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# Computer anxiety: A comparison of adolescents with and without a history of specific language impairment (SLI)

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ABSTRACT

Individuals who are anxious about computers may be at a disadvantage in their learning. This investigation focused on the use of home computers for educational purposes. It compared computer anxiety in adolescents with and without a history of special needs related to language difficulties. Participants were 55 17-year-olds with specific language impairment (SLI) and 72 typically developing (TD) peers. Participants completed interviews regarding computer anxiety as well as computer importance and computer enjoyment. Measures of psycholinguistic skills, perceived ease of use and general anxiety were also obtained. Results showed that adolescents with SLI experience more computer anxiety than TD peers and that females are more anxious than males. Level of general anxiety, perceived ease of use and language ability had a direct association and were predictive of level of computer anxiety in adolescents with SLI. In contrast, only perceived ease of use was significantly predictive in TD adolescents. Gender was not a significant predictor in the context of other influential variables. The findings reveal a complex relationship between linguistic, attitudinal and emotional factors and computer anxiety. Adolescents with SLI who are at a greater risk may require multifaceted support for a number of influencing factors including general anxiety.



## 1. Introduction

### 1.1. Background

Computers are fast becoming an integral part of education. Computer use is seen as essential to the school curriculum providing students with opportunities to access information and enhance their learning. It has long been recognized that attitudes to computers play an influential role in determining the extent to which individuals perceive the computer as a learning tool (Teo, 2008). It has also been noted that attitudes influence related and future behaviours towards the computer such as using it outside the school/college context such as when doing homework or when engaging in further study (Huang & Liaw, 2005; Rosen & Weil, 1995). Computer anxiety has been identified as one of three key factors of computer attitudes, the other two involving computer importance (perceived usefulness) and computer enjoyment (Woodrow, 1991). Computer anxiety involves an individual's feelings of unease, apprehension and fear about computer use (Igbaria & Parasuraman, 1989). Importantly, a large body of literature has provided consistent evidence of a relationship between computer anxiety and computer use (Chau, Chen, & Wong, 1999; Czaja et al., 2006; Kay, 2008). Individuals who are anxious about computers are less likely to make use of them.

### 1.2. Theoretical framework

One of the most widely applied models of computer usage behaviour is the technology acceptance model (TAM; Davis, Bagozzi, & Warshaw, 1989). In this model, perceived ease of use is an important predictor of an individual's intention to use computers. The easier the

*Abbreviations:* SLI, Specific language impairment; TD, Typically developing.

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computer system/application is to use, the greater the user's perceived self-efficacy regarding his/her capacity to use it comfortably. Discomfort, and hence anxiety, has been found to be significantly correlated to perceived ease of use. However, the argument has usually taken the direction of effect to be from computer anxiety to perceived ease of use, i.e., less anxious individuals perceive computers to be easier to use (Hackbarth, Grover, & Yi, 2003; Saadé & Kira, 2007; Venkatesh, 2000). Researchers, nonetheless, have also been mindful of the potential bidirectionality of this relationship (Brosnan, 1999), in that perceived ease of use may be a contributor to computer anxiety. Individuals who perceive that a computer system/application is easy to use will be less anxious about using it. It is this potential direction of influence that is explored in the present investigation.

A second relevant model involves the influence of human psychological traits and states on behaviour, such as computer usage. Recent research suggests that computer anxiety is more than a state anxiety which manifests itself only in the presence (actual or symbolic) of a computer and is therefore predominantly a context-dependent, temporary state (Beckers, Wicherts, & Schmidt, 2007). Beckers and colleagues suggest that, at least for some individuals, computer anxiety may be a trait. Computer anxiety in this model is conceived as part of a broader, more general anxiety disorder. Individuals who are generally more anxious are therefore more likely to suffer from computer anxiety. This distinction is important as it has bearing on the type and breadth of interventions and support that may need to be provided to ameliorate the condition. A temporary, context-dependent computer anxiety is likely to respond to specialised training regarding the specific intricacies of computer systems/applications. But if computer anxiety is directly influenced by more elevated levels of general anxiety, it is likely to be more resistant to specific computer training and to be more pervasive in individuals' interactions with learning more generally. In this case, general anxiety itself may also require addressing more directly. Following this model, we examine the potential role of general anxiety on individuals' feelings of discomfort related to computer use.

Finally, socio-emotional models of development propose that boys and girls are likely to be exposed to different expectations for computer use (Cooper & Weaver, 2003). The gender stereotype affirms that men and boys are better at computers than women and girls. Cooper (2006) suggests that this stereotype is ingrained in the socialization patterns experienced by females and males at home, school and in society at large. These socio-emotional experiences are the antecedents of the gender divide, i.e., increased computer anxiety usually experienced by females (Broos, 2005; Rees & Noyes, 2007). However, there is some recent evidence to suggest that gender inequality may be abating given the prevalence of computer exposure and use across society (Popovich, Gullekson, Morris, & Morse, 2008). Thus, it is of interest to include gender in the examination of potentially influencing factors in computer anxiety.

