
Ownership of computer by the participant	-0.04	-0.03	-0.17*	0.18*
Frequency of access to computers	0.02	-0.01	-0.04	0.03
Number of hours per week of computer use	0.10*	-0.01	-0.01	-0.07

Correlation coefficients between Computer Setting choices, simple LOC measure and computer LOC subscales – all participants

	Score for A	Score for B	Score for C	Score for D
Simple LOC measure	-0.05	0.02	0.07	-0.01
Overall LOC	0.13**	-0.05	-0.01	-0.09

Correlation coefficients between Computer Setting, simple LOC measure and computer LOC subscales – all male participants (significant correlations only)

	Score for A	Score for B	Score for C	Score for D
Simple LOC measure	-	0.13*	-	-0.18**
Overall LOC	-	-	-	-

Correlation coefficients between Computer Setting, simple LOC measure and computer LOC subscales – all female participants (significant correlations only)

	Score for A	Score for B	Score for C	Score for D
Simple LOC measure	-	-	0.10*	-
Overall LOC	0.15*	-0.16**	-	-

Correlation coefficients between Computer Setting, simple LOC measure and computer LOC subscales – significant correlations only by group and gender

	Score for A	Score for B	Score for C	Score for D
Simple LOC measure	-	-0.28* (16-18f)	0.16* (ug-f)	0.30* (16-18f) -0.33* (adult-f)
Overall LOC	0.19* (ug-f)	0.35* (13-14m) 0.48* (ug-m)	-	-

Computer Setting and affect scales – all participants

	Score for A	Score for B	Score for C	Score for D
Opinion of computers	-0.07	-0.06	-0.09*	0.18**
Positive emotion	0.11*	-0.03	-0.01	-0.08
Negative emotion	-0.08	0.03	0.03	0.06
Level of engagement	0.12*	0.00	-0.02	-0.10*
Level of emotionality	0.09	-0.02	-0.01	-0.06

Computer Setting and affect scales – male participants (significant correlations only)

	Score for A	Score for B	Score for C	Score for D
Opinion of computers	-	-0.31**	-	0.31**
Positive emotion	-	-	-	-0.18*
Negative emotion	-	-	-	-
Level of engagement	-	0.17*	-	-0.19*
Level of emotionality	-	-	-	-

Computer Setting and affect scales – female participants (significant correlations only)

	Score for A	Score for B	Score for C	Score for D
Opinion of computers	-	-	-	-
Positive emotion	-	0.12*	-	-
Negative emotion	-	-	-	-
Level of engagement	0.14*	-	-	-
Level of emotionality	-	-	-	-

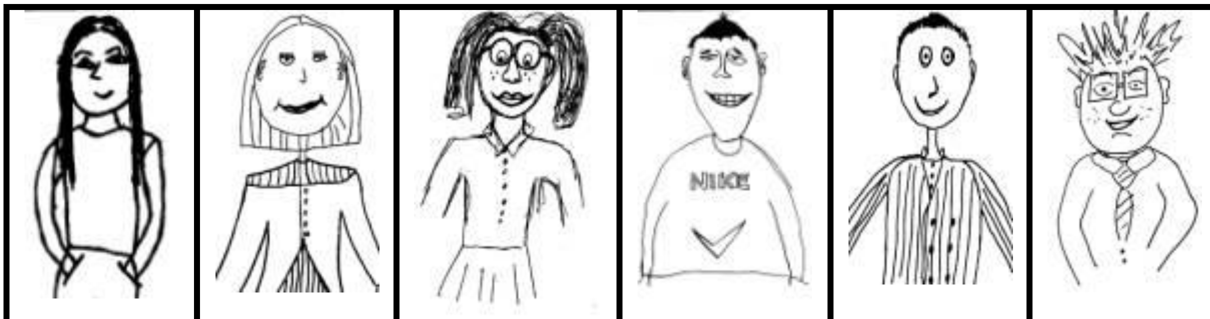
Computer Setting and affect scales – significant correlations only by group and gender

