TECHNOLOGY, DISABILITY AND COMMUNICATION:
USER VIEWS AND RELIABILITY

A thesis submitted to The University of Manchester for the degree of
Doctor of Clinical Psychology
in the Faculty of Medical and Human Sciences

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RUTH SEED

SCHOOL OF PSYCHOLOGICAL SCIENCES
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Paper 2

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This thesis investigated the use of technology, the benefits this can offer, and the experience of using technology, for individuals with a range of difficulties that impact on their learning. It also explored the benefits of technology for facilitating children to communicate.

Paper 1 is a meta-synthesis of qualitative studies exploring the experience of using different types of technology for children, young people and adults with learning difficulties and disabilities. A systematic literature search of nine databases, specific journals and Google Scholar identified 1221 studies, of which ten met inclusion criteria. Noblit and Hare's (1988) meta-ethnographic approach and Britten et al.’s (2002) second- and third-order interpretations were used to synthesise the studies, resulting in three themes and nine sub-themes, and third-order interpretations to inform further research. A model of overarching themes and those unique to people with learning disabilities was developed and clinical implications were discussed.

Paper 2 is an empirical paper exploring the comparability of an iPad application (app) assessment tool called This Much! as a response modality for a paper-based health-related quality of life measure. It explored the use of different statistical methods to test agreement between response modalities, including correlation, paired samples t-test, and a recommended approach which is the Bland and Altman method (1986). Finally it explored the acceptability of the iPad app for children. Seventy children aged 5 to 9 years completed the paper and iPad app response modalities in a counter-balanced design and indicated their preference. All children could use the iPad app and the majority understood the questionnaire across both modalities. The two modalities did not show acceptable agreement in total scores, and only the recommended approach to measuring agreement between methods identified this. Fifty seven children (82.6%) reported preferring the iPad format.

Paper 3 is an empirical paper that builds on Paper 2, exploring the feasibility of the iPad app response modality with children with special educational needs (SEN). It included 15 children aged 5 to 10 years in mainstream primary schools with a range of SEN. It examined their understanding of the questionnaire, their use of and engagement with the iPad app, their response times to the different subscales, and their views on the iPad app. All children were able to use the iPad app regardless of their level of understanding. It discussed the potential for the iPad app to facilitate assessment with children with SEN in an engaging and accessible way, and some of the difficulties children experienced with this.

Paper 4 is a critical reflection on the research process as a whole and on the individual papers described above, in terms of methodology, clinical and research implications, and personal reflections.
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What do people with learning difficulties and disabilities think about using technology?

A meta-synthesis

Prepared in accordance with requirements for submission to

*Computers and Education* (Appendix A)
What do people with learning difficulties and disabilities think about using technology?

A meta-synthesis

Abstract

This review describes a meta-synthesis of qualitative studies exploring the views of children and adults with learning disabilities and specific learning difficulties on using technology. Technology was defined as including hardware (such as electronic devices and computers), software and the Internet. A systematic search of nine databases and specific journals identified 10 studies, which were quality-assessed and then synthesised using Noblit and Hare's (1988) meta-ethnographic approach and Britten et al.'s (2002) second- and third-order interpretations. Three themes were identified; 'The outcomes of using technology', 'The process of using technology' and 'Technology and the people around me', comprising nine sub-themes. A model of overarching themes and those unique to people with learning disabilities was developed. Recommendations for effective technology use and future research are discussed.

Key words: Systematic review; Synthesis of qualitative evidence; Educational technology; Post-secondary education.
Highlights

- Interviewing people with learning difficulties & disabilities gains rich insights.

- There were overall themes & themes unique to people with learning disabilities (LD).

- ‘The outcomes of using technology’ included learning, independence & new roles.

- Helpful/unhelpful features, support level & relational aspects influenced outcomes.

- The views of and support from others influenced how people with LD used technology.
Introduction

The context

Technologies can take many forms, including everyday devices such as phones and computers, as well as more specialist assistive and communication devices. The variety of available software and applications is vast, from accessing the Internet or social media, to apps on iPads and virtual environments. The value of technology for people with learning difficulties and disabilities (LDD) has long been recognised (Abbott, 2007; Aspinall & Hegarty, 2001) and is reflected at government level (Valuing People; Department of Health, 2001). Alongside these developments has been a growing acceptance that people with learning disabilities are the experts in their own views and lives (Stalker, 1998) and a recognition of the importance of consulting with technology users (Clarke, McConachie, Price, & Wood, 2001). With this in mind, it is timely to review our understanding of the views of technology users with LDD.

For children and adults with LDD, technology in its many forms has increased access to learning and employment, provided and enhanced education, and facilitated independence, communication and consultation (Almekhalfi & Tibi, 2012; Barrow & Hannah, 2012; Church et al., 2000; Florian, 2004; Stendal, 2012). Through these benefits there is potential for enhancing quality of life (Renblad, 2003). Despite this, people with LDD are not always enabled to use technology effectively (Brodin, 2010) and continue to lack choice and control in their lives (Jingree, Finlay, & Antaki, 2006). Their views are essential in understanding the experience of, and the barriers to, using technology. It is important to explore whether the benefits described above are those identified and valued by users, and to what extent particular issues such as stigma or lack of access are part of the experience.

Quantitative research

Quantitative approaches to gathering the views of technology users with LDD are increasingly used. For example, surveys have examined the relationship between the use of communication devices and loneliness (Stancliffe et al., 2010) and the acceptability of assistive technology (AT) has been evaluated via social validity questionnaires (Scheeler,
Macluckie, & Albright, 2010). Quantitative reviews have described how individuals use and experience technology (Abbott, 2007; Williams, Jamali, & Nicholas, 2006). However where qualitative papers are included in reviews (e.g. Stendal, 2012) these may involve proxy-interviews or individuals with physical disabilities only. Mixed-methods approaches are increasingly used (Breivik & Hemmingsson, 2013; Okolo, Rieth, & Bahr, 1989) although quantitative elements often remain the focus.

**Qualitative research**

Qualitative approaches enable us to "understand and represent the experiences and actions of people as they encounter, engage, and live through situations" (Elliott, Fischer, & Rennie, 1999, p.216). This can lead to richer data and greater insight into areas outside those considered by researchers (Downe, Simpson, & Trafford, 2007). Between 1999 and 2011 qualitative research relating to people with learning disabilities (LD) doubled across three major learning disability journals (Beail & Williams, 2014), however just under half involved people with LD as the interviewees.

One reason for this may be the challenges of interviewing people with cognitive or communication difficulties, and associated with their participation in interviews or focus groups (Beail & Williams, 2014). Simple questions can help individuals with receptive language impairments however this has implications for when discussing abstract concepts. While closed questions risk acquiescence (Sigelman, Budd, Spanhel, & Schoenrock, 1981), open questions are associated with issues concerning articulation and generalising ideas (Booth & Booth, 1996). The higher levels of support needed can unintentionally influence individual's responses or represent coercion when gathering consent (Cameron & Murphy, 2007; Lewis, Newton, & Vials, 2008). Despite there being numerous ways to overcome these difficulties (e.g. Nind, 2008) there will likely be a limit to what people with more profound difficulties can be enabled to express (Beail & Williams).

Successful use of qualitative methods has generated meaningful insight into users' experiences. Technology can be viewed as useful and enjoyable (e.g. Clarke et al., 2001; Jeffs, Behrmann, & Bannan-Ritland, 2006; Renblad, 2003) however a range of barriers also exist. People with communication devices have described the potential for reducing
loneliness and making friends, but that devices could be viewed as 'uncool', 'boring', 'embarrassing', too 'slow' and 'difficult' (Clarke et al.) and peer attitudes to AT can have particular influence (Breivik & Hemmingsson, 2013). The potential for empowerment through technology use has been identified, but that access to appropriate support and the disparate views of significant others can be an issue (Bevan, 2003; Renblad). When negative aspects of technology use can influence whether devices continue to be used (Jeffs et al., 2006) there is a clear need to understand users’ views.

The review

With expansion in the field of technology providing increased opportunities for learning, independence and communication, and increasingly more studies exploring users’ views, a review of the qualitative literature to date appears timely. This review aimed to present a meta-synthesis of qualitative papers exploring the experience (including benefits and barriers) of using different types of technology for individuals with LDD. Through situating studies in a larger interpretive context, meta-synthesis can enable them to have greater impact (Sandelowski, Docherty, & Emden, 1997). It aimed to:

1. Review the current state of knowledge about the experience of using technology for children, young people and adults with LDD.

2. Review the representation of different technologies (e.g. AT, software, virtual environments, Internet).

3. Develop new understandings of users’ experiences with particular reference to their age, the type of technology and the level of their difficulties.

The review considered people living with a learning disability (LD) or specific learning difficulties (SLD):

- LD; a "significantly reduced ability to understand new or complex information, to learn new skills...with a reduced ability to cope independently...which started before adulthood, with a lasting effect on development" (Department of Health, 2001, p.14).

- SLD; an educational term used to describe difficulties such as dyslexia.
Although the difficulties experienced by people with LD and SLD are different in many ways, and the challenges to their participation in qualitative research vary, the views of all users are important and necessary in developing an understanding of the experience of using technology.

Method

Literature search

The research involved a systematic literature search and a meta-synthesis of the studies identified. Nine relevant databases (PsychINFO, Embase, CINAHL, Medline, Science Direct, Web of Science, PubMed, AMED and ERIC) were searched systematically. This was supplemented by manually searching two journals (International Journal of Qualitative Studies in Education and Assistive Technology) and Google Scholar. The qualitative journal was searched as qualitative research can be under-represented in databases (Bhati, Hoyt, & Huffman, 2013) and Assistive Technology was searched as it contained several relevant papers. No restrictions on publication date were specified as the results would be limited by the invention of electronic technology. Only English-language papers were included.

Prior to searching the literature it had been intended to include only studies involving people with LD and Autism Spectrum Disorder (ASD). However a number of North American papers using the term LD to mean SLD were identified during the search. These were included as people with a range of difficulties use technology and this offered the possibility of exploring differences in the themes that arose.

Search terms

Four different categories of search terms were combined using the OR and AND functions (see Appendix B). These included terms for technology (e.g. technolog*, computer), the sample (intellectual disabilit*, learning disabilit*, including historic terms), the exploration of views (perspective, preference) and the methodology (qualitative, interview).
Studies were included if they:

1. Explored the views of individuals of any age with LD, SLD or ASD on technology (including hardware such as electronic devices and computers, software, and the Internet). Studies that also interviewed others were included, provided that their views could be clearly differentiated.

2. Described an original study utilising a qualitative or a mixed-methods approach.

3. Were published in a peer-reviewed journal.

Studies were excluded if they:

1. Reported the views of individuals who did not have LD, SLD or ASD (e.g. brain injury, or sensory, communication or physical impairments alone).

2. Did not focus at least partly on views about technology.

3. Provided insufficient quotes to support the analysis or only descriptive results with no element of interpretation.

The literature search identified 1221 studies, and following the removal of duplicates and non-journal articles 1002 remained. The titles and abstracts of these were reviewed based on the inclusion criteria and 48 were retained. The full texts of these were read and seven meeting criteria were retained. The reference lists of these were checked resulting in 10 papers for the meta-synthesis (see Appendix C for flow diagram of the process).

**Researcher’s background and beliefs**

The first author was a trainee clinical psychologist working in a multi-disciplinary community setting with individuals with LD. She has an interest in quality of life, the potential for technology to enable this, and the value of consultation.