### 1.3. Students with SEN and computers

Researchers and professionals have viewed computers as affording opportunities for students with special educational needs (SEN). Florian (2004) suggests that computer use can facilitate individualised computer-based learning, enhance exploration and students' interactions with educational materials such that they can have more control over their learning. Florian also suggests that the tools of computer technology can provide access to information and provide new opportunities for students with SEN. This area of research has focused on students with sensory (blindness, deafness) and physical needs (Dobransky & Hargittai, 2006). Investigations involving students with SEN with learning limitations lags considerably behind (Harrysson, Svensk, & Johansson, 2004). Furthermore, there has been a lack of research investigating the perspective of SEN computer users themselves (Williams, 2006). It is not clear, for example, whether students with SEN perceive computers as important tools for their learning. It also not clear how comfortable they may feel with computer use. The prevalence of computer anxiety amongst students generally is substantial, affecting approximately 10% (King, Bond, & Blandford, 2002). However, no such quantitative data is available for young people with SEN. Are students with SEN over-represented among students experiencing computer anxiety?

A particularly relevant group of students are individuals with SEN whose difficulties relate to language. This is the case for at least two reasons. First, among students with SEN, problems with language are the most common type of difficulty affecting individuals (Vitkovitch, 2008). Second, language is a key factor in computer system interfaces. Thus students with SEN who have language difficulties may be particularly vulnerable to experiencing discomfort in computer use. In the present study we focus on students who have SEN related to language difficulties. These individuals are referred to as young people with specific language impairment (SLI).

### 1.4. SLI and computer anxiety

SLI is an interesting disorder as it involves marked difficulties with language in the absence of sensory impairment (e.g. deafness), learning difficulties or frank neurological damage (Bishop, 1997; Leonard, 1998). At early school entry age (around 5 years), SLI is common with an incidence of approximately 7% (Tomblin et al., 1997). This rate appears to decline with development. One of the few prevalence studies suggests that approximately 3% of adolescents experience SLI (McKinley & Larson, 1989). Thus, some individuals initially diagnosed with SLI appear to recover and attain normal language competence (Bishop & Edmunson, 1987; Botting, Faragher, Simkin, Knox, & Conti-Ramsden, 2001). However, there is a significant proportion of children who have continued difficulties with language and associated areas of functioning which extend through adolescence and into adulthood (Clegg, Hollis, Mawhood, & Rutter, 2005; Conti-Ramsden & Botting, 2008; Conti-Ramsden, Durkin, Simkin, & Knox, 2009; Durkin & Conti-Ramsden, 2007; Snowling, Adams, Bishop, & Stothard, 2001).

There are several reasons to expect that young people with linguistic impairments would be anxious in the face of language-dependent modes of learning. Importantly, much, though not all, computer use entails language. Computer user interfaces involve reading texts and instructions, seeking information, following hyperlinks and sending and receiving messages. Young people with SLI have difficulties in the production (Dockrell, Lindsay, Connelly, & Mackie, 2007; Mackie & Dockrell, 2004) and comprehension of written text (Bishop & Clarkson, 2003; Snowling, Bishop, & Stothard, 2000). Research indicates that the vocabulary demands of search engines can be off-putting for some young people (Livingstone & Bovill, 2001) and vocabulary growth tends to be poorer in individuals with SLI compared to typical peers (Beitchman et al., 2008). These findings suggest that young people with SLI are more likely to feel anxious when reading and writing with computers but also that language ability may well contribute to how comfortable typically developing young people feel when using the computer. Previous research with this sample of young people with SLI has revealed that they find computer applications generally less easy to use than their typically developing peers (Durkin, Conti-Ramsden, Walker, & Simkin, 2009).

In addition, young people with SLI often experience broader educational disadvantages. Their educational achievements tend to lag behind those of their peers through the school years (Conti-Ramsden et al., 2009; Dockrell, Lindsay, Palikara, & Cullen, 2007; Durkin, Simkin, Knox, & Conti-Ramsden, 2009). Hence, in general, educational work is likely to be more arduous for these children, and this may be particularly the case when working with the computer at home, where direct personal support is not always available. In the UK, young people are regularly given homework and are expected to undertake independent study. Increasingly they are required to use the Internet as well as off-line software (Kitchen, Mackenzie, Butt, & Finch, 2006). Common uses of computers for educational purposes include searching for information, using the Internet to revise for exams, downloading educational materials as well as using wordprocessing software and spreadsheets (Durkin, Conti-Ramsden et al., 2009). It is within this context of adolescents' educational experiences that we examine computer anxiety.