	Score for A	Score for B	Score for C	Score for D
Opinion of computers	0.37* (13-14f)			0.45** (13-14m)
	-0.36* (adult-m)	-0.70** (ug-m)	-0.16* (ug-f)	0.38* (ug-m)
	-0.32* (adult-f)	0.30* (adult-f)		0.30* (adult-f)
Positive emotion	0.33* (16-18m)	-	-	-
Negative emotion	-	-0.35* (ug-m)		-0.48* (13-14f)
			-0.32* (adult-f)	0.31* (adult-f)
Level of engagement	-	-	0.28* (adult-f)	-0.29* (adult-f)
Level of emotionality	0.32* (16-18m)	-	-	-0.39* (13-14m)

Appendix B-8

Computer User Choices

Please choose ONE of the following six people that you think is a computer user



Emma	Someone's mum	Cynthia	Nathan	Someone's dad	Bob

I think the computer user is …

Proportions (%) of participants choosing each figure

	10-11 year-olds	13-14 year-olds	16-18 year-olds	under-graduates	adults
Bob	48.9	51.4	38.3	59.8	29.9
male friend (Nathan)	10.4	17.6	21.5	12.8	20.7
dad	9.3	6.8	13.1	9.6	8.0
Cynthia	13.7	6.8	5.6	6.4	11.5
female friend (Emma)	9.3	9.5	15.9	11.4	19.5
mum	8.2	8.1	5.6	0.0	10.3

Proportions (%) of participants choosing each figure defined by gender, age and stereotypical features

	10-11 year-olds	13-14 year-olds	16-18 year-olds	under-graduates	adults
Male user	68.7	75.7	72.9	82.2	58.6
Young user	82.4	85.1	81.3	90.4	81.6
Stereotype (Cynthia or Bob)	62.6	58.1	43.9	66.2	41.4

Proportions (%) of participants choosing each figure defined by gender, age and stereotypical features

	10-11 year-olds		13-14 year-olds		16-18 year-olds		under-graduates		adults	
	m	f	m	f	m	f	m	f	m	f
Male user	80.0	57.6	83.3	65.6	74.0	71.9	82.4	82.2	64.7	54.7
p value of χ^2 test for gender	< 0.01		0.07		0.49		0.60		0.24	
Young user	87.8	77.2	83.3	87.5	82.0	80.7	88.2	90.8	85.3	79.2
p value of χ^2 test for gender	< 0.05		0.44		0.53		0.42		0.34	
Stereotype (Cynthia or Bob)	72.2	53.3	50.0	68.8	48.0	40.4	64.7	66.5	44.1	39.6
p value of χ^2 test for gender	< 0.01		0.08		0.27		0.49		0.42	

Relationships with other variables

Choice of typical computer user correlations with educational attainment and science vs. non-science basis of study

	sex of user chosen	age of user chosen	ST of user chosen	Bob chosen	same gender chosen	same age chosen
Gender of participant	0.08*	0.01	0.02	0.02	0.47**	-0.02
Age-group of Participant	-0.02	-0.05	0.05	0.07	0.19**	0.27**
Number of GCSE's being taken/obtained	0.00	-0.03	-0.04	-0.06	0.06	-0.03
Number of 'A' levels being taken/obtained	-0.04	0.14*	0.05	0.05	0.10	0.14*
UCAS points obtained by undergraduates	0.01	0.09	0.03	0.05	-0.01	0.09
Adult's highest level of educational attainment	-0.04	0.27*	0.11	0.02	-0.05	-0.27*
Preference for non-science subjects	0.10*	0.04	-0.02	0.04	-0.03	0.04

Participants' 'A' levels being taken in relation to choices of same gender and same age 'typical' computer users

	Number of 'A' levels being taken/obtained						
	0	1	2	3	4	5	6
same gender chosen (%)	27	62	43	41	31	33	38
same age chosen (%)	91	92	100	90	82	94	63
N for each level of qualification	11	13	14	115	109	18	8

Adult participants' choices of same gender and same age 'typical' computer users in terms of educational attainment

	Level of Highest Qualification					
	No exams	Low GCSE	High GCSE	'A' levels	Degree	Higher degree
same gender chosen (%)	50.0	50.0	41.2	60.0	59.3	52.0
same age chosen (%)	0.0	0.0	17.6	0.0	14.8	36.0
N for each level	2	6	17	10	27	27
Median age range (years) for this group	25-35	45-55	25-35	25-35	35-45	45-55