**Critical appraisal**

There is continuing controversy about the quality assessment of qualitative papers (Downe, 2008) and quality assessment tools are not widely agreed upon or established.
(Walsh & Downe, 2006). However one argument is that some consideration of confirmability and credibility is needed if qualitative research is to contribute to care or change policy and practice (Downe; Walsh & Downe).

Walsh and Downe's (2006) framework was selected as it comprises the aspects considered essential in existing checklists. This includes scope and purpose, design, sampling strategy, analysis, interpretation, reflexivity, ethical dimensions and relevance and transferability (see Appendix D). It assigns a rating in relation to the credibility, transferability, dependability and confirmability of each study, from A (no or few flaws), B (some flaws but unlikely to affect the credibility etc), C (some flaws which may affect this) or D (significant flaws which are very likely to affect this) by Downe et al. (2007; adapted from Jackson, unpublished). The studies were critically appraised using the tool to weight each paper during synthesis. Additional information was gathered about support provided to participants in understanding the research and interview questions, and whether there was sufficient detail about the sample.

In order to establish inter-rater reliability of quality ratings, an independent researcher rated three studies, two of which they gave harsher ratings than the researcher (by one unit). Following discussion and arrival at a consensus, the researcher adjusted ratings where necessary and reflected on their personal biases. Only the qualitative aspects of the mixed-methods studies were considered as this was the focus of interest and likely to provide richer data.

**Synthesis process**

A meta-ethnographic approach to meta-synthesis was followed (Noblit & Hare, 1988; see Appendix E) although studies taking a range of theoretical perspectives were included (Downe, 2008). The researcher immersed themselves in the findings by reading each study several times. Key themes and concepts in each study were identified and were compared and contrasted across all studies to look for relationships, holding in mind each study's purpose and context. The studies were then translated into one another through a process of comparing the core themes and their relationships between studies (reciprocal translation) and considering how they refuted one another (refutational translation). This was combined
into the synthesis and resulted, once checked against the original studies for coherence, in a final synthesis comprising three themes and nine sub-themes.

Within the translation, second- and third-order interpretations were used (Britten et al., 2002; based on Schutz, 1962) which distinguish the interpretations made by the authors of each paper (second-order) from interpretations of these interpretations, made by the review author (third-order). The relationships between the papers appeared to be reciprocal as contradictions were not identified, and therefore a line of argument was developed involving third-order interpretations, which go beyond the interpretations within and between papers.

Results

**Characteristics of included studies**

All studies were published between 2005 and 2013. They collectively represented the views of 98 individuals with LDD aged 9 to 45 years. Two studies utilised focus groups and eight used interviews. Inadequate sample descriptions meant that two papers could only be classified cautiously as involving people with SLD.

Three qualitative studies included people with LD. One was conducted in the UK within a specialist educational setting asking students about Information and Communications Technology (ICT) in their lives. Two were conducted in Sweden with adults with mild LD or developmental disabilities using AT in the community. Limited information was provided about participant's level of difficulty, and only one study adequately described participant's communication abilities.

Seven studies appeared to involve people with SLD in educational settings in North America and therefore mainly used the term 'LD' to refer to SLD. Only one study defined SLD, although two specified that individuals had difficulties with reading comprehension or literacy. Four studies included some individuals who also had Attention Deficit Hyperactivity Disorder (ADHD). Three studies interviewed students about AT, three about online/blended courses, and one about computer-based tests. Four studies were qualitative and three were mixed-methods (see Appendix F for details).
**Quality of included studies**

All studies were rated between B and D (B=4, C=2, D=4). The four D-rated studies were not excluded as there is considerable variation in the definition of quality within qualitative research (Sandelowski et al., 1997). The researcher ensured that each sub-theme was supported by at least two studies (one B-rated) to reduce reliance on lower-rated studies. All three mixed-methods studies were D-rated, which for two may have resulted from the primary focus being quantitative.

Few studies included discussion or rationale for the researcher's theoretical approach or the specific qualitative methods. Justification of the sampling strategy and retention of context during analysis were rarely discussed, and data saturation was mentioned by none. There was little description of the social, physical and interpersonal contexts of data collection, and most did not demonstrate researcher reflexivity. When interviewing people with more significant difficulties, more concrete questions and a more proactive role for the researcher in interpretation was necessary (e.g. Bunning, Heath, & Minnion, 2009), however reflection on the possible impact of this was needed.

Ethical approval was mentioned only in studies involving people with LD. In seven studies, including one with people with LD, additional support in understanding the research and gathering consent was not mentioned, and six did not mention additional support in understanding the interview questions (see Appendix G). The sparse sample descriptions made it difficult to judge whether this would have been necessary.

**Synthesis**

The synthesis resulted in three over-arching themes and nine sub-themes that captured the views of technology users with LDD in the papers synthesised (Appendix H). Two themes, *The outcomes of using technology* and *The process of using technology* were identified across studies, however *Technology and the people around me* was unique to people with LD. The relationship between the themes is described below and presented in Figure 1. Appendix I presents the second- and third-order interpretations. These are also
woven into the written synthesis, with third-order interpretations specifically identified to show the lines of argument.

Figure 1. Diagrammatic representation of the synthesis.

The process of using technology involved numerous factors that influenced the outcome for users, including intrinsic aspects of the technology such as helpful versus unhelpful features, which often coexisted. A common barrier was a support mismatch, when the individual needed more help using the technology than was provided (sometimes exacerbated by unhelpful features). Helpful features and appropriate support enabled technology to be used successfully which was associated with individuals feeling connected; however the opposite could lead people to feel disconnected from others.

The most common outcome of using technology was that it increased people’s independence and autonomy, or that educational technology helps my learning. The role of technology in my life formed part of this. Technology enabled some people to acquire new
roles however there were differing views about whether people wanted technology to be a temporary or lifelong support.

For people with LD, *technology and the people around me* played a significant role in determining how they used technology. Many people described that *I have to rely on others* in order to use technology, which meant that *the influence of other's views* (often negative) could impact on whether they were willing or able to use technology. In contrast, some individuals described that *I choose to have help from people* rather than technology.

**Theme 1: The process of using technology**

**Sub-theme 1: Helpful versus unhelpful features**

The decision about whether a feature was helpful or not was often influenced by its functionality and how tailored it was to an individual's difficulties. This sub-theme was present in all studies involving people with SLD. In educational settings, features that supported specific difficulties such as being able to proof-read written work facilitated functional tasks, and highlighting text meant that students did not "*mix the lines up*" (Chiang & Jacobs, 2010) when reading. This saved time and reduced pressure.

"*The fact I read slow...This device takes that pressure off and so I feel like the time I save struggling with the reading or procrastinating to not read will help with my overall time management*" (student with reading difficulties; Floyd & Judge, 2012).

Flexibility was also an advantage when it came to constant access to material for online courses, as resources could be returned to if students had missed something or for "*processing it more fully*" (Madaus, McKeown, Gelbar, & Banerjee, 2012). Being able to use AT and the Internet as they wished was important in determining whether features were helpful.

"*I really like using textHELP...but from time to time it would get too annoying so then I would only use it to read words I don't know instead of the whole thing*" (child with literacy difficulties; Jeffs et al., 2006).
The annoyance with aspects of technology highlighted above was also identified in two other studies, where people described the device ‘voice’ as being annoying, too robotic or hard to understand. For individuals with SLD unclear course navigation on online courses was an unhelpful feature, and having "stuff not mapped out on a wall but tucked away in my computer" (Madaus et al., 2012) impacted on their organisational skills. In two of the three studies on online/blended courses technical problems were an issue.

Helpful features were identified by people with LD in only one study, in which they described that cognitive assistive devices helped them make plans and have an overview of their weekly schedule. They did not identify any unhelpful features. People with LD may be more likely to attribute barriers to a lack of support rather than intrinsic features of technology, possibly due to the experience of relying on others being a more common part of their lives (a third-order interpretation).

**Sub-theme 2: A support mismatch**

This factor was an issue for people who needed greater levels of support and for those in situations with little to no face-to-face contact (e.g. individuals with LD and those on online/blended courses). In two studies people with LD identified needing more frequent support using their devices, and in one that they lacked sufficient training to use their device well, which could lead to reduced confidence and autonomy. Variable computer literacy and communication ability, combined with inconsistently available support, could impact on independent use.

"I need to phone Anna [staff] to ask her about the time on my quarter hour watch many times every day. Otherwise I do not know if it is working well" (adult with developmental disabilities; Arvidsson & Jonsson, 2006).

For students enrolled on online/blended courses, support could feel unobtainable and expectations were unclear, there was a lack of guidance on using the online system, and more frequent reminders of deadlines were needed. Others identified that the instructor’s poor computer literacy undermined the benefits of online courses. On two online/blended courses, students’ performance was affected by not being provided with extra time for tests.
Sub-theme 3: Connected versus disconnected

This sub-theme was present almost entirely in studies describing an online component or online course. Individuals could experience both connection and disconnection through the same technology. On online/blended courses students identified that communication with instructors could be the greatest advantage when this was direct and rapid. However it could simultaneously be the greatest disadvantage when instructors were unavailable.

“I didn’t know and still don’t know what I did wrong...I honestly feel like from the first day you log on you learn it yourself, and there has been very little direction from the professor” (student with SLD; Madaus et al., 2012).

In two studies there was greater engagement with peers as students could share problems and felt bolder participating in online discussion groups. This contrasted with uncertainty when the group did not know the answers, in the context of poor communication with professors. For some, online/blended courses could lead to increased anonymity as the lack of face-to-face contact meant that “the information or the personality of the person” speaking was lost (Madaus et al., 2012) which led to feelings of isolation. For others there was decreased anonymity, because “once you post it on the discussion board you can’t edit it which is not good” (Madaus et al.).

This sub-theme was present in only one study involving people with LD. Young people experienced connectedness and inclusive communication though ICT in terms of maintaining relationships with relatives. The helpfulness of intrinsic features combined with the appropriateness or availability of support may determine the relational experience of using technology for people with LD and SLD (a third-order interpretation).

Theme 2: The outcomes of using technology

Sub-theme 1: Independence and autonomy

This sub-theme was identified in five studies, most prevalently in two involving people with LD. Technology use increased independence and autonomy in a range of areas, but
importantly it had individual meaning. Time aids enabled people to complete morning routines and get to work on time independently.

"Nobody tells me when to leave. I look at my quarter hour watch and leave when I feel ready" (adult with developmental disabilities; Arvidsson & Jonsson, 2006).

Cognitive assistive devices enabled people with LD to manage their money, start activities without prompts and plan their diaries. For some, independence was not increased as they were completely reliant on staff to use their device. In contrast others who could use theirs alone to some extent experienced freedom from the 'over-involvement' of others.

"Now I am reminded in a better way. The Handi peeps and tells me instead of a nagging mom or a nagging staff member" (adult with LD; Wennberg & Kjellberg, 2010).

For some, independence was achieved at the expense of autonomy in decision making, with one adult reporting "The rehabilitation staff force me to look at the quarter hour watch to be on time for dinner" (Arvidsson & Jonsson, 2006). Outcomes in this area were influenced heavily by other's views, whether appropriate support was in place, and whether technology was individually-tailored.

**Sub-theme 2: It helps my learning**

This sub-theme was noted in nearly all studies involving technology to support learning. Students described that an AT device to support reading aided the recall of information, as they could hear words aloud and read text simultaneously.