Adolescents with SLI are more likely to experience general anxiety than their peers. For example, Beitchman and colleagues followed up a cohort of children with SLI from 5 to 19 years of age, whom they assessed for psychiatric comorbidity. They found that in adolescence participants had higher rates of anxiety disorders (Beitchman et al., 2001). Clegg and colleagues (2005) followed a cohort of children from the age of four years to mid adulthood and found an increased risk of psychiatric impairment compared to both peers and siblings, particularly concerning social anxiety. Conti-Ramsden and Botting (2008) found increased general anxiety symptoms amongst adolescents with SLI regardless of the severity of their language and communication difficulties. In this sense, young people with SLI constitute an interesting group of individuals with regard to the examination of the potential influence of general anxiety on computer anxiety.

### *1.5. The present study*

In this investigation we aimed to compare levels of computer anxiety when using home computers for educational purposes in adolescents with and without a history of SLI. Given research findings related to the potential influence of demographic variables on computer anxiety (Beckers & Schmidt, 2003; Czaja et al., 2006) we ensured that all participants were the same age, all had access to a computer at home and all were in full-time education. The sample was drawn from a broad socio-economic spectrum and the language impaired and typically developing groups were matched for level of household income and maternal education. SLI is more prevalent in males than females (at a ratio of approximately 2:1, Silva, 1980). Thus, our sample reflects this gender ratio and comprises a larger proportion of males in both groups. In addition, we examine gender as a potential influencing factor. We were also interested in investigating the perspectives of adolescents themselves regarding computer use for educational purposes. To this end, participants completed interviews regarding computer anxiety and the other two key attitudes identified by Woodrow (1991): computer importance and computer enjoyment. In addition to language/literacy abilities and performance IQ, we measured perceived ease of use and general anxiety.

We expected that adolescents with SLI would experience higher levels of computer anxiety than their peers. However, it is less clear in adolescents with SLI whether computer anxiety is one manifestation of an overall more negative attitude towards computer use (which would include viewing computers as less important and less enjoyable to use) or whether computer anxiety and overall negative computer attitudes are more independent of each other. Part of the purpose of the present study is to examine the relationship between computer anxiety and other attitudes towards computer use as this may well be informative for intervention and support. We expected those with SLI to perceive computers as harder to use and to be more generally anxious. Within the context of recent work by Popovich and colleagues (2008) on the amelioration of the gender computer divide, our expectations with regard to gender and computer anxiety were not firm. We were interested in finding out whether we would observe a significant main effect of gender across both groups of adolescents participating in the study.

Given the ubiquity of language in computer use we expected language ability to be a predictive factor for both groups. However, given the wider range of language difficulties of young people with SLI, we expected this effect to be stronger for these adolescents. In light of evidence from previous literature regarding the relationship between perceived ease of use and computer anxiety, we expected perceived ease of use to be a strong predictor of computer anxiety for both groups of adolescents (Hackbarth et al., 2003; Saadé & Kira, 2007; Venkatesh, 2000). Finally, following Beckers et al. (2007), we expected that general anxiety would be a predictor of computer anxiety for both groups of adolescents.

## 2. Method

### *2.1. Participants*

#### *2.1.1. Adolescents with SLI*

The adolescents with a history of SLI in this investigation were originally part of a wider longitudinal study: the Conti-Ramsden Manchester Language Study (Conti-Ramsden & Botting, 1999a, 1999b; Conti-Ramsden, Crutchley, & Botting, 1997). This initial cohort was recruited from 118 language units attached to English mainstream schools. These language units provided a list of year two children attending for at least 50% of the week. Across England approximately 500 children fitted this criterion. All language units were asked to participate and two declined this invitation. Subsequently, approximately half of the eligible children in each unit were randomly sampled. This resulted in an initial study cohort of 242 children. The age range was 7;5–8;9 years and consisted of 186 males and 56 females (females forming 23.1% of the cohort). These children were reassessed as part of the original study at 8, 11, 14 and 16 years of age.

From the original cohort of 242 children described above, 111 (45.9% of the original cohort) were approached to participate in the present study. Longitudinal data showed that all of these adolescents met criteria for SLI at least at one time point (7, 8, 11, 14 or 16 years) prior to the data collection for the present study. These criteria comprised:

1. Performance IQ (PIQ) of 80 or more and at least one standardized language test score > 1*SD* below the population mean at one of the longitudinal assessment stages.
2. No sensory-neural hearing loss.
3. English as a first language.
4. No record of a medical condition likely to affect language.

Of the 111 adolescents invited to take part, 90 agreed to participate. An additional criterion was that these young people with a history of SLI had access to a computer at home and were in full-time education at the time of the study. This resulted in a final sample of 55 adolescents with a history of SLI (69% male and 31% female) aged between 16 years 2 months and 18 years 2 months (mean age 17;1 years).

*2.1.2. Typically developing (TD) adolescents*

A comparison group of adolescents from a broad background participated in the study. They had no history of special educational needs or speech and language therapy provision and had participated in the Manchester Language Study at the 16 year phase. The Manchester Language Study used Census data as per the 2001–2002 General Household Survey (Office of National Statistics) to target adolescents who would be representative of the range and distribution of households in England in terms of household income and maternal education. Ninety one TD adolescents agreed to participate. Of these a total of 72 TD adolescents (57% male and 43% female) participated in the present study. They were aged between 16 years 2 months and 17 years 10 months (mean age 16;10 years), had access to a computer at home and were in full-time education.