Choice of typical computer user correlations with computer use

	sex of user chosen	age of user chosen	ST of user chosen	Bob chosen	same gender chosen	same age chosen
Ownership of computer by the participant	-0.04	-0.02	0.02	-0.01	0.06	0.01
Frequency of access to computers	-0.06	-0.05	-0.01	-0.05	-0.03	0.02
Number of hours per week of computer use	0.01	-0.08	-0.01	-0.04	-0.08	0.07

Correlation of implicit measures of typical user, simple LOC and computer LOC subscales (no significant correlations with % time computer or % time user in charge of computer or work/education overall LOC sub-scale)

	sex of user chosen	age of user chosen	ST of user chosen	Bob chosen	same gender chosen	same age chosen
Simple LOC measure (*N* = 657)	0.00	-0.07	-0.04	-0.03	0.04	-0.12*
Overall LOC (*N* = 395)	0.04	-0.03	0.02	0.02	-0.14**	0.06

Correlation of implicit measures of typical user, simple LOC (10-11 year-olds only as remainder of age-groups had no significant correlations) and computer LOC subscales by age group for female participants only as there were no significant correlations for any LOC measures for any of the age-groups for males analysed separately (significant correlations only shown)

	sex of user chosen	age of user chosen	ST of user chosen	Bob chosen	same gender chosen	same age chosen
10-11 year-old girls						
Simple LOC measure (*N* = 89)	0.23*	-0.26*	-0.23*	-	-0.23*	-0.26*
13-14 year-old girls						
Overall LOC (*N* = 28)	-0.54**	-	-0.41*	-0.39*	0.54**	-
16-18 year-old female participants						
Overall LOC (*N* = 46)	0.36*	-	-	-	-0.36*	-
Undergraduate women						
Overall LOC (*N* = 131)	-	-	-	-0.18*	-	-
Women from the adult age-group						
	no significant correlations for any LOC measures					

Whole sample: Implicit measure of typical user and opinion/emotion relationships-Spearman Correlation coefficients (significant values only)

	sex of user chosen	age of user chosen	ST of user chosen	Bob chosen	same gender chosen	same age chosen
Opinion of computers	-	-	-	-	0.12**	-
Positive emotion	0.18**	-	0.14**	0.16**	-0.12**	0.11*
Negative emotion	-	-	-	-	0.13**	-
Level of engagement	0.16**	-	0.14**	0.15**	-	0.11*
Level of emotionality	0.20**	-	0.11*	0.13**	-0.10*	0.13**

Spearman correlational analyses of the implicit measure of typical user and opinion of computers by each gender and age group independently indicated that there were no significant relationships other than that for the youngest age group as shown below:

	sex of user chosen	age of user chosen	ST of user chosen	Bob chosen	same gender chosen	same age chosen
10-11 year-old participants only:						
Opinion of computers	-	-	-	-	0.21**	-

Male participants only: Implicit measure of typical user and opinion/emotion Spearman correlation coefficients by gender

	sex of user chosen	age of user chosen	ST of user chosen	Bob chosen	same gender chosen	same age chosen
Positive emotion	-	-	-	-	-	-
Negative emotion	-	-	-	-	-	0.20**
Level of engagement	0.19*	-	0.18*	0.19*	0.19**	-
Level of emotionality	-	-	-	-	-	-

Female participants only: Implicit measure of typical user and opinion/emotion Spearman correlation coefficients

	sex of user chosen	age of user chosen	ST of user chosen	Bob chosen	same gender chosen	same age chosen
Positive emotion	0.21**	-	0.14*	0.17**	-0.21**	0.16**
Negative emotion	-0.14*	-	-	-	0.14*	-
Level of engagement	0.14*	-	-	0.12*	-0.14*	0.13*
Level of emotionality	0.23**	0.12*	0.15**	0.18**	-0.23**	-0.20**