"I am fighting to decode and sound out, so I lose the mental image. When I hear it, I can also see it and that helps me remember what I have just read" (student with reading difficulties; Floyd & Judge, 2012).

Students described that technology could aid understanding and clarity through reducing inconsistencies in their notes and through being more suited to visual learners. There was a benefit for students with ADHD who described that access to online material meant they
could “go back and listen to recordings...It cleared a lot of things” (Graves, Asunda, Plant, & Goad, 2011).

The assistance with learning led to improved outcomes in grades, test performance and specific skills such as reading, and this achievement could increase confidence and enjoyment in previously avoided tasks.

"Like I just have more confidence...Before I start[ed] to use Kurzweil, I didn’t have that much confidence, and now I like to read just a little bit, and I’ve done much better" (student with special educational needs; Chiang & Jacobs, 2010).

This sub-theme did not appear in the study describing the online course that had no face-to-face contact, which may relate to the difficulties described by the students enrolled on that course with accessing information and support.

**Sub-theme 3: The role of technology in my life**

This sub-theme was described by people with LD and SLD. Technology had many different functions in the lives of people with LD, with technology skills being associated with pride and enjoyment. When asked about seeing their own picture on a screen, one young person described it as “fantastic...Transactive - yeeeeahhh!!!!...brilliant” (Bunning et al., 2009).

There was a sense of new opportunities in four studies. For adults with LD it afforded a more adult role when previously they were told what to do: “yes, now you must do the dishes, yes, now you must eat and like that” (Wennberg & Kjellberg, 2010). For some people, Internet access meant they could explore a broader view outside their everyday life experiences. For others it was an empowering experience that led to enjoyment and interest in something previously avoided or too difficult.

"I am excited about using the Internet and AT for writing...I want to type my name. I have never written my name or anything for that matter” (child with literacy difficulties; Jeffs et al., 2006).
There were mixed views concerning the role that technology would play in people's futures. For some students with SLD, technology represented a disability coping mechanism and a "life saver" (Floyd & Judge, 2012) that allowed them to self-manage their difficulties. In contrast, others did not want to depend on technology or believed they should be able to cope without it.

"It is good to have this opportunity but I also need to be able to learn to cope with it so that when I get into the work field then I can be able to function like everybody else" (student with SLD; Graves et al., 2011).

For people with LD there were also mixed views. Some adults thought that technology would continue to be essential and that they "can't do without it", or that they may need it more in transition into adulthood "because it gets more difficult when I get a home of my own" (Wennberg & Kjellberg, 2010). Others, however, described a hope that they would be able to cope without technology in the future.

**Theme 3: Technology and the people around me**

This theme was unique to studies involving people with LD. It may be that for individuals with LD, and not for those with SLD, the interaction between technology and the people around them is a key determinant in the use and experience of technology (a third-order interpretation).

**Sub-theme 1: I have to rely on others**

In all three studies the extent to which technology enabled independence could be influenced by others being unreliable or unable to help. There was great variation in the degree to which the devices could be used without assistance and therefore the use of technology was controlled by others. One adult commented "I still feel insecure with my quarter hour watch. I need to phone Anna. She always tells me when to wake up" (Arvidsson & Jonsson, 2006). Staff sometimes forgot to upload activities to cognitive assistive devices which reduced a device's reliability. There was a reliance on others to repair devices which led to frustration and feeling out of control.
“I do want my quarter hour watch back but my father is very busy...I don’t want to ask him again. He has so many other things to do...I don’t know my occupational therapist” (adult with developmental disabilities; Arvidsson & Jonsson, 2006).

Young people with LD often relied on parents to support them with technology tasks which could reduce their freedom in choosing how to use technology. For some, limited parental computer literacy was an issue, for example "I find sending emails difficult - at home dad hasn’t learnt how to use it yet" (Bunning et al., 2009). Within the parent-child relationship, the person occupying the role of expert varied which could lead to barriers to technology use.

**Sub-theme 2: The influence of other’s views**

This sub-theme was identified in both studies involving AT and could be a barrier to technology use. The perceived or actual negative views of others led to reluctance to use technology in public or around people. Some people stopped using devices that had successfully facilitated their independence.

“I used to bring the time aid to work to be able to know when we should take a break, have a coffee, etc., but the people I work with did not like the signal and told me that it wasn’t good that I brought it..." (adult with developmental disabilities; Arvidsson & Jonsson, 2006).

One adult with LD said “It peeps a lot...then it wakes my brother” (Wennberg & Kjellberg, 2010). The critical views of others could also be undermining, with one adult describing that their mother said they were "too stupid" (Arvidsson & Jonsson, 2006) to use their time aid. The hope held by some of not needing technology forever could be associated with the negative views of others and the stigma of technology use.

Some adults described reduced autonomy through being forced to obtain and use their time aid, with no say in how it was used. There was sometimes a sense that this decision was to benefit others more than the individual.
“My parents think I am lazy. They are really tired of telling me to hurry up in the morning. They wanted me to get this time aid to see if I could become faster in the mornings and the evenings” (adult with developmental disabilities; Arvidsson & Jonsson, 2006).

There was a strong sense that other people often held the control over whether individuals were able or willing to use technology.

**Sub-theme 3: I choose to have help from people**

This sub-theme was identified in both studies involving AT and could be a sign of individuals asserting their autonomy, albeit in a way that did not increase their independence (Arvidsson & Jonsson, 2006).

“The time aid could help me to plan my time in the mornings, but I prefer to get help from the staff to make my bed and to prepare breakfast. I like to have people around...” (adult with developmental disabilities; Arvidsson & Jonsson, 2006).

This contrasts to the idea that AT may sometimes be implemented more for the benefit of others than for people with LD. The differential expression of autonomy by people with LD choosing support from people rather than technology may relate to an experience or fear of increasing independence leading to reduced social contact (a third-order interpretation). This sub-theme was not identified by younger people with LD. They may not identify a distinction between help from technology and from people because reliance on others is a more typical part of being a younger person (another third-order interpretation), or because of the communication difficulties of those interviewed.

**Discussion**

This review is the first meta-synthesis of qualitative studies exploring the views of individuals with LD and SLD on technology use. The synthesis resulted in a model bringing together overarching themes and those unique to people with LD. It aimed to review the current state of knowledge about the experience of using technology for children, young
people and adults with LDD, the representation of different technologies within this, and to develop new understandings of users’ experiences.

**The findings in context**

The findings were in line with past research however they also offer new interpretations. Technology was found to play an important, and individual, role in many people's lives, and could offer benefits in terms of learning, independence and autonomy. Previous research has reflected this variety in meaningful outcomes, through enabling individuals to engage in valued activities, to have increased awareness of what is happening around them, or to access the community and build relationships (e.g. Cooper, Balandin, & Trembath, 2009; Renblad, 2003; Trembath, Balandin, Togher, & Stancliffe, 2010). This ability for technology to connect people together was identified here, but so too was the potential for disconnection. Young people with disabilities have previously identified that practical difficulties with technology can lead to feelings of isolation (Morris, 2001). This was true here for students enrolled on online courses. The intrinsic features of devices and the level of support provided could influence the outcome of using technology and the experience of being connected or disconnected through this. Adults with communication devices have previously identified the need for appropriate support, and sufficient knowledge in using a device is essential for empowerment (Almekhalfi & Tibi, 2012; Trembath et al., 2010). For people with LD, technology use was often controlled by others. Increased reliance on others can reduce opportunities for young people to build relationships and be involved in a social world (Blum, Resnick, Nelson, & Germaine, 1991). The need to consider social aspects of technology use and stigma has been highlighted (Breivik & Hemmingsson, 2013; Clarke et al., 2001) and seemed especially pertinent for younger people in this meta-synthesis.

Despite the many types of technology, the majority of papers reviewed took an educational focus. None described technology to enable consultation, access to social media or virtual environments, and only one asked broadly about the Internet and everyday devices. Although there are qualitative papers published on these topics, many interview significant others or take a purely descriptive approach that does not involve interpretation.
Limitations

It is recognised that the absence of search terms relating to SLD (e.g. SLD, dyslexia) means that the findings may not include or represent all qualitative research involving this group. However, the majority of relevant studies published in North America are likely to have been identified due to their use of the terminology 'LD', and those in the UK may have been identified through using the phrase 'learning difficult". The inclusion of these papers allowed the consideration of those involving people with LD, through providing a sufficient number for review and therefore a context in which papers involving people with LD could be considered. This will hopefully encourage the publication of more qualitative studies involving people with LD, thus enabling more specific meta-syntheses.

An element of judgement was required in several areas. Whilst some researchers in the studies allowed themes to emerge freely, others divided findings at a more practical level (e.g. by device features), requiring the researcher to take a greater role in identifying themes. In four studies they had to differentiate between the views of people with LDD and others interviewed in the same study, and for two it was difficult to describe the sample due to poor description.

The involvement of an independent researcher in reviewing the themes and appraising all papers could have provided assurance that the model was grounded in the studies and offered a measure of inter-rater reliability. However the support for the findings from previous research, and the use of discussion and reflection on bias in quality ratings, can offset these concerns. The inclusion of quantitative data from the mixed-methods papers, and a mixed-methods quality assessment tool, could have enabled a more thorough review. However the qualitative aspects were the focus due to the richer data, and consistency in the appraisal tool used was preferred.

There are broader debates about whether attempts to synthesise qualitative data lose the richness and coherence that is integral to individual accounts (Sandelowski et al., 1997). Whilst some suggest that D-rated studies and those not specifying their qualitative method should be excluded (Downe, 2008; Walsh & Downe, 2006), any contributions to this field were considered valuable. The focuses of the studies varied, which may reflect the different
types of technology developed for people with LD compared to those with SLD; however it may be that more abstract concepts were avoided in interviews with people with LD. A lack of additional support in understanding questions may have limited this.

The underrepresentation of qualitative papers in databases can lead to difficulties in identification. Despite the systematic approach taken, three additional studies were identified through reference lists. Two were in journals that were not at all, or only partly, available in the databases searched. One was not identified as the database it appeared in does not allow searches broad enough to include reference lists. Searching the specific journal identified this study and no others. A retrospective search of the reference lists of the 48 papers read in full identified no additional papers. Therefore it was felt that all relevant studies were likely to have been identified. Terms considered too broad such as ‘device’, ‘digital’ and ‘consumer’, and those aimed at different populations such as ‘augmentative and alternative communication’, were not included however this could have ensured a more thorough search.

**Future research**

It is heartening to note the continuing trend in interviewing people with LDD; however the poor methodological quality of much of the research identified, alongside a lack of researcher reflexivity, reveals scope for greater methodological rigour. It may be that word limits on published articles limit researchers’ scope to fully discuss their reflections on their assumptions or on their role in the process, however this is needed to establish the context in which to interpret and evaluate qualitative findings as a reader. It is recommended that researchers use quality assessment tools to guide their write-up to ensure that all key areas are considered.

There is also a need for greater support for individuals with LDD to engage in qualitative research (or greater transparency about support provided in the researcher’s write-up). This could include providing pictorial aids or written words to support understanding and memory, the use of simple sentences and the careful consideration of questions about more abstract concepts, and repetition where necessary. Checking transcripts and themes with
participants can ensure that it is a close representation of their views, and providing the opportunity for significant others to be present can help people to feel more supported and relaxed. The provision of clear and understandable information should extend to gathering consent, and participants should be shown how they can withdraw consent if they choose to and asked to repeat back key aspects (such as confidentiality, right to withdraw) wherever possible.