*2.1.3. Participants' socio-economic status background*

TD adolescents were matched in terms of age and socio-economic status (SES) to the adolescents with SLI. As part of a previous stage of assessment at 16 years of age, data were collected from participants' parents in order to ascertain levels of maternal education (no educational qualifications to degree level) and household income (<£5200 to >£52,000 per annum), as measures of SES. No significant differences were found between the adolescents with SLI and TD adolescents in maternal education level, $\chi^2(2, N = 122) = 1.78$, $p = .410$, or household income band, $\chi^2(3, N = 123) = 4.64$, $p = .200$. Importantly, therefore, the adolescents with SLI were similar to the TD adolescents in terms of socio-economic status indicators. Further, the household income of both groups ranged from the lowest bracket found in the 2001–2002 General Household Survey (Office of National Statistics) to the highest bracket and thus was representative of the range of household income distribution found in England as a whole.

## 3. Tests and materials

Two main considerations guided our choices of questionnaires for the interviews and standardized assessments. First, it was important to include instruments that had been used in previous research that could provide reliable, quantitative measures of the key areas of interest to the study and potential influencing factors. Second, we were interested in tapping the perspectives of adolescents. Thus, it was important to situate the relevant materials within the context of home computer use for educational purposes, i.e., homework, independent study, so that the adolescents could reflect on their feelings and experiences within this context.

### *3.1. Computer anxiety*

A short-version of the computer attitude questionnaire (CAQ; Knezek, Christensen, & Miyashita, 1998) that has been previously used in research in this area (e.g. Bovée, Voogt, & Meelissen, 2007) was used. Responses to 20 items were recorded using a four-point scale coded 1–4 (strongly disagree, disagree, agree, and strongly agree). Following guidelines from the CAQ, a measure of computer anxiety was derived. Computer anxiety is an affective component of the CAQ that examines fear of computers and the tendency of a person to be uneasy and apprehensive towards the use of computers. Examples of statements include: 'Working with a computer makes me nervous'; 'I get a sinking feeling when I think of trying to use the computer'. As a number of the computer anxiety items are reverse scored, a higher score on the anxiety scale denotes lower anxiety. The reliability of the anxiety scale was found to be high in this study ($\alpha = .83$), in line with the findings of the original authors.

### *3.2. Computer importance and computer enjoyment*

The CAQ provides guidelines for deriving two further measures: computer importance and computer enjoyment. Computer importance is a cognitive component and implies the degree of perceived usefulness of using computers for work. Examples of statements used in the CAQ include: 'I believe it is very important for me to learn how to use a computer'; 'I know that computers give me opportunities to learn many new things'. Computer enjoyment is an affective component and involves liking working with computers. Given that the focus of the study was on educational uses, where appropriate some items were customized to reflect this, e.g.: 'I enjoy doing things on a computer' (item one) became 'I enjoy doing educational things on a computer'. Other examples of statements used in the CAQ computer enjoyment component include: 'I enjoy educational computer games very much'; 'I enjoy lessons on a computer'. The reliabilities of these two components were found to be high in this study ($\alpha = .69$, $\alpha = .71$, respectively).

### *3.3. Psycholinguistic abilities*

To provide a profile of the adolescents' language-related abilities, a number of standardized assessments were carried out. The inclusion of performance IQ is usual in research with SLI in order to provide evidence of problems in the linguistic domain in the absence of overall learning difficulties.

1. Performance IQ (PIQ) was assessed using the full form of the Wechsler abbreviated scale of intelligence (WASI; Wechsler, 1999). The WASI is a battery of four tests (Vocabulary, Block Design, Similarities, and Matrix Reasoning) and is used to provide a brief measure of a person's intellectual ability. It can be used with people aged 6–89 years. The Block Design and Matrix Reasoning subtests were used to derive performance IQ. This test has been shown to have good reliability for performance IQ (.94–.96) as well as validity (.76–.84).

2. Language abilities were assessed using the Clinical Evaluation of Language Fundamentals – Fourth edition (CELF-4; Semel, Wiig, & Secord, 2003). The CELF-4 is an individually administered language test designed for 5–21 year olds. The core language score provides an overall assessment of language ability and is derived using the following subtests: Recalling Sentences, Formulated Sentences, Word Classes 2 (both receptive and expressive parts), and Word Definitions. The CELF-4 has been shown to have good reliability with stability coefficients for the above composite scores ranging from .88 to .92 as well as good validity as demonstrated by high correlations with other independent language measures (correlations of .80–.87).
3. Reading efficiency was assessed using the full form of the test of word reading efficiency (TOWRE; Torgesen, Wagner, & Rashotte, 1999). The TOWRE consists of two timed subtests: sight word efficiency and phonemic decoding efficiency. These are suitable for use with individuals aged 6–24 years. An overall measure of reading efficiency is derived from the two subtests. This test has been shown to have good reliability (.93–.96) and validity (.89–.84).
4. Literacy abilities were assessed using the reading and spelling subtests of the Wide Range Achievement Test – Third edition (WRAT-3; Wilkinson, 1993) to provide an overall literacy score. This test can be used with people aged 5–75 years. The WRAT-3 has been found to have good reliability (.92–.93) and validity (.83–.87).