Implicit measure of typical user and opinion/emotion Spearman correlation coefficients by age group

	sex of user chosen	age of user chosen	ST of user chosen	Bob chosen	same gender chosen	same age chosen
13-14 year-old participants only: *no significant correlations*						
16-18 year-old male participants only:						
Positive emotion	-	-	0.30*	-	-	-
Negative emotion	-	-	-	-	-	-
Level of engagement	-	-	0.38**	0.29*	-	-
Level of emotionality	-	-	-	-	-	-
16-18 year-old female participants only:						
Positive emotion	-	-	-	-	-	-
Negative emotion	-	-	-0.46**	-0.33*	-	-
Level of engagement	-	-	-	-	-	-
Level of emotionality	-	-	0.31*	-	-	-
Undergraduate male participants only:						
Positive emotion	0.36*	-	-	-	0.36*	-
Negative emotion	-	-	-	-	-	-
Level of engagement	0.40*	-	-	-	0.40*	-
Level of emotionality	-	-	-	-	-	-
Undergraduate female participants only:						
Positive emotion	0.17*	-	-	-	-0.17*	-
Negative emotion	-0.17*	-	-	-	0.17*	-
Level of engagement	-	-	-	-	-	-
Level of emotionality	0.16*	-	-	0.15*	-0.16*	-
Adult participants only: *no significant correlations*						

Mean values of computer setting ratings and t-tests of difference based on choice of a typical computer user as same or opposite gender to participant

	Male participants				Female participants			
	Same gender	Opposite gender	t-test results		Same gender	Opposite gender	t-test results	
			N	*t*			*N*	*t*
Score for A	3.25	3.07	241	0.46	2.79	2.54	406	2.59*
Score for B	2.28	2.21	238	0.46	2.01	2.20	408	-1.67
Score for C	2.08	2.13	238	-0.39	1.96	1.89	406	0.68
Score for D	2.45	2.59	239	-0.66	3.28	3.43	405	-1.23

** indicates significant $p < 0.05$*

Regression Models of choice of representation of a typical user on various dependent variables: standardized coefficients, annotated if predictive above a certain level of probability *(* indicates p < 0.05; ** indicates p< 0.01)*

Independent variables	Dependent variable Overall Computer LOC
Overall life LOC	0.41**
Bob chosen as user	0.02
Stereotypical user chosen	0.02
Same gender user chosen	-0.14**
Same age user chosen	0.04

	Dependent variables - subscales of emotion			
Independent variables	Positive emotion	Negative emotion	Measure of Engagement	Measure of emotionality
Overall life LOC	0.29**	-0.34**	0.27**	0.23**
Bob chosen as user	0.17**	-0.06	0.17**	0.15**
Stereotypical user chosen	0.15**	-0.02	0.15**	0.13**
Same gender user chosen	-0.12*	0.14**	-0.10*	-0.10*
Same age user chosen	0.12*	0.04	0.10*	0.14**

	Dependent variables – ratings of computer settings			
Independent variables	Computer Setting A	Computer Setting B	Computer Setting C	Computer Setting D
Overall life LOC	0.00	0.00	-0.06	0.04
Overall computer LOC	0.13*	-0.05	-0.01	-0.09
Bob chosen as user	0.05	-0.08	0.02	0.00
Stereotypical user chosen	0.01	-0.02	0.01	-0.01
Same gender user chosen	-0.25**	0.01	-0.06	0.21**
Same age user chosen	0.01	-0.07	0.00	0.05

Appendix B-9

Explicit Questions on Typical Computer Users

Look at the following statements and decide how much you agree or disagree with them

	strongly agree	agree	disagree	strongly disagree
It's traditional to think of a certain person being keen on computers				
Computer enthusiasts are born not made				
Men are more likely to be keen on computers than women are				
Being a computer enthusiast is unlikely to alter in a person's lifetime				
Computer enthusiasts tend to be younger rather than older				

Explicit Measures of Typical Computer User Responses in proportions that agreed with each statement overall and by gender and age-group

	Traditional stereotype exists	Computer users - born not made	Computer users not necessarily male	Computer users do not alter	Computer users are young
Overall	77.3	25.1	48.3	46.3	54.1
Male participants	82.0	34.9	55.0	44.6	61.7
Female participants	75.0	20.3	45.0	47.1	50.5
13-14 year-olds	67.2	42.9	31.7	53.2	58.7
16-18 year-olds	71.9	31.9	40.0	38.9	60.0
Undergraduates	84.3	17.5	57.1	48.6	51.6
Adults	72.9	23.5	47.1	43.5	50.6

Mean values of explicit measures by age group and gender from 4-point Likert scale (2.5 indicates neutral position, value increases with level of agreement)