The third-order interpretations provide hypotheses for further exploration. The relational experience of using technology may be determined by a combination of features internal and external to the technology, with potential for both connection and disconnection from others. Indeed, when the possibility of connecting with others is offered but then not realised, this can increase experiences of isolation (Cooper, Balandin, & Trembath, 2009). The reliance on others experienced by people with LD may mean that they attribute barriers to a lack of support from others, rather than to intrinsic features of devices. They may also have experienced, or feared that, through increased independence they would subsequently lose social contact. When often the only touch that people with more significant LD have is during functional tasks (Brennan, Wu, & Love, 1998) (Hewitt, 2007), and when people with LD may see paid carers as friends in what is already a restricted and compartmentalised social world (Pockney, 2006) this loss could be considerable. These interpretations could be explored through more specific qualitative research, for example exploring people’s experience of increased independence in terms of the impact on their social world.

In relation to more specific meta-syntheses this review points to a number of possible avenues that could lead to deeper understandings, once this area of research has developed further. One option is to consider the views of people with particular difficulties such as dyslexia, or ASD, to explore how technology can be specifically helpful. Another option is to consider more specific types of technology. For example, considering the views of people with LDD on using the internet, or on access to and use of social media. A further possibility is considering technology for a specific purpose, such as technology to facilitate communication, learning or memory. It is important to consider how the views of people with
LDD compare to those of people without these difficulties. The consideration of mixed methods studies could also add depth to our understanding.

More broadly still there are quantitative reviews needed about the use of technology such as mobile telephones, tablet devices, the internet, social media or virtual environments specifically by individuals with LD. Alongside a greater understanding of the views of technology users this would contribute to our understanding of the benefits and use of technology by people with LD.

**Implications**

This meta-synthesis attests to the rich insights gained through consulting with people with LDD. There are clear implications that if technology is to have its promised impact, people need to be enabled to make decisions about technology use, the level of support they need to feel confident, and when they would prefer input from another person. Once barriers to inclusion are overcome the next step for an individual is choice about *whether to be included* (Bevan, 2003). There needs to be recognition of the unique value of face-to-face contact for students with SLD enrolled on online courses and that they need access to the same support as on traditional courses. Broader changes are needed in access to computers for people with disabilities and in attitudes at organisational levels. Until more qualitative research is available, people who support individuals to acquire and use technology should consider the importance of people feeling skilled, well supported and in control of their technology use, and especially having choice over whether they wish to use technology. Greater involvement of people with LDD in the research process will add richness to our understanding (Beall & Williams, 2014) and more importantly maximise the role of technology in enabling people to have a better quality of life.
Paper 2: Empirical paper

A new iPad app assessment tool:

Comparability, acceptability and children's preferences

Prepared in accordance with requirements for submission to

The Journal of Clinical Child and Adolescent Psychology (Appendix J)
A new iPad app assessment tool:
Comparability, acceptability and children's preferences

Abstract

1) Objective. To explore the comparability of an iPad application (app) assessment tool, This Much!, as a response modality for a paper-based health-related quality of life measure using the Pediatric Quality of Life Inventory Short Form (PedsQL SF15). Comparability was distinguished from repeatability and reproducibility. Different statistical methods to test agreement between modalities were explored. Acceptability of the iPad app was undertaken by asking for children's preferences.

2) Method. Seventy children, comprising 38 females (54.3%) and 32 males (45.7%) in mainstream primary schools aged 5 to 9 years (mean age six years 11 months) completed the iPad and paper response modalities in a counter-balanced design over a two-week period and indicated their preference and reason for this.

3) Results. All children could use the iPad app. The majority appeared to understand the questionnaire across both modalities. Two widely-used statistical tests of similarity (correlation and paired samples t-test) indicated that the two response modalities showed agreement. However the Bland and Altman (1986) method for establishing agreement identified a lack of agreement between the iPad and paper scores. Ninety five percent of children's scores had a difference ranging from -30.7 to 25.7, which was judged as clinically unacceptable. Greater agreement existed between older children's scores compared to younger children. Fifty seven children (82.6%) reported preferring the iPad modality.

4) Conclusions. The iPad app was found to be an engaging assessment tool for children in school settings however it was not a comparable response modality for the paper-based questionnaire. Future research is discussed.

Keywords: iPad, computer, comparability, acceptability, assessment.
Introduction

Context

Children enjoy using computers for many different purposes, such as games, learning, communication and accessing the Internet, and computers are increasingly found in children's homes and schools (Siegle, 2013). Technological developments in hardware and software mean computerised devices are becoming more available, interactive, portable, and affordable, particularly through the development of tablet technology. The use of computers in assessment and therapy is expanding (Berger, 2005) and, increasingly, computerised versions of existing paper measures are being developed (Schaeren et al., 2005). However it is important to evaluate new modalities carefully and to not confuse enjoyment with effectiveness (Hill, 2006). This paper aimed to explore the comparability and acceptability of an iPad application (app) assessment tool when used as a response modality for an established paper-based health-related quality of life questionnaire. When two measurement methods are compared the question is whether the comparability is sufficient for the intended purpose (Altman & Bland, 1983). This differs from the repeatability and reproducibility of a measurement method, as this relates to comparing a measure against itself.

Computers in assessment

The benefits of computer-based assessment require careful consideration from the perspective of those completing and administering them. Through the years computerised assessments have been used to replace clinician-based interviews, to administer tests or questionnaires as an alternative to paper measures, and in the form of Internet-based surveys, with many more benefits identified than pitfalls (Epstein & Klinkenberg, 2001). For example, computer-based assessments can be more engaging and enjoyable to use and may be preferred to paper-based assessments by children and parents (Ogden et al., 2011; Sawyer, Sarris, Quigley, Baghurst, & Kalucy, 1990). They can gather as much, if not more, sensitive information provided that privacy is considered (Beebe, Harrison, Mcrae Jr, Anderson, & Fulkerson, 1998; Newman et al., 2002) and they may enable greater disclosure
of sexual topics for three to six year olds, perhaps even more so for older children (Steward & Steward, 1996). For children, however, computer-based assessments cannot replace interviews, and assessment approaches with children instead tend to involve computer-assisted interviewing. Children can feel they are being taken more seriously when their views are gathered via technology (Wilson & Davies, 1999).

Children are familiar with computers and their use in assessments can give young people a sense of mastery over an activity (Calam, Cox, Glasgow, Jimmieson, & Groth Larsen, 2000). Children prefer tasks on computers in which they feel in control (Mumtaz, 2001) and this has important implications for engagement. There are practical advantages such as the automatic recording of responses and the ability to provide immediate feedback to individuals or for clinical notes, and computerised assessments can be cost-effective (Brown, Vanable, & Eriksen, 2008; Hill, 2006; Parkin, 2000). Children as young as four years and those with a range of difficulties and disabilities have been able to engage with assessments on computers (Barrow & Hannah, 2012; Cousins & Simmonds, 2011; Davies & Morgan, 2005; Murdock, Ganz, & Crittendon, 2013).

**Tablet devices**

Tablet devices are becoming more widely used, particularly in healthcare settings and in the classroom, in light of their specific benefits. They are relatively inexpensive in comparison to laptops, apps can be made available free or at low cost, the touch-screen design is intuitive and especially suited to the developing motor skills of younger children, and they are light and portable (Bradshaw, 2013; Siegle, 2013). The appeal of tablets as devices that are 'cool' can promote use and acceptance (Bradshaw; Brady, 2011). They can be simpler to operate than computers whilst offering a larger and more intuitive interface than mobile telephones (Marceglia, Bonacina, Zaccaria, Pagliari, & Pincioli, 2012). iPads have been used to collect routine outcome measures in Child and Adolescent Mental Health Services (Hall et al., 2014) and iPad play stories have successfully increased the pretend play skills of four-year-olds with autism spectrum disorder (Murdock et al., 2013). Although there are many available computerised versions of questionnaires, some of which are preferred by children to paper versions (e.g. Ogden et al., 2011; Simola & Holden, 1992;
Vinney, Grade, & Connor, 2012), many of these do not go beyond the transfer of a response modality onto a computer screen. Interactive iPad apps can provide a new approach to measurement that goes beyond this in terms of children's engagement.

**A new measurement tool**

This Much! is a recently released app developed by David Glasgow and Phil Jimmieson (www.childandfamilytraining.org.uk). This newly developed assessment tool provides a framework to ask children about their feelings and views on any topic, using an adaptable sliding scale and the facility to personalise the scale with their photograph or an illustration of a person of their choice. This app holds promise for facilitating children in engaging with assessment and sharing meaningful information around a structured format.

In order to evaluate an app as a new measurement tool, it must be compared to conventional administration of an existing validated measure. Health-related quality of life (HRQOL) is a valuable area of assessment for children (Ravens-Sieberer et al., 2006; Zekovic & Renwick, 2003) and measures are widely used for evaluating interventions, allocating resources, and understanding the experience of living with illness and disability (Solans et al., 2008; Young, Rice, Dixon-Woods, Colver, & Parkinson, 2007). Quality of life is significant for many areas of children's lives.

Following a review of options (e.g. see Schmidt, Garratt, & Fitzpatrick, 2001; Solans et al., 2008; Wolpert et al., 2009), the Pediatric Quality of Life Inventory Short Form (PedsQL™ SF15) (Chan, Mangione-Smith, Burwinkle, Rosen, & Varni, 2005) was selected for the present study. It was the only measure identified that included a self-report version for children as young as five years, was sufficiently brief (defined as 15 questions or fewer), and included a three-point Likert-scale. A three-point scale was desirable as it was intended that the iPad app would be explored as a response modality for children with special education needs (SEN), and there is evidence that three-point scales are easier for individuals with learning disabilities to understand than those with four points (Mindham & Espie, 2003). It was also necessary that the original measure did not require the use of props in its administration, such as the use of soft toys as in the TedQL (Lawford, Volavka, & Eiser, 2001). The PedsQL SF15 is a widely-used HRQOL measure for children with and without
health problems, and it has been used successfully via a handheld electronic device for children with speech and voice disorders (Vinney et al., 2012).

**Establishing comparability**

It is essential that appropriate methods are used when validating new measurement tools. When comparing different measurement methods such as computer and paper-based questionnaires, issues can arise if authors are not clear about the question they are aiming to answer (Altman & Bland, 1983). As described above, terms such as repeatability (e.g. test-retest reliability) and reproducibility (e.g. varying factors such as the observer and time of day) are not appropriate as they relate to comparing a measure against itself. It is comparability that is the focus when comparing response modalities.

Comparability relates to the extent of agreement between measurement methods (e.g. two different response modalities), however the measurement of this has been frequently misunderstood or approached inappropriately (Bland & Altman, 1986; Myles & Cui, 2007). In two seminal papers, Bland and Altman (Altman & Bland, 1983; Bland & Altman) described the reasons that the widely-used product-moment correlation coefficient (r) and comparing means (e.g. through a paired samples t-test) are inappropriate analyses for measuring agreement. Correlation is not a measure of agreement but of the strength of a relationship between two variables. Perfect correlation would be achieved with all data points lying along any straight line. However it is the line of equality that is relevant when comparing two measurement methods. Data could be perfectly correlated if one method gave a score that was twice that of the other, however this would not indicate agreement, and strong correlations can often mask a lack of agreement for this reason. The comparison of means is inappropriate as a lack of a significant difference does not necessarily equate to agreement, as large positive and negative differences may average out to falsely suggest a small difference. Bland and Altman suggest an alternative approach involving the graphical display of differences between the scores, and the consideration of agreement in relation to what is judged as clinically acceptable.