### 3.4. Perceived ease of use

An overall index of perceived ease of use was derived based on the work of Durkin, Conti-Ramsden and colleagues (2009) on educational uses of computers at home. Nine questions (reported on a 1–4 scale from 'very hard' to 'very easy') regarding ease of use of the most common educational applications used by adolescents were included (e.g. downloading educational materials, using the internet to revise for exams, using spreadsheets, using online libraries, using word processing). A Cronbach's $\alpha$ of .71 was found for the sample in the present study.

### 3.5. General anxiety

The child manifest anxiety scale (CMAS-R; Reynolds & Richman, 1978) was used in this study. This is a 28 item questionnaire designed to measure anxiety symptoms in young people aged 6–18. Adolescents were required to say whether statements are 'true' or 'not true' for the previous 3 months. A Cronbach's $\alpha$ of .88 was found for the sample in the present study.

### 3.6. Procedure

Each young person was individually assessed and interviewed in a quiet room or area, at home or in school. The measures detailed above were administered as part of a wider battery of assessments and interviews. Portions of the battery (i.e., some of the interviews) were carried out over the telephone for those adolescents for whom a further personal visit was not practical. The standardized assessments of IQ, language and literacy were administered in the manner specified by the test manuals. The interviews entailed the researcher reading the questions/statements aloud to the participants and offering them the response options. Care was taken to ensure all the participants comprehended the questions/statements and the response options. The participants were given additional clarification if needed. The participants indicated their choice by responding verbally and this was noted by the researchers on the interview sheet. Ethical approval for the study was gained from The University of Manchester. Informed written consent was gained from all participants.

## 4. Results

### 4.1. Computer anxiety

A 2 (group: SLI v. TD) $\times$ 2 (gender) ANOVA was conducted with computer anxiety as the dependant variable. Results revealed two main effects. Young people with SLI were significantly more anxious than TD peers ($M = 3.07$ $SD = 0.49$, and $M = 3.26$ $SD = 0.51$, respectively), $F(1, 123) = 7.46$, $p = .007$, $d = 0.40$, and females were significantly more anxious than males ($M = 3.05$ $SD = 0.59$, and $M = 3.26$ $SD = 0.44$, respectively), $F(1, 123) = 7.96$, $p = .006$, $d = 0.38$, with regard to use of their home computers for educational purposes. The interaction however was not significant ($p = .31$).

### 4.2. Computer importance and computer enjoyment

Results revealed identical levels of perceived computer enjoyment across groups ($M = 3.02$ $SD = 0.39$, and $M = 3.02$ $SD = 0.37$, respectively). In addition, adolescents with SLI were significantly more positive than TD adolescents with regard to the importance of computers, ($M = 3.09$ $SD = 0.44$, and $M = 2.92$ $SD = 0.39$, respectively, $t(125) = 2.25$, $p = .026$, $d = 0.40$). Further analysis revealed a strong correlation

**Table 1**
Psycholinguistic profiles (standard scores) of adolescents with SLI and TD adolescents.

| | Adolescents with SLI | | | TD adolescents | | |
|---|---|---|---|---|---|---|
| | *N* | *M* | *SD* | *N* | *M* | *SD* |
| Performance IQ (PIQ) | 55 | 93.0 | 17.8 | 72 | 108.0 | 10.6 |
| Language | 54 | 70.1 | 19.4 | 72 | 104.4 | 12.2 |
| Word reading efficiency | 55 | 73.5 | 17.2 | 72 | 95.9 | 12.7 |
| Literacy | 54 | 83.4 | 15.1 | 71 | 103.4 | 9.3 |

All *p*-values < .001.

between computer importance and computer enjoyment ($r$ = .52). Correlations with computer anxiety were moderate for computer importance ($r$ = .35) and very strong for computer enjoyment ($r$ = .80) whereby less anxious young people enjoy using the computer more. Similar patterns were found when each group was examined separately.

### 4.3. Participant language profiles

All 127 adolescents had psycholinguistic data available from the present stage of the study (see Table 1). As expected, $t$-tests revealed that TD adolescents performed significantly better than adolescents with SLI on a range of psychometric language and literacy tests (all $p$-values < .001).

Adolescents with SLI were classed as currently impaired if, at the time of the study, they met the following criteria for SLI: PIQ (WASI; Wechsler, 1999) of 80 or more and concurrent expressive or receptive language index score (CELF-4 Semel et al., 2003) less than 85. Exactly 60% of the adolescents with SLI (33/55) were classified as meeting criteria for SLI at the time of the study. The remaining 40% had all met the established SLI criteria at some point in the last 10 years. Of this group, 11 (20% of the total) demonstrated concurrent normal PIQ and language ability and 11 (20% of the total) showed PIQ and language ability in the impaired range. None of the adolescents had impaired nonverbal abilities but normal language scores. Therefore, at the time of the study, a total of 44/55 of the adolescents (80%) had concurrent language difficulties.