		Traditional stereotype exists	Computer users - born not made	Computer users not necessarily male	Computer users do not alter	Computer users are young
13-14 years	m	3.17	2.28	2.37	2.50	2.80
	f	2.64	2.22	1.86	2.50	2.57
16-18 years	m	2.87	2.26	2.62	2.38	2.81
	f	2.73	2.27	2.04	2.35	2.60
undergrads	m	3.18	1.85	2.74	2.29	2.59
	f	3.01	2.03	2.61	2.50	2.55
adults	m	3.00	2.24	2.70	2.33	2.76
	f	2.77	1.87	2.25	2.27	2.37

Correlation between Implicit and Explicit Measures of Typical Computer User

	Traditional stereotype exists	Computer users - born not made	Computer users not necessarily male	Computer users do not alter	Computer users are young
sex of user chosen	-0.15**	0.00	-0.21**	-0.03	-0.10*
young user chosen	-0.10*	0.05	-0.06	-0.03	-0.07
ST user chosen	-0.14**	-0.05	-0.16**	-0.03	-0.16**
Bob chosen	-0.15**	-0.06	-0.19**	-0.03	-0.15**
same gender user as self	0.02	-0.05	0.05	0.05	0.00
same age user as self	-0.01	-0.01	-0.02	-0.05	-0.03

Correlation of explicit measures of typical user with work/education and computer LOC subscales (all other LOC measures were not significantly correlated)

	Traditional stereotype exists	Computer users - born not made	Computer users are male	Computer users do not alter	Computer users are young
Work/education Overall LOC	-0.02	-0.25**	-0.03	-0.07	-0.03
Computer Overall LOC	0.02	-0.11*	-0.07	-0.09	0.03

Correlation of explicit measures of typical user and affect scales

	Traditional stereotype exists	Computer users - born not made	Computer users are male	Computer users do not alter	Computer users are young
Positive emotion	-0.06	-0.12*	-0.15**	-0.12*	-0.07
Negative emotion	-0.03	0.15**	0.11*	0.08	-0.05
Level of engagement	-0.03	-0.07	-0.13**	-0.06	-0.05
Level of emotionality	-0.06	-0.17**	-0.13**	-0.13**	-0.06

Correlation of explicit measures of typical user and choice of computer setting

	Traditional stereotype exists	Computer users - born not made	Computer users are male	Computer users do not alter	Computer users are young
Computer setting A	0.02	0.05	-0.04	-0.04	0.04
Computer setting B	0.11*	0.04	0.12*	0.10*	0.04
Computer setting C	-0.04	0.07	-0.10*	0.05	0.03
Computer setting D	-0.10*	-0.12**	0.01	-0.08	-0.10*

Appendix C-1

*Listed below are instructions to make the letter '*A*' plus moving forward to make an inter-character space. The instructions are simply to rotate and move a pen a certain angle or distance and whether to have it in contact with the page or not. You have also been given the same instructions on cards. Read the sequence below and practise the steps so you can understand the idea. Then order the cards into the same sequence.*

Put pen on paper

Assuming up (vertical) the page is zero, rotate the pen by 15^{o} in a clockwise direction