Despite many thousands of citations of Bland and Altman’s papers, the use of inappropriate methods continues (Myles & Cui, 2007). This is in part due to the tendency for
researchers to draw on apparently similar (but inappropriate) examples in textbooks and published papers. In the process of establishing the degree of comparability between modalities, therefore, this study aimed to explore the use of different statistical methods for testing agreement, using the Bland and Altman method as the recommended approach (Schmidt & Steindorf, 2006; van Stralen, Jager, Zoccali, & Dekker, 2008).

**The current study**

This study explored the comparability and acceptability of a new iPad app as a response modality for an existing validated questionnaire, against the traditional paper modality. The measure chosen was a paper-based HRQOL measure, the PedsQL SF15.

The research questions were as follows. 1) Do children understand the questionnaire presented via the iPad app? 2) Can children use the iPad app? 3) What impact does the inappropriate choice of statistical analyses have on conclusions about agreement between the two response modalities? 4) Are scores obtained on the iPad app assessment tool comparable to the paper version and are any differences found acceptable (through the use of a recommended method for assessing agreement)? 5) Is there an effect of age on the agreement between the two response modalities? 6) Which format do children prefer and why?

It was hypothesised that children would understand the questionnaire presented via the iPad app as it is a questionnaire that has been widely used with children of this age group. It was also hypothesised that they would be able to use the iPad app. It was hypothesised that if the two modalities did not show agreement that this would not be clear from using inappropriate statistical analyses. In terms of agreement between the iPad and paper versions no hypotheses were made. This is because agreement might be expected considering that the same questions were being asked, but it was also possible that the iPad app helped children to respond more easily to questions which could have led to different responses on the iPad version. In terms of an effect of age, no hypotheses were made as it was unknown how children might respond differently to this questionnaire over time. Finally it was hypothesised that children would prefer the iPad app, based on previous research about children's enjoyment of using tablet devices.
Method

Recruitment

Nine mainstream primary schools in a large urban area were approached. Of these, three agreed to take part. Children with lower level additional needs were included to ensure a representative sample of the majority of children at mainstream urban schools in the area. In order to ensure a wide spread of ability, teachers were asked to identify children who met the following criteria:

- Children with no identified additional needs.
- Children with lower level additional needs. This included:
  - Children with specific learning difficulties (SLD) such as dyslexia and dyspraxia.
  - Children on 'School Action'. This meant they received additional support provided internally by school, for example a number of 1:1 hours of support a week, but without the need for external advice or support.
- English speaking (sufficiently well to manage in a classroom).
- Aged 5-8 years.

The educational definitions described above were used to enable teachers to accurately identify children who met criteria. Written information was sent to the parents of these children, who were asked to provide written consent (Appendix K). Parents were asked to rate how often their child used a touch-sensitive tablet device. Although the questionnaire is designed for 5-7 year-olds, 8 year-olds were also recruited as it was intended to use the iPad app response modality with children with SEN in another study. There is a version for 8 to 12 year-olds available, which asks about the same 15 items using similar questions (in slightly more detail and in the first person) and asks children to rate their responses on a five-point scale. However this was judged to be too complex for children with SEN who would be recruited to the other study. All children at each school who met these criteria were invited to take part (n=393 children). Eighty eight parents returned written consent, a response rate of 22.4%.
Participants

At the time of data collection four children had left the schools. Data are therefore reported on the remaining 84 children. The sample comprised 44 females (52.4%) and 40 males (47.6%). Children were aged 5-9 years with a mean age of 6 years 11 months. In terms of touch-sensitive device use, data were available for 79 children (94.0%). Of these 79 children, two-thirds of parents rated their children as using a touch-sensitive tablet device either every day (36.7%) or once a week (30.4%). The remaining third used one monthly (6.3%), a few times ever (19.0%), or never (7.6%) (see table 1).

Table 1. Descriptive statistics for the sample.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Frequency n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>44 (52.4%)</td>
</tr>
<tr>
<td>Male</td>
<td>40 (47.6%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Frequency n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>19 (23.8%)</td>
</tr>
<tr>
<td>6</td>
<td>21 (26.3%)</td>
</tr>
<tr>
<td>7</td>
<td>29 (36.3%)</td>
</tr>
<tr>
<td>8</td>
<td>10 (12.5%)</td>
</tr>
<tr>
<td>9*</td>
<td>1 (1.3%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Touch-sensitive tablet device use</th>
<th>Frequency n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>6 (7.6%)</td>
</tr>
<tr>
<td>A few times ever</td>
<td>15 (19.0%)</td>
</tr>
<tr>
<td>Once a month</td>
<td>5 (6.3%)</td>
</tr>
<tr>
<td>Once a week</td>
<td>24 (30.4%)</td>
</tr>
<tr>
<td>Every day</td>
<td>29 (36.7%)</td>
</tr>
</tbody>
</table>

* Children aged five to eight were recruited but one child turned nine before data collection began.
**Measures**

The PedsQL SF15 is a 15-item HRQOL questionnaire that produces a total score where higher scores indicate higher levels of HRQOL. It takes a broader perspective on wellbeing than the original 23-item version (Varni, Seid, & Rode, 1999) and is quicker to administer. The scale for 5-7 year-olds was selected because of its simple wording (approximately 6-7 years reading level) and the simple three-point Likert-scale. The scale presents the question “How much of a problem is this for you?” in the last few weeks, and for each item the child points to one of three faces (see figure 1). It includes items such as “Do you feel scared?” and “Is it hard for you to get along with other kids?” (See inside back cover for full measure). The items are spread across four domains (physical health, emotional, social and school functioning). Iranian, Chinese and Japanese versions have been developed and validated (Chen, Origasa, Ichida, Kamibeppu, & Varni, 2007; Lin et al., 2012; Pakpour, 2013).

The 15-item version has comparable reliability to the original 23-item version, with an internal consistency of $\alpha = 0.82$ compared to 0.86 for the original, and the short-form scales and subscales distinguished a healthy from a chronically ill sample as well as the original version, but with lower effect sizes (Chan et al., 2005). The short-form is less sensitive to group differences and the physical health summary score is less reliable in group comparisons, and ceiling effects have been reported (Chan et al.). However overall it is a reliable and valid measure and one that has relevance to many aspects of children’s lives, therefore it represented a good choice as a brief established measure against which to evaluate the iPad app.

**The iPad app**

The iPad app assessment tool ‘This Much!’ provides a framework to ask children about their views on any topic, using an adaptable sliding scale as shown in Figure 1. The iPad can be used to take a photograph of the child, which they can select to appear on the line. They can move their photograph along the line whilst considering how to respond and then position it to show their response. If they do not choose to have a photograph taken (or for children whose parents did not consent to this) there is a range of illustrated people of different ages to choose from, ranging from babies to older people. The illustration appears
on the line and is moved in the same way as the photograph. Under the photograph or illustration is a box in which the child can type their name. The chosen picture can be easily deleted and another chosen if the child wishes. A template can be saved that allows the child or researcher to click to the next screen which resets the image to the central point on the line ready for the next question. The app follows the development of the computer-assisted interview ‘In My Shoes’ (IMS; Calam, Cox, et al., 2000) by utilising techniques to enable children to respond and engage in discussion via an easy format and a personalised interview experience.

Figure 1. The standard paper response format and the iPad format.

Procedure

A counter-balanced design was utilised in which the children were randomised to complete either the iPad app or the paper modality first. Randomisation involved a computer-generated list of the numbers one and two to indicate which response modality each child would complete first (e.g. one = iPad first, two = paper first), specified prior to
data collection. Forty children completed the iPad app version first and 44 completed the paper version first. Each child completed the alternative version two weeks after first administration, with the exception of 10 children who had a one-week break due to school holidays.

Children were collected from class individually and the researcher explained that they had an activity for them to try, and that they could find out about it first and then make a decision about whether to take part. All children agreed to accompany the researcher to hear about the research. Children were seen individually in a quiet, familiar room at their school. The study was explained and the voluntary nature of the research was emphasised. Children were informed that they could stop and go back to class whenever they chose. Confidentiality was explained and children were informed that they could speak to the researcher or their teacher if they felt sad or worried afterwards. Each child was then asked if they understood the information so far and if they agreed to take part. If they did not understand, further explanation was provided and their assent was checked again. All children agreed to take part and none chose to leave before the end of the task.

Both formats of the questionnaire were administered as per the original paper questionnaire instructions. All children were provided with an anchor event to help them understand the time frame "last few weeks", which was typically a recent half term holiday or a special assembly, identified by a teacher. The interviewer read the questions aloud for both presentations and a similar layout of the response format was used (see Figure 1). The original instructions asked the child to respond by selecting one of three faces, and this was adhered to regardless of the response modality being used. However children were not dissuaded from placing their picture anywhere on the line on the iPad app if they asked if they could do this. The only other difference between the two administrations was that when completing the iPad app modality children had their photograph taken or selected an illustrated person and the template had to be saved, and they or the researcher selected ‘next’ to reset the screen ready for the next question (this automatically saves their previous response). Children were free to experiment with moving their picture around at any point during the task provided that each response was automatically saved.
Children were thanked for taking part to any degree with their choice of a sticker. The researcher explained that they would return in two weeks to complete the other version with the child. When the researcher returned, the same explanations were provided as on first administration and children were asked if they understood and agreed to take part again, which all children did. They completed the alternate version as described above. Following this, they were asked whether they liked the iPad app or the paper version best and why this was. They were thanked with another sticker.

During administration of the questionnaire all children's comments were written verbatim and any significant observations were noted, for example if a child's understanding was queried or whether their English language level appeared to be sufficient for the task, any difficulty moving their picture, or difficulties with concentration. The study was granted ethical approval by the University of Manchester (Appendix L).

**Statistical analysis**

The statistical analysis for each research question was as follows. Descriptive statistics were used to describe the proportion of children who appeared to understand the questionnaire presented via the iPad app (including their use of the response scale) and who were able to use the iPad app. A lack of understanding was judged by incongruence between their verbal response and their response to the questionnaire (e.g. saying "It's easy" but selecting the sad face) or an inability to respond to the questions at all. Two widely-used statistical tests of similarity (a correlation and a paired samples t-test) were used to test the results found using these approaches.

The Bland and Altman method was then used as a recommended approach (Schmidt & Steindorf, 2006; van Stralen et al., 2008) to examine the comparability of responses to using the two modalities and to judge whether any differences were acceptable (Altman & Bland, 1983; Bland & Altman, 1986). Their approach involves calculating the difference between each child's two scores, calculating the mean difference, and plotting this on a graph along with the limits of agreement (at ± 1.96 standard deviations of the mean difference). If the differences are normally distributed, 95% of differences will be between the limits of agreement. Examination of the graph aids in making a decision about the clinical
acceptability of the difference. Bland and Altman advise that decisions about acceptability should be based on clinical judgement. This requires a decision about what is a sufficiently small difference to be confident that a new method can be used as well as, or instead of, the original method. The Bland and Altman method was also used to examine whether agreement between response modalities was greater for older children than younger ones.