Of the TD adolescents, 62/72 (86.1%) had normal PIQ and language scores (as defined above). 9/72 (12.5%) had normal PIQ but low expressive or receptive language and 1/72 (1.4%) had normal language but low PIQ. None of the TD adolescents had both low nonverbal and language skills. Thus, regardless of PIQ, 63/72 (87.5%) of the TD adolescents had normal language functioning. It is to be expected that a representative sample of TD adolescents without a history of special education or language problems drawn from the full range of the socio-economic spectrum would include some adolescents who obtain poor scores on language or other psycholinguistic measures (Durkin & Conti-Ramsden, 2007).

### 4.4. Perceived ease of use

Data on the perceived ease of use of educational applications can be found in Table 2. In general, adolescents with SLI ($M$ = 3.08 $SD$ = 0.38) found it harder to use educational applications than did the TD adolescents ($M$ = 3.25 $SD$ = 0.34), $t(107) = 2.44$, $p = .016$, $d = 0.47$. Examination of each of the individual applications studied suggested that, in particular, adolescents with SLI found it harder to use the Internet to revise for exams, $t(58) = 3.77$, $p < .001$, $d = 0.85$, and to use the computer for word processing, $t(107) = 2.53$, $p = .013$, $d = 0.50$.

### 4.5. General anxiety

Adolescents with SLI were more generally anxious than TD peers, $M$ = 10.09 $SD$ = 6.48, and $M$ = 7.19 $SD$ = 4.97, respectively, $t(98) = 2.75$, $p = .007$, $d = 0.50$.

### 4.6. Relationships among computer anxiety, language abilities, ease of use and general anxiety

We examined the associations amongst computer anxiety, psycholinguistic characteristics (PIQ, language, and literacy), ease of use and general anxiety. Results revealed a number of strong correlations across the psycholinguistic characteristics for both groups of adolescents (see Table 3). In addition, there were strong correlations between ease of use and computer anxiety, and moderate correlations between language and computer anxiety, for both groups of adolescents. There were strong correlations between general anxiety and computer anxiety and moderate correlations between general anxiety and ease of use for both groups of adolescents. There were also moderate correlations between literacy and ease of use for the adolescents with SLI only, and between general anxiety and language for the TD adolescents only.

**Table 2**
Perceived ease of use of different educational applications for adolescents with SLI and TD adolescents.

| | Adolescents with SLI | | | TD adolescents | | |
|---|---|---|---|---|---|---|
| | *N* | *M* | *SD* | *N* | *M* | *SD* |
| *Online* | | | | | | |
| Use Internet to search for information | 45 | 3.31 | .56 | 67 | 3.22 | .65 |
| Download educational material | 9 | 3.11 | .60 | 25 | 3.16 | .47 |
| Use an online library | 3 | 3.00 | .00 | 14 | 3.21 | .43 |
| Use online discussion groups | 3 | 2.67 | .58 | 8 | 3.25 | .71 |
| Use internet to revise for exams | 30 | 2.63 | .56 | 58 | 3.10 | .55*** |
| Use internet to track information | 10 | 2.90 | .57 | 17 | 3.12 | .33 |
| *Offline* | | | | | | |
| Word processing | 44 | 3.27 | .59 | 65 | 3.54 | .50* |
| Spreadsheets/databases | 21 | 2.90 | .70 | 45 | 3.09 | .63 |
| Presentation software | 22 | 3.14 | .71 | 43 | 3.40 | .50 |
| Overall perceived ease of use | 44 | 3.08 | .38 | 65 | 3.25 | .34* |

* $p < .05$.
*** $p < .001$.

**Table 3**
Correlation matrix across the variables examined for adolescents with SLI and TD adolescents.

| Variable | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| 1. Computer anxiety | .17 | **.29**$^{*}$ | .05 | .06 | **.46**$^{**}$ | **−.44**$^{**}$ |
| | .11 | **.24**$^{*}$ | −.11 | .04 | **.53**$^{***}$ | **−.29**$^{*}$ |
| 2. PIQ | . | **.50**$^{***}$ | **.39**$^{**}$ | **.35**$^{**}$ | .22 | .07 |
| | . | **.45**$^{***}$ | .06 | **.30**$^{*}$ | −.02 | −.06 |
| 3. Language | | . | **.69**$^{***}$ | **.68**$^{***}$ | .13 | -.02 |
| | | . | **.48**$^{***}$ | **.60**$^{***}$ | .16 | **−.24**$^{*}$ |
| 4. Word reading efficiency | | | . | **.88**$^{***}$ | .12 | .08 |
| | | | . | **.64**$^{***}$ | .12 | −.15 |
| 5. Literacy | | | | . | **.30**$^{\#}$ | .11 |
| | | | | . | .02 | −.02 |
| 6. Ease of use | | | | | . | **−.33**$^{*}$ |
| | | | | | . | **−.26**$^{*}$ |
| **7.** General anxiety | | | | | | . |
| | | | | | | . |

*Note*: Upper value in each cell denotes SLI, lower value denotes TD.
Bold font denotes significant correlations.
$^{*}$ $p < .05$.
$^{**}$ $p < .01$.
$^{***}$ $p < .001$.
$^{\#}$ $p = .050$.