Move the pen forward 82 mm

Rotate the pen by 150^{o}

Move the pen forward 82 mm

Lift the pen from the page

Rotate the pen by 180^{o}

Move the pen forward 41 mm

Rotate the pen by 285^{o}

Put pen on paper

Move forward 20mm

Lift the pen from the page

Rotate the pen by 180^{o}

Move forward 20mm

Rotate the pen by 75^{o}

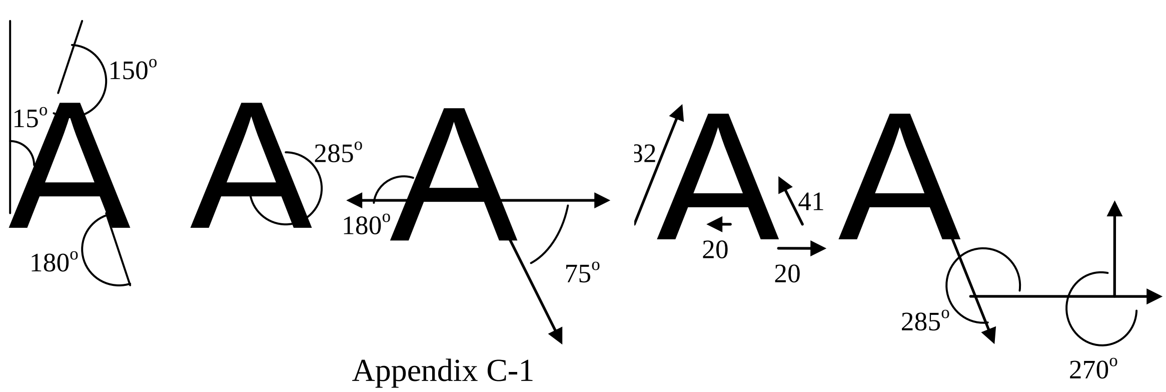
Move the pen forward 41 mm

Rotate the pen by 285^{o}

Move forward 20mm

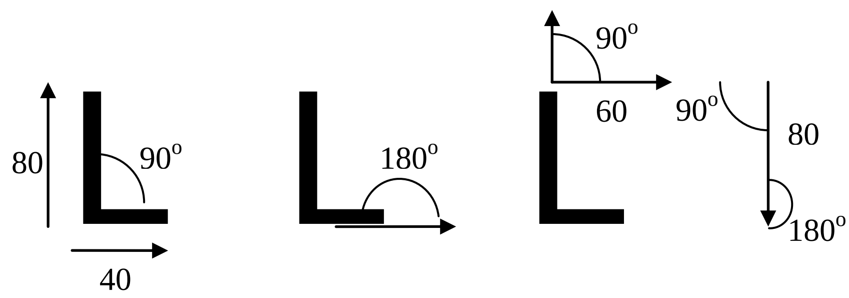
Rotate the pen by 270^{o}

End

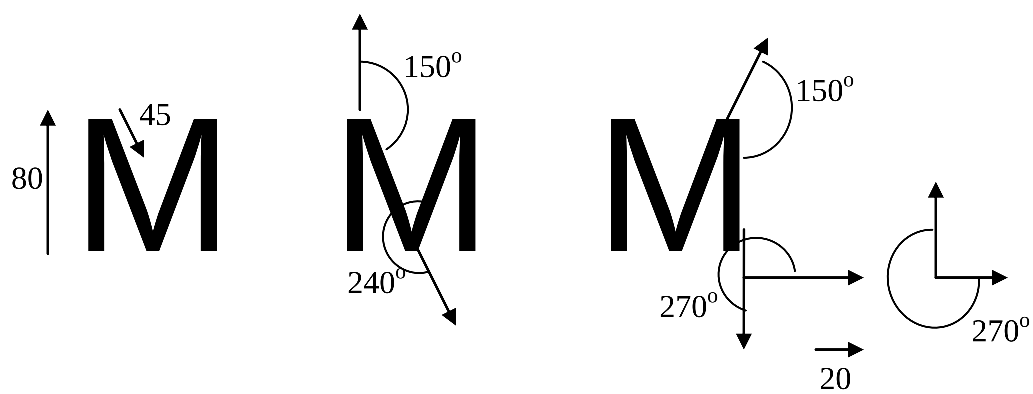


Appendix C-1

Using the same principle, order the instructions you are given to make the letter ‘L’. You will be timed in this task and told when the task is complete and correct.



Using the same principle, order the instructions you are given to make the letter ‘M’



Thank you very much for your participation in the first part of this task.

Listed below are instructions to make the letter 'A' plus moving forward to make an inter-character space. The instructions are simply to rotate and move a cursor a certain angle or distance and whether to leave a mark on a computer screen or not. You have also been given the same instructions on cards. Read the sequence below and practise the steps so you can understand the idea. Then order the cards into the same sequence.