Finally the children's preference for the iPad or paper format was examined using descriptive statistics and qualitative content analysis. All children's comments were transcribed from verbatim notes made during data collection. Content analysis, a qualitative approach to interpreting text that takes a systematic approach to identifying and coding themes, was selected as an appropriate method and a 'conventional approach' was specified in which coding categories were derived directly from the children's verbatim responses (Hsieh & Shannon, 2005). All analyses were conducted using SPSS version 20 and Excel 2007. All data were judged to be normally distributed based on tests for normality of distribution and on a range of key indicators including histograms (Altman, 1991).

Results

Do children understand the questionnaire presented via the iPad app?

Eighty four children attended school at the point of data collection (see Appendix M for a flow diagram of the recruitment and data collection process). Of the 84 children, 70 were seen twice and appeared to understand the questions, six did not complete both versions due to practical reasons such as illness, and eight did not understand one or both formats of the questionnaire. Of these eight children, five showed clear evidence of not understanding whereas for three their understanding was queried. These three children completed both formats to determine if the format impacted on their understanding, however it did not appear to. All eight children appeared to speak very little English. One of the eight children had an identified language delay that had not been communicated to the researcher. Within the 70 children who completed both versions and appeared to understand the questionnaire there were three outliers. One outlier was removed as the child was feeling unwell at the administration of one version of the questionnaire. Therefore the results reported here relate
to 69 children who completed and appeared to understand the questionnaire with both response modalities.

In terms of their use of the response scale (see table 2), four children used only the most positive rating for each format of the questionnaire (two children did this for both formats and two children did this for only one format). Thirty four children (49.3%) used two faces for the iPad modality compared to 29 children (42.0%) for the paper modality. Within this, three children (4.3%) used only the two extreme responses for the iPad modality and two children (2.3%) did this for the paper modality. Thirty one children (44.9%) used all three faces for the iPad modality compared to 36 children (52.2%) for the paper modality.

As hypothesised, the majority of children appeared to understand the questionnaire presented via the iPad app.

Table 2. Descriptive statistics for children’s use of the different faces on the scale for the iPad and paper response modalities.

<table>
<thead>
<tr>
<th>Number of faces used</th>
<th>Response modality</th>
<th>Frequency n (%)</th>
<th>Average number of times chosen</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Not at all (happy)</td>
</tr>
<tr>
<td>1</td>
<td>iPad</td>
<td>4 (5.8%)</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>Paper</td>
<td>4 (5.8%)</td>
<td>4.0</td>
</tr>
<tr>
<td>2 *</td>
<td>iPad</td>
<td>34 (49.3%)</td>
<td>9.8</td>
</tr>
<tr>
<td></td>
<td>Paper</td>
<td>29 (42.0%)</td>
<td>9.5</td>
</tr>
<tr>
<td>3</td>
<td>iPad</td>
<td>31 (44.9%)</td>
<td>7.6</td>
</tr>
<tr>
<td></td>
<td>Paper</td>
<td>36 (52.2%)</td>
<td>7.6</td>
</tr>
</tbody>
</table>

*Three children used only the two extreme responses for the iPad format and two children did this for the paper format.

Can children use the iPad app?

All children seen were able to use the touch-screen and move their picture regardless of whether they appeared to understand the questionnaire. The majority were skilled at this and needed no introduction or demonstration to understand how to use the sliding scale. A small number tried to move their picture hastily and the touch-screen did not identify this
movement, but with a prompt they changed their approach. The majority of children appeared to express excitement when using the iPad or in anticipation of it, through verbal and facial expression and excited gestures. They appeared to enjoy having their photograph taken, with many 'posing' for the picture. One child asked if she could draw a picture of a bear and photograph that instead, which she did.

In relation to how children used the iPad app sliding scale, 11 children placed their picture on the iPad's sliding scale between the faces on a total of 20 questions. These responses were rounded to the 'nearest face' using the precise figures gathered by the iPad app, to describe the child's response position on the line. For the 69 children seen, a total of 1,035 questions were asked on the iPad, of which the 20 questions represented only 1.9%. They were therefore unlikely to have significantly affected the results, although one outlier of the two remaining was included within this.

As hypothesised, children could understand how to use the iPad app.

**What impact does the inappropriate choice of statistical analyses have on conclusions about agreement between the two response modalities?**

**Correlation**

Using the Pearson product-moment correlation coefficient ($r$) the iPad and paper total scores were moderately and positively correlated ($r = 0.54$, $p<0.01$).

**Paired samples $t$-test**

The average total score for the PedsQL SF15 on the iPad was very slightly higher than on the paper modality, and the iPad scores had a slightly smaller range (see table 3). They had equivalent median scores (80.0). The mean difference of -2.5 (paper score minus iPad score) was very small and appeared clinically acceptable considering the possible range of scores (from 0 to 100).
Table 3. Descriptive statistics comparing the total scores and difference between them for the two modalities.

<table>
<thead>
<tr>
<th></th>
<th>Mean (Std. Dev)</th>
<th>Median</th>
<th>Min - Max (Range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>iPad</td>
<td>78.9 (13.4)</td>
<td>80.0</td>
<td>50.0 - 100.0 (50.0)</td>
</tr>
<tr>
<td>Paper</td>
<td>76.4 (16.1)</td>
<td>80.0</td>
<td>33.3 - 100.0 (66.7)</td>
</tr>
<tr>
<td>Differences</td>
<td>-2.5 (14.4)</td>
<td>0.0</td>
<td></td>
</tr>
</tbody>
</table>

A paired-samples t-test found no significant difference between the iPad and paper scores ($t(68)=1.453, p=0.151$). This suggests that the response modality did not impact significantly on the total score.

*Are scores obtained on the iPad app assessment tool comparable to the paper version and are any differences found acceptable?*

Bland and Altman recommend first plotting the two data sets with a line of equality to visually represent the level of agreement (Graph 1). This revealed that the iPad and paper scores did not appear to agree closely with one another.
Next, the difference between each child's two total scores was plotted against the mean of their two scores (graph 2). The limits of agreement (at ± 1.96 standard deviations of the mean difference) and a line to show the mean difference for the whole sample were plotted to aid the consideration of the clinical acceptability of the differences. It is expected that 95% of differences will fall between these two lines on graph 2.

Graph 2. Bland and Altman plot.
In the light of this plot, the small mean difference (-2.5) appeared misleading as the agreement limits ranged from -30.7 to 25.7. Based on a clinical judgement this difference was large and unacceptable considering that scores are on a scale from 0 to 100. The data were spread evenly and without pattern and with no reliable direction in which the modalities differed. Although the moderate positive correlation, the lack of a significant difference, and the small mean difference appeared promising, they did not reflect the large variability between the scores and masked what was a clinically unacceptable lack of agreement.

Further exploration of agreement was conducted by determining a clinically acceptable difference to be ±10 (a clinical judgement based on the scale ranging from 0 to 100). Forty three children's scores fell within the acceptable range (62.3%), whilst 26 (37.7%), did not (see Appendix N). The fact that two-thirds of the sample's scores fell within a clinically acceptable range appears positive, except that the difference could be in either direction.

A number of exploratory graphs were produced using the Bland and Altman method, to examine possible reasons for the lack of agreement (Appendices O.1 to O.4). This included the influence of gender, previous use of touch-sensitive devices, which format was completed first, and length of administration gap (1 or 2 weeks). There was no discernible pattern on the graphs and agreement limits remained unacceptably wide for all of these exploratory analyses.

As hypothesised, the use of inappropriate statistical analyses did not reflect the lack of agreement between the two versions. This was reflected when using the recommended approach to exploring agreement.

**Is there an affect of age on the agreement between the two response modalities?**

When looking at each child's two scores by age, they became gradually closer together from age 5 to 8 years. Using the Bland and Altman method, this is reflected both in table 4 in the decreasing mean difference and the narrowing limits of agreement and range, and graphically in Appendix P. Five year-olds' scores varied within each child by more than the older children's did. Both outliers on graph 2 were 5 years old.
Table 4. The mean difference and limits of agreement (using the Bland and Altman method) presented by age.

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Frequency</th>
<th>Mean difference</th>
<th>Limits of agreement (mean ± 1.96*Std. Dev.)</th>
<th>Range (from largest positive to largest negative)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>15</td>
<td>-6.4</td>
<td>-48.5 - 35.6</td>
<td>84.1</td>
</tr>
<tr>
<td>6</td>
<td>19</td>
<td>-2.2</td>
<td>-27.1 - 22.6</td>
<td>49.7</td>
</tr>
<tr>
<td>7</td>
<td>23</td>
<td>-1.0</td>
<td>-25.3 - 23.3</td>
<td>48.6</td>
</tr>
<tr>
<td>8-9*</td>
<td>12</td>
<td>-0.8</td>
<td>-20.0 - 18.3</td>
<td>38.3</td>
</tr>
</tbody>
</table>

*Grouped as there was only one nine year old.

Five year-olds were excluded from the analysis to explore the data without their influence. Table 5 shows the descriptive statistics excluding 5 year-olds, which shows a smaller mean difference between iPad and paper total scores (-1.42 now, compared to -2.5 including 5 year-olds). The standard deviations are slightly smaller for both modalities and there are smaller or similar ranges, however these differences appear negligible.

Table 5. Descriptive statistics comparing the total scores and difference between them for the two modalities excluding 5 year-olds.

<table>
<thead>
<tr>
<th></th>
<th>Mean (Std. Dev)</th>
<th>Median</th>
<th>Min - Max (Range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>iPad</td>
<td>79.2 (13.6)</td>
<td>81.67</td>
<td>50.0 - 100.0 (50.0)</td>
</tr>
<tr>
<td>Paper</td>
<td>77.8 (15.5)</td>
<td>80.0</td>
<td>40.0 - 100.0 (60.0)</td>
</tr>
<tr>
<td>Differences</td>
<td>-1.42 (11.8)</td>
<td>0.0</td>
<td>-26.7 - 20.0 (46.7)</td>
</tr>
</tbody>
</table>

In order to check the impact of age on correlation coefficients and a paired samples t-test, re-analysis was undertaken excluding 5 year-olds. There was an improved correlation ($r =+0.68$ (p<0.01)) and as before, the paired-samples t-test found no significant difference between the iPad and paper scores ($t(53)=0.886$, p=0.379).
Using the Bland and Altman method to plot a graph excluding five year-olds (Appendix Q) showed greater agreement, with agreement limits from -24.5 to 21.7 and a mean difference of -1.4. However the level of agreement remained unsatisfactory based on clinical judgement, with the graphs showing no discernible pattern and still widely distributed data points. The results obtained through the use of correlation and a paired-samples t-test still masked the lack of agreement identified by using the Bland and Altman method.

No hypotheses had been made about the effect of age, however it was apparent that there was a greater discrepancy between iPad and paper scores for younger children.

**Which format do children prefer and why?**

Fifty seven children reported preferring the iPad (82.6%), five preferred the paper format (7.2%), five liked them equally (7.2%) and two did not know (2.9%).

Sixty three children gave specific comments about their preference for the iPad or paper format (recorded verbatim), but none commented on why they liked them equally well or did not know. The comments were analysed using qualitative content analysis. They were entered into a spreadsheet and read several times to familiarise the researcher with the contents. Sub-categories were identified by classifying each phrase into a new or existing sub-category until all had been categorised. They were then grouped into broader categories, whilst maintaining the preference for iPad or paper version. Ideally all sub-categories would be supported by a minimum of three examples to ensure validity (Berg, 2009) however all were preserved in order to represent all views at this exploratory stage.