### 4.7. What predicts computer anxiety?

As there were significant differences in computer anxiety between the groups, regression analyses were carried out for each group separately. Hierarchical regressions were conducted with computer anxiety as the outcome variable. Only the variables significantly correlated with the outcome variable were included as predictors. Given our interest in language abilities, language was entered first, followed by ease of use and general anxiety in the second step.

The regression models are presented in Table 4. The models were significant at step one and step two for both the adolescents with SLI, $F(1, 42) = 6.11$, $p = .018$, and $F(3, 40) = 9.70$, $p < .001$, respectively, and the TD adolescents $F(1, 63) = 4.25$, $p = .043$, and $F(3, 61) = 9.95$, $p < .001$, respectively. Language contributed significantly towards educational computer anxiety for both groups of adolescents. However, the model accounted for 11% of the variance for the adolescents with SLI (medium effect size) but only 5% of the variance for the TD adolescents (small effect size). After accounting for language abilities, overall ease of use and general anxiety added an additional 27% of variance for the adolescents with SLI (large effect size) and overall ease of use added an additional 25% of the variance for the TD adolescents (large effect size). In the final model, language abilities, ease of use, and general anxiety contributed significantly to computer anxiety in adolescents with SLI, explaining 38% of the variance. For the TD adolescents, ease of use was the only significant predictor in the final model which explained 30% of the variance.

Given the findings of a gender main effect, the models were repeated with gender as a control in a first step. Neither the models nor the gender variable were significant. The addition of gender did not change the above pattern of findings nor the magnitude of the effect sizes.

## 5. Discussion

This is the first study to investigate computer anxiety in adolescents with a history of specific language impairment. The findings indicate that adolescents with SLI experience more computer anxiety than their typically developing peers when using their home computers

**Table 4**
Hierarchical regression analyses predicting computer anxiety.

| Variable | Unadj. $R^2$ | $\Delta R^2$ | Adj. $R^2$ | $f^2$ | B | SE B | $\beta$ |
|---|---|---|---|---|---|---|---|
| *Adolescents with SLI* | | | | | | | |
| Step 1 | .127 | | .106 | 0.15 | | | |
| Language | | | | | .009 | .004 | .356$^{*}$ |
| Step 2 | .421 | .294 | .378 | 0.51 | | | |
| Language | | | | | .007 | .003 | .271$^{*}$ |
| Ease of use | | | | | .383 | .165 | .298$^{*}$ |
| General anxiety | | | | | −.029 | .010 | −.373$^{**}$ |
| *TD Adolescents* | | | | | | | |
| Step 1 | .063 | | .048 | 0.07 | | | |
| Language | | | | | .010 | .005 | .251$^{*}$ |
| Step 2 | .328 | .265 | .295 | 0.39 | | | |
| Language | | | | | .006 | .004 | .146 |
| Ease of use | | | | | .700 | .164 | .466$^{***}$ |
| General anxiety | | | | | −.015 | .011 | −.150 |

$^{*}$ $p < .05$.
$^{**}$ $p = .01$.
$^{***}$ $p < .001$.

for educational purposes. Level of general anxiety, perceived ease of use and language ability had a direct association and were predictive of level of computer anxiety in young people with SLI. In contrast, although language ability and general anxiety were correlated with computer anxiety, only perceived ease of use was significantly predictive of typically developing young people's level of computer anxiety.

Importantly, the findings revealed that computer anxiety in young people with SLI is not simply a manifestation of an overall negative attitude towards home computer educational uses. To the contrary, despite their lower language skills adolescents with SLI were very much like their TD peers in perceiving home computers as enjoyable to use. Furthermore, adolescents with SLI appeared to be even more aware than their peers of the importance of home computer use for their education. Adolescents generally viewed computers as an important learning tool. These positive attitudes may have been influenced not only by the kinds of personal experiences the youngsters may have had (Beckers & Schmidt, 2003; Saadé & Kira, 2007) but also by institutional ethos. The integration of information technology in education today highlights its capability to support pupils in their own learning, emphasizing the potential of the technology to cater for individual pupils' needs (Salomon, Lajoie, & Derry, 1993). In this sense, it is possible that adolescents with SLI who have a history of difficulties with education (Conti-Ramsden et al., 2009; Durkin, Simkin et al., 2009) are more sensitive to the potentiality of the computer as a helping device to increase or improve their performance.