pendown

rt 15

fd 82

rt 150

fd 82

penup

rt 180

fd 41

rt 285

pendown

fd 20

penup

rt 180

fd 20

rt 75

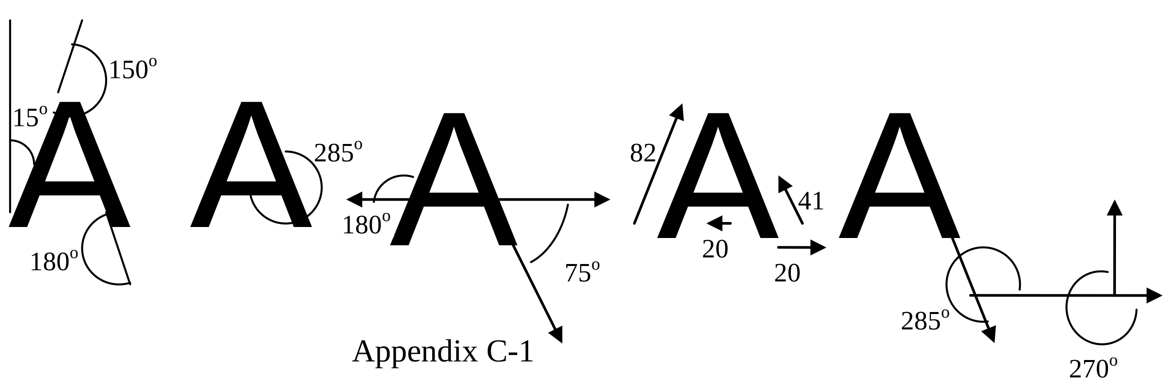
fd 41

rt 285

fd 20

rt 270

end



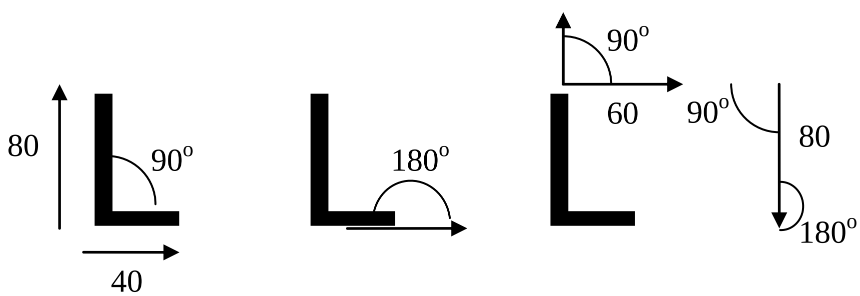
Appendix C-1

Now, please type the instructions on the sheet of paper or ordered cards into the laptop to create the letter 'A'.
You will need to position the cursor in the bottom left hand corner of the screen to enter the commands and then either press enter or move the cursor across after each step to click on 'execute'. Should you make a mistake and need to start again the command CS will clear the screen.

Once the 'A' is complete and correct, enter the command **cs** *to clear the screen ready for the next part of this experiment.*

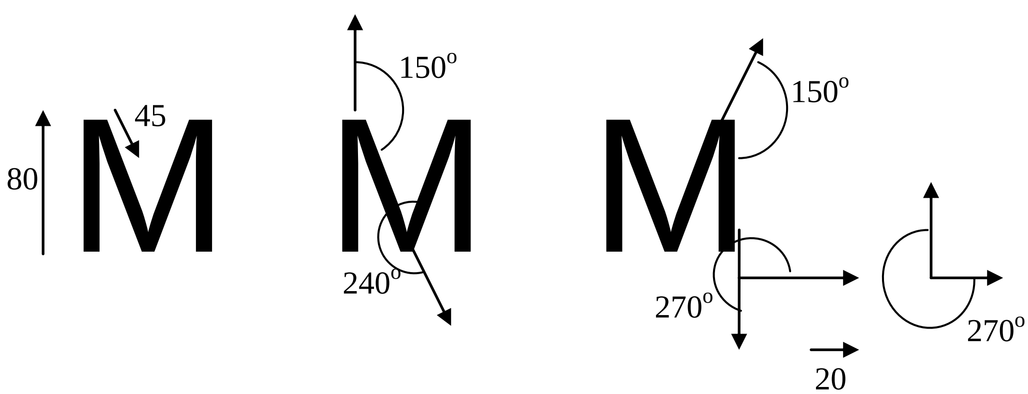
Using the same principle and programming language, try to write similar commands to make the letter 'L'. Type these into the computer to create the letter on the screen. You will be timed in this task and told when the task is complete and correct.

If you have not managed to complete this task after 3 minutes you will be given the required command on cards. You may then order them and type in their contents to create an 'L'.



Finally, using the same principle, create an 'M' on the screen. This is again, a timed task.

If you have not completed an 'M' after three minutes you will be given the cards to help you as before.