Six categories were identified, which each comprised two or three sub-categories (see table 6, and Appendix R for the frequency count for each category and sub-category). Categories one to five relate to a preference for the iPad app and category six relates to a preference for the paper modality. The sub-categories are described below with illustrative quotes.

As hypothesised, children preferred the iPad app to the paper version of the questionnaire.
Table 6. Categories and sub-categories derived from content analysis.

<table>
<thead>
<tr>
<th>1. I like iPads and technology</th>
<th>2. My experience with iPads</th>
</tr>
</thead>
<tbody>
<tr>
<td>I like iPads and technology</td>
<td>I've got an iPad at home</td>
</tr>
<tr>
<td>iPads are fun/Good for games</td>
<td>This iPad is better than mine/My iPad is broken</td>
</tr>
<tr>
<td></td>
<td>I've not used an iPad before</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. The experience of using the app</th>
<th>4. I have control over it</th>
</tr>
</thead>
<tbody>
<tr>
<td>It like it when the picture jumps back to the middle</td>
<td>I get to move it to different faces</td>
</tr>
<tr>
<td>The iPad has more colour</td>
<td>I get to touch/Move it to choose/It does what I tell it to</td>
</tr>
<tr>
<td>It's easier to use/It's quick</td>
<td>My hand will get tired with the paper*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5. It's personalised and individualised</th>
<th>6. The paper version was easier and quicker</th>
</tr>
</thead>
<tbody>
<tr>
<td>It's got my photo/I can choose a picture</td>
<td>I just had to point so it was easier/Quicker</td>
</tr>
<tr>
<td>I can choose an answer in between the faces</td>
<td>The person was not easy to move*</td>
</tr>
</tbody>
</table>

* A negative view of the alternative format rather than a positive view of their preferred format.

NB. Categories one to five refer to a preference for the iPad version, whilst category six refers to a preference for the paper version.

1. **I like iPads & technology** covered general positive comments about technology and iPads and their suitability for playing games on. One child described "cos I usually like stuff when I go on iPads and electric stuff. They have nice games on them". Another said "I love the iPad...When you touch something it's like fun playing games and things".

2. **My experience with iPads** included comments about the child having expertise, or little experience with using tablet technology, and comments about their own iPads. Children seemed to like iPads either because of their familiarity with them or because of the appeal of trying one out for the first time. One child explained they liked it "cos I've never used an iPad before".

3. **The experience of using the app** involved more specific comments children made about the app. They liked it when their picture 'jumped' back to the centre when it was reset ready for the next question, and they liked the colour on the screen which contrasted to the black-
and-white images for the paper response format. One child said "Because it had more colour and it was a bit easier" and another preferred it "cos you get to move it around and click the button and it jumps back to the middle".

4. **I have control over it** related specifically to children enjoying the interactive aspects of the app and their ability to control it and have choice. One child liked that "you got to choose with your hands" and another preferred the iPad "Because you could like move it, it felt much more fun, but with the paper you just had to do that [pointed]".

5. **It's personalised and individualised** captured their engagement with the photograph and illustration aspects of the app, and for some their appreciation of being able to respond using the whole sliding scale if they chose to (this was not suggested to the children but they were not dissuaded from doing this if they asked if they could). One said "I liked when I took a picture of myself" and another preferred it "because you get to choose who you want to be instead of just pointing".

6. **The paper version was easier and quicker** captured the reasons for children's preference for the paper version. The main reason for this was that by pointing it was quicker and/or easier to respond than having to move a picture. A number of children found the person to be "fiddly" to move, and these tended to be the children who responded hastily which was not recognised by the touch-screen. One explained that "This one [paper] was a bit quicker, I could move my thoughts quicker, with that one [iPad] it wasn't as quick" and another preferred the paper "Because it's easy all you have to do is point and that boy is annoying me, I have to press him really hard [on iPad]".

Discussion

This study aimed to explore the value of a new iPad app assessment tool as an innovative approach to engaging children in assessment. This necessitated the comparison with an existing valid measure. The PedsQL SF15 was chosen as it is a widely-used paper-based HRQOL measure that assesses an important area of children's lives. The study explored children's understanding of the questionnaire presented via the iPad app; their use of the iPad app; the comparability of the iPad and paper response modalities using three
different statistical approaches; the effect of age on comparability of scores, and children's preferences.

The majority of children appeared to understand the questionnaire presented via the iPad, and no children were identified who appeared to understand one format but not the other. The iPad app was found to be an engaging assessment tool for children aged 5 to 8 years in a school setting. All children were able to use the iPad app, most finding this easy and intuitive. Those who struggled to move their picture tended to try to respond hastily and impulsively, however with prompts they were able to slow their movements down. No children had difficulty understanding the idea that they could move their picture along the line using the touch-screen. In terms of children's use of the scale, only four children used only the most positive face on the iPad and paper response modalities, including only two children doing this for both modalities. There was a fairly even spread between children using two and three of the faces on the scale for both modalities, however on average children used the most positive option the most frequently, followed by the middle option and finally the negative option. This may reflect an extent of ceiling effects, as described by Chan et al. (2005).

Two widely-used statistical tests of similarity did not show the lack of agreement identified by the Bland and Altman method. The correlation found was moderate and positive, and no significant differences were found between the children's scores on the two response modalities. According to Chinn (1991) any measure should have a correlation of at least 0.6 (for example when measuring test-retest reliability) which was achieved when 5 year-olds were excluded. These results would typically be taken to indicate agreement and this highlights the potential issues arising from using inappropriate statistics, considering the lack of agreement found when using the recommended Bland and Altman method.

The iPad app assessment tool and the paper-based questionnaire were not found to be comparable in terms of total scores. The limits of agreement around the difference between children's two scores were wide, ranging from -30.7 to 25.7. This means that for 95% of the children their iPad score could be up to 31 points higher than their paper score, or their
paper score could be up 26 points higher than their iPad score. Taken together, the lack of a consistent direction in this difference, the fact that the data points were spread evenly up to the limits of agreement on the graphs and not clustered around the mean difference line, and the potential size of this difference, indicated that the two modalities did not show agreement and that this was at a clinically unacceptable level.

A number of explanations were considered for this. Children's age appeared to play a role, with younger children's scores across the two time-points being more discrepant than those of older children. Both outliers were 5 year-olds and the large discrepancy between their two scores may relate to their young age. Even the younger children showed understanding of the questionnaire, therefore it may have been their ability to generalise how they were feeling to the 'past few weeks' (rather than in the moment) that was difficult for them. With no test-retest reliability data available for the English language version of the questionnaire it cannot be determined whether they would have been able to do this when completing the paper version twice. It may be that children respond differently due to intrinsic aspects of the modalities. For example, the individualised or interactive element of the iPad might enable greater understanding or easier expression of children's views, which could feasibly impact on children's scores in either direction. The lack of consistent differences within the results could indicate that factors such as these affect children differently.

A number of factors were considered that did not appear to explain the lack of agreement. The majority of children appeared to understand the questionnaire so a lack of understanding is unlikely to have contributed to the lack of agreement between methods. Children's gender, previous use of touch-sensitive devices, the length of the administration gap and the order in which they completed the modalities were explored and none appeared to impact on the results in a discernible way. As only a small number of children had an administration gap of one week, however, it may be difficult to identify an impact of this. A shorter interval could perhaps have resulted in greater agreement between results, particularly for the younger children. Varni, Limbers and Burwinkle (2007) report that on the
full-length version of the questionnaire, five year-olds can report on their HRQOL but that internal consistency reliability increased slightly with age.

Children expressed excitement and enthusiasm for the iPad, reflected in the overwhelming preference for it. The reasons for their preference related to a general enthusiasm for technology as well as more specific aspects of the app such its personalised and interactive nature and the attractiveness of the images. This preference for a computerised version is consistent with previous research (e.g. Ogden et al., 2011), and with children's enjoyment of computers being related to their experience of mastery and having control over an assessment (Calam, Cox, et al., 2000; Mumtaz, 2001).

**Limitations**

A number of limitations should be recognised. Information about children's first language and receptive language ability was not gathered, and those with lower level additional needs included in the sample (e.g. with specific learning difficulties) were not specifically identified. Therefore, hypotheses about the lack of agreement being due to understanding of English, receptive understanding, or specific learning difficulties, could not be tested. The inclusion of children with some additional needs could have introduced confounding variables related to their understanding of the measure, their ability to respond consistently, or their understanding of the time frame they were responding in relation to (Booth & Booth, 1996). For the children who provided little additional verbal information, their understanding could only be judged if they indicated or appeared to be struggling with the questionnaire. Therefore, for some children understanding was judged through them not seeking further clarification. However as an exploratory study it sought to draw preliminary conclusions about the use of the iPad app as an assessment tool using a representative sample of children at urban mainstream schools, in order to then inform future research.

Children were asked to indicate their preference following completion of the questionnaire for the second time. It may be that the iPad had greater salience in their mind, either because they especially enjoyed using iPads or for children who had rarely used one before. If this was the case they might report it as being their preference regardless of whether they completed this modality first or second. It would have been preferable to ask them to rate
their enjoyment and ease of use of each modality separately following completion to avoid this. However the finding that they tended to prefer the iPad is consistent with previous research and with observations about their enjoyment and engagement with the iPad app, and therefore appeared to be a true reflection of their preference.

Information on test-retest reliability is not available for the English-language PedsQL (short or full-length versions). The developers of the measure have argued that "test-retest reliability may be less useful than internal consistency reliability in HRQOL instrument development, given that short-term fluctuations are highly likely in a health condition in which external factors, such as disease and treatment variables, are expected to influence functioning" (Varni et al., 2003, p.635). It was not appropriate to measure internal consistency in this study as it is a statistic that is used primarily when developing scales rather than when testing them. However, with the wide use of the PedsQL with children without health concerns, information about test-retest reliability would be a helpful addition. Although this information is available for the measures published in other languages, only the Japanese study (Chen et al., 2007) included children under eight years and it is unclear how their reported values of 0.46 - 0.73 varied by children's age. Therefore it cannot be assumed that if children completed the paper version twice that there would be high agreement.

This issue relates more broadly to the availability of reliable and valid self-report measures for younger children on topics such as HRQOL, and the difficulties in identifying measures that have a self-report version for younger children, are sufficiently brief, and have acceptable reliability and validity. A systematic review in 2007 (Grange, Bekker, Noyes, & Langley) identified no generic HRQOL measures for very young children that were psychometrically and conceptually robust. A different topic to quality of life could have been selected however a general topic with a broad application to children's lives was desired.

Further research

A number of areas of further research are indicated by this study. Children could be video- or audio-taped completing the questionnaire in order to make more structured
observations about their engagement with the iPad app, and this would have also provided a measure of completion time. A measure of test-retest reliability would be valuable, and therefore the study could be repeated with each child completing both versions twice in order to establish this. There is a parental version of the PedsQL SF15 and its agreement with the children's scores on the iPad and paper versions could have been examined. Teacher ratings of children's use of touch-sensitive devices may have been more accurate than parental reports and it would be interesting to explore if this could explain any differences in the comparability of scores.

The iPad app modality could be completed with children with learning disabilities, autism spectrum disorder, attentional or language difficulties, in order to explore specific benefits for children with additional needs and their use of and engagement with the iPad app. It could also be evaluated in relation to other valid existing measures, for example other HRQOL or generic quality of life measures or more specific measure for issues such as anxiety or trauma.