Nevertheless, these broadly positive attitudes need to be situated within the context of increased computer anxiety experienced by the young people with SLI. Why are adolescents with SLI more anxious about the use of home computers for educational purposes? In order to contextualize these findings we need to recall that the adolescents were asked to reflect on their experiences with computers at home, when carrying out homework or independent learning. Thus, school/college work provided the motivation for the adolescents to reflect on their experiences when using the computer. The adolescents had also rated a number of educational applications for their ease of use. These included online facilities (e.g. using online libraries, using the Internet to revise for exams) as well as offline materials (e.g. word-processing packages, spreadsheets). These applications also provided a background within which the adolescents' reflections were situated. Consequently, the anxiety measure used here reveals discomfort in the use of computers within this context and cannot be generalized to other home computer uses such as gaming or Internet surfing for fun.

The findings of the present study revealed a complex relationship between linguistic, attitudinal and emotional factors and computer anxiety. We expected language ability to play a role and this was confirmed. Those young people with poorer language skills experience greater computer anxiety than those with better language skills. This was a medium effect size for adolescents with SLI that remained significant in the context of other influencing factors. For typically developing adolescents, there was also an association between language ability and computer anxiety but the effect size was small and the relationship became non-significant in the context of attitudinal and emotional factors. Taken together, these findings indicate that language abilities are important for individuals' feelings of discomfort with educational uses of the computer but that this relationship is more evident when language abilities are significantly compromised, as they are in the case of SLI.

In line with previous research (Hackbarth et al., 2003; Venkatesh, 2000), we found a strong relationship between perceived ease of use and computer anxiety in both groups of young people. How much adolescents perceive educational uses of home computers as free of effort influences how comfortable they feel using them. For typically developing young people, this is the most predictive and significant factor contributing to computer anxiety, even in the context of other potentially influencing factors such as language skills and level of general anxiety. Interestingly, the amount of variance explained by the model for the TD youngsters (30%) is very similar to that reported by Davis (1993) with regard to the technology acceptance model (TAM). The TAM, which has perceived ease of use as a key attitudinal component, accounts for approximately one third of the variance of computer use. For adolescents with SLI, perceived ease of use was also an important influencing factor, but the magnitude of its influence was similar to the effect of language abilities on computer anxiety. This was in the context of adolescents with SLI generally finding computers harder to use than their TD peers. These results suggest that at least for certain types of users, non-attitudinal (ability) factors are as important as perceived ease of use in understanding technology acceptance and degree of comfort with its use.

The possible implications of general anxiety for more specific computer anxiety were also a focus of this investigation. Recent research suggests that computer anxiety is a complex phenomenon which may harbour components of more general anxiety (Beckers et al., 2007). Like Beckers et al. we found a relationship between general anxiety and computer anxiety for both groups of adolescents. However, general anxiety was predictive of computer anxiety only for adolescents with SLI and not for their TD peers. Furthermore, general anxiety was the strongest predictor of computer anxiety for adolescents with SLI, exerting a stronger influence than language ability and perceived ease of use. Thus, general anxiety appears to be a crucial factor in developing our understanding of computer anxiety in young people. Indeed, this investigation adds to the work of Beckers and colleagues and suggests that the relationship between general anxiety and computer anxiety is likely to be stronger in vulnerable groups of individuals, such as young people with language limitations. Further research with individuals with a range of special educational needs is required to better understand factors relating to computer anxiety. There is a pressing need also to address more general issues regarding the usability of information and communication technology for what constitutes a significant proportion of young people in education (Stevens, 2004; Williams, 2006; Williams, Jamali, & Nicholas, 2006).

The results of the present study with regard to gender were mixed. Overall, females were more anxious than males about educational uses of computers, a common but not universal finding in the literature (Broos, 2005; Popovich et al., 2008). This was generally the case for adolescents, regardless of whether they had language problems or not. However, gender was not a key predictive factor of computer anxiety in the context of other influential variables such as perceived ease of use. These findings suggest that concerns about gender inequality and computer anxiety are still warranted but that other factors are likely to play a more direct role.

Finally, the findings have practical implications for interventions targeted to alleviate computer anxiety. An exclusive focus on specialised training regarding the specific intricacies of computer systems/applications is unlikely to be successful and provide a lasting solution, at least for a proportion of individuals. An approach based mainly on gender, targeting females, is also unlikely to be successful. Other influential factors, such as language skills and in particular general anxiety, are likely to need addressing in supporting individuals overcome their feelings of discomfort. Intervention is likely to have to be multifaceted. The good news is that young people with SLI bring to the situation a positive attitude towards the usefulness and enjoyment that computer use can bring which can be harnessed in the intervention process. The challenge is for the support to be available early so that negative attitudes do not have the opportunity to become established. It is known that attitudes not only influence current behaviours but also have an impact on what individuals engage with in the future (Teo,

2008). In the case of adolescents who are making the transition to adulthood, computer anxiety is likely to be a disadvantage in both further education (e.g. taking online courses) and occupational contexts.

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