Thank you very much for your participation in the experiment. Your help is very much appreciated.

Once you have completed the computer task please fill in the following details about yourself by circling the appropriate answers.														
Sex:		m		f										
Age:	16	17	18	19	20	21	22	23	24	25	other:			
Degree Course:	____													
Undergraduate year of study:				1st		2nd		3rd		4th				
GCSE's														
Number of A*	12	11	10	9	8	7	6	5	4	3	2	1	0	other:
Number of A	12	11	10	9	8	7	6	5	4	3	2	1	0	other:
Number of B	12	11	10	9	8	7	6	5	4	3	2	1	0	other:
Number of C	12	11	10	9	8	7	6	5	4	3	2	1	0	other:
Number of D	12	11	10	9	8	7	6	5	4	3	2	1	0	other:
Number of E	12	11	10	9	8	7	6	5	4	3	2	1	0	other:
A2 level's														
Number at Grade A		5	4	3	2	1	0	Specify subjects: ________________						
								______________________________						
Number at Grade B		5	4	3	2	1	0	Specify subjects: ________________						
								______________________________						
Number at Grade C		5	4	3	2	1	0	Specify subjects: ________________						
								______________________________						
Number at Grade D		5	4	3	2	1	0	Specify subjects: ________________						
								______________________________						
Number at Grade E		5	4	3	2	1	0	Specify subjects: ________________						
								______________________________						
Number at Grade U		5	4	3	2	1	0	Specify subjects: ________________						
								______________________________						
please turn over														

Did you take any subjects for AS level that you dropped before A2 level?			
If so, fill in details for each one:			
AS subject:	______________________	AS grade obtained:	_________
AS subject:	______________________	AS grade obtained:	_________
AS subject:	______________________	AS grade obtained:	_________

How successful do you rate yourself in each of the tasks (marks out of 10)?			
Arranging the cards to describe how to form letters	_____	/	10
Using a computer programme to form letters on the screen	_____	/	10

How successful do you think others were in each of the tasks (marks out of 10)?			
Arranging the cards to describe how to form letters	_____	/	10
Using a computer programme to form letters on the screen	_____	/	10

How good a computer user in general do you think you are?				
expert	above average	average	below average	novice

Any comments? ____

____

____

Experimenter use only:					
Participant ID:					
Date:		Time:		EPR credit?	
‘A’ time		‘L’ time		‘M’ time	
Comp ‘A’ time		Comp ‘L’ time		Comp ‘M’ time	

Appendix C-2

Additional (non-significant) results from Chapter Five

Differences in Self-Ratings for each Task in Terms of Online Questionnaire Responses to View on Computers

	Non-diagnostic (no ST)			Diagnostic (computer ST)		
	Mean	SD	N	Mean	SD	N
Computers are 'good'	1.44	1.46	34	1.28	2.20	32
Computers are 'good and bad'	1.06	1.39	36	1.09	1.44	39

Difference in Self-rating for each Task in Terms of Online Questionnaire Responses to choosing 'typical user' as same gender or not; overall and in relation to GCSE score

	Non Diagnostic (no ST)			Diagnostic (computer ST)		
	Mean	SD	N	Mean	SD	N
Same gender user chosen	1.38	1.60	21	1.29	1.15	21
Opposite gender user chosen	1.35	1.95	46	0.99	1.50	54

Linear Regression Model Standardised Coefficients (β) of and % of variance explained by Main Variables on Difference in Self-ratings for each Task, overall and in terms of each experimental condition.

	Overall		Non Diagnostic (no ST)		Diagnostic (computer ST)	
Variable	*β*	*% var*	*β*	*% var*	*β*	*% var*
Experimental condition	-0.07	0.6	-	-	-	-
Sex	0.02	0.0	-0.04	0.2	0.08	0.7
Educational attainment group	-0.01	0.0	0.04	0.1	0.04	0.1
Level of computer expertise	0.12	1.5	0.17	2.8	0.09	1.0
2-way Locus of Control	-0.11	1.3	-0.26*	6.6	0.02	0.0
View on Computers	-0.02	0.0	-0.05	0.2	0.01	0.0
Same gender user chosen	-0.05	0.3	-0.01	0.0	-0.10	1.0

** significant predictor variable, p < 0.05*

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Appendix C-2