The iPad app also needs examination in terms of its broader uses. Through a need to adhere to the administration of the measure the app's sliding scale was not used to its full potential and it is important to explore the value of this further. A version of the PedsQL called the Present Functioning Visual Analogue Scales utilises a line as a response format, however there are only two published papers on its use and both report only on paediatric patients (Sherman, Eisen, Burwinkle, & Varni, 2006; Wehby, Naderi, Robbins, Ansley, & Damiano, 2014). The use of the iPad app for this measure would be interesting to explore.

The iPad app was engaging and enjoyable for children to use. There is potential for its further development through developing a way of organising the electronic results that is easier to manage for larger sets of questions, as was used here. The addition of a simpler 'next' button would allow children to take an even greater degree of control over the assessment. Finally, being able to tap on the screen to move their picture rather than drag it could have been a useful feature for some children and may be beneficial to children with physical disabilities.
Clinical implications and conclusions

The iPad app has value as an assessment tool to engage children in meaningful assessments of their current HRQOL. The fact that children could use the iPad app intuitively and without difficulty, the clear appeal of tablet technology and their familiarity with apps, means that it holds considerable promise as a tool for typically-developing children and those who have more specific difficulties. Although in this study it was not found to be comparable to an existing measure, as a stand-alone tool it was successful as it engaged and intrigued children, including those who might otherwise be difficult to engage.

As with all app and tablet technology there is a need to think carefully about the storage and transfer of personally identifiable information (Marceglia et al., 2012). It is also important to consider the ‘digital divide’ that can exist around the use of technology in economically disadvantaged areas and for marginalised groups such as individuals with disabilities (Macdonald & Clayton, 2012). However when British Educational Suppliers Association have forecast an increase in spending on technology for UK schools for 2014 to 2015 to £596 million (Vaughan, 2013) children have increasing access to this technology at school if not also at home. There is certainly scope for the development of app technology to access children's thoughts and feelings in an innovative and increasingly available format.
Feasibility and acceptability of an iPad app assessment tool with children with special educational needs

Prepared in accordance with requirements for submission to

The Journal of Clinical Child and Adolescent Psychology (Appendix J)
Feasibility and acceptability of an iPad app assessment tool with children with special educational needs

Abstract

1) Objective. To explore the feasibility and acceptability of This Much!, a new iPad assessment tool, as a response modality for the Pediatric Quality of Life Inventory Short Form (PedsQL SF15), with children with special educational needs (SEN). First their understanding of the questionnaire required examination. The study then examined children's use of, engagement with, and views on the app.

2) Method. Fifteen children (5 female, 10 male) with SEN aged 5-10 years (mean 7 years 10 months) participated. They completed the PedsQL SF15 using the iPad app response modality and formal and informal ability measures. They indicated whether they liked the iPad app and if it was easy to use.

3) Results. Of the 14 children who could complete the questionnaire, eight (57.1%) appeared to understand the questions and did not seek further clarification. Three children (21.4%) needed clarification and two appeared to understand all but one question (14.3%). One child did not understand the questions (7.1%). Most could use the three-point scale and respond using the time-frame. All children could use the iPad app and 14 engaged with it.

The physical functioning subscale had the shortest response times. Twelve children liked the iPad app (85.7%) and 10 thought it was easy to use (71.4%). No children disliked the app.

4) Conclusions. The iPad app has value as a tool to facilitate assessment with children with SEN in an engaging, accessible way. Difficulty understanding the questionnaire related to children's language or social and communication difficulties. Future research is discussed.

Keywords: iPad, assessment, special educational needs, feasibility, acceptability.
Introduction

Computers are being increasingly used to facilitate assessment with children who struggle to express their views or engage with traditional paper-based questionnaires (Barrow & Hannah, 2012). There are benefits of using computers in assessment with children in general, such as their enjoyment of using technology (e.g. Parkin, 2000). However there also exist specific benefits for children with special educational needs (SEN). This study explored a new iPad app assessment tool as a response modality for the Pediatric Quality of Life Inventory Short Form (PedsQL™ SF15; Chan et al., 2005) with children with SEN, as part of a larger study. According to the Revised Code of Practice for Children with SEN (Department for Education, 2014) due to be implemented in September 2014, a child has SEN if:

They have a learning difficulty or disability which calls for special educational provision to be made for him or her...he or she has a significantly greater difficulty in learning than the majority of others of the same age, or has a disability which prevents or hinders him or her from making use of facilities of a kind generally provided for others of the same age in mainstream schools (p.4-5).

Computers and children with SEN

Computers have been used in assessments with children with SEN and those described as vulnerable, including those with learning disabilities and autism spectrum disorder (ASD), about a range of sensitive and complex topics (Barrow & Hannah, 2012; Cousins & Simmonds, 2011; Davies & Morgan, 2005). This has included the successful use of computer-based questionnaires. Davies and Morgan suggest that "asking questions electronically in a graphical and stimulating computer-based context seems to yield surprisingly rich and useful information from vulnerable children, whose views hitherto may have been hard to reach" (p.390).

Computers can provide consistent information and feedback, and respond in predictable ways which can support children with severe learning difficulties to learn (Lee, McGee, & Ungar, 1998). Children have scope in computer assessments to set the pace which can
increase the validity of their responses (Calam, Jimmieson, Cox, Glasgow, & Groth Larsen, 2000) and programmes can be tailored to children's verbal ability (Barrow & Hannah, 2012). There are specific benefits for children with ASD in terms of their social interaction difficulties and social anxiety (Preece, 2002). For example, computer-assisted interviewing can provide a shared point of reference which removes the pressure of eye contact, children can have control over the direction of conversation, and they appear to enjoy using computers (Barrow & Hannah; Beresford, Tozer, Rabiee, & Sloper, 2004; Swettenham, 1996).

**Tablet technology**

Within the field of using technology with children with SEN, the use of applications (apps) on tablet devices is rapidly developing. The benefits of tablets include their intuitive touch-screen format, their light and portable design, and their acceptability to young people with and without disabilities (Bradshaw, 2013; Brady, 2011; Siegle, 2013). Their capacity to be used in a variety of settings means they are suited to individuals with physical disabilities. Through their portability there is greater scope for users to engage with them where and when they choose, which may be particularly important for individuals with social and communication difficulties.

Apps are being increasingly developed with people with disabilities in mind, for example the creation of communication systems (Bradshaw, 2013; Flores et al., 2012) and Talking Mats (Murphy & Cameron, 2002) for iPad and Android tablets. Tablets and innovative new apps have the capacity to be multi-sensory through the use of the touch-screen, visual and auditory elements (Walling, 2014). This can be especially beneficial for individuals with learning or sensory disabilities, or ASD (Obaid, 2013; Preece, 2002; Walling).

**The current study**

This study was part of a larger exploration of the comparability and acceptability of a new iPad assessment tool, This Much!, using an existing paper-based measure (the PedsQL SF15) as an exemplar to test its feasibility and comparability. Health-related quality of life (HRQOL) was chosen as it addresses many areas of potentially significant concern for children with a range of disabilities (Young et al., 2007). Furthermore, as there is evidence
that children with SEN can have poorer quality of life than those without disabilities (Watson & Keith, 2002) this is an important area of assessment.

This study explored the use of the iPad app as a response modality for the questionnaire by children with SEN. Alongside formal assessment, children's abilities were informally assessed through pre-test questions (Cummins, 1997; Hartley & MacLean, 2006) and the response times for the subscales were examined for differences. In order to comment on children's use of the app it was necessary to examine their apparent understanding of the questionnaire. Through video- or audio-recording children whilst completing the questionnaire it was intended that their verbal responses to questions, along with their views about the app, would be analysed qualitatively.

The research questions were as follows. 1) Do children understand the questionnaire using the iPad app response modality (the use of pre-test questions, and their understanding of the questions, the scale and the time frame)? 2) Can children with SEN use the iPad app? 3) Do children appear to engage with the iPad app (defined as enjoyment and concentration)? 4) Do children's response times to the subscales of the questionnaire vary? 5) Do children like the iPad app and think it is easy to use?

It was unknown whether children would understand the questionnaire however the use of a self-report scale for children as young as five years increased the likelihood of them understanding it. It was hypothesised that children with SEN would be able to use the iPad app and that they would engage with it, because of its intuitive, personalised nature and based on previous research about children's enjoyment of tablet devices. It was hypothesised that children would take longer to respond to the emotional functioning subscale because of its more abstract nature. Finally it was hypothesised that children would like the app.
Method

Recruitment

Fifteen mainstream urban schools were approached and five agreed to take part. Teachers and special educational needs coordinators (SENCOs) identified children who met the following criteria:

- Children on 'School Action Plus' (where a child’s learning needs require externally provided advice and support from the local education, social or health authority).
- Children with a statement of SEN (where additional support is required as School Action Plus is not sufficient).
- Diagnosed with Autism Spectrum Disorder (ASD) or a learning disability.
- Aged 5-11 years. The full primary school age range was included due to the exploratory nature of the study.

Educational definitions were used to enable teachers and SENCOs to accurately identify children who met criteria. Written information was sent to parents who were asked to provide written consent for their child (see Appendix S). Consent for taking a photograph of their child, videoing the interaction and gathering information about their child’s difficulties was also requested. Parents were asked to rate how often their child used a touch-sensitive tablet device. All children who met these criteria were invited to take part (n=142). Sixteen parents returned written consent, a response rate of 11.3%.

Participants

One child was not included as they did not meet the above criteria. Therefore data are presented on the remaining 15 children. They comprised five females (33.3%) and 10 males (66.7%), aged between 5 years 2 months and 10 years 5 months (mean age 7 years 10 months). Eleven parents (73.3%) provided information about their child’s use of touch-sensitive tablet devices. Of these 11, approximately half reported that their child used a touch-sensitive tablet device daily (n=6) and a quarter that they used one weekly (n=3). Two parents reported that their child had never used one (see table 1). Eight children had English
as a first language, four had English as a second language, and three were bilingual (see table 2).

Table 1. Descriptive statistics for the sample.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Frequency n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>5 (33.3%)</td>
</tr>
<tr>
<td>Male</td>
<td>10 (66.7%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age (years)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>2 (13.3%)</td>
</tr>
<tr>
<td>6</td>
<td>1 (6.7%)</td>
</tr>
<tr>
<td>7</td>
<td>7 (46.7%)</td>
</tr>
<tr>
<td>8</td>
<td>1 (6.7%)</td>
</tr>
<tr>
<td>9</td>
<td>2 (13.3%)</td>
</tr>
<tr>
<td>10</td>
<td>2 (13.3%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Touch-sensitive tablet device use</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>2 (18.2%)</td>
</tr>
<tr>
<td>A few times ever</td>
<td>0</td>
</tr>
<tr>
<td>Once a month</td>
<td>0</td>
</tr>
<tr>
<td>Once a week</td>
<td>3 (27.3%)</td>
</tr>
<tr>
<td>Every day</td>
<td>6 (54.5%)</td>
</tr>
</tbody>
</table>

**Description of the sample**

Table 2 describes the sample of children with SEN, including their current school year and their equivalent school year based on their national curriculum levels. Children ranged from being on target (two children) to being more than three school years behind in terms of their achievement levels. All children were on School Action Plus (SAP) with the exception of one on Intensive SAP and one with a statement of SEN. All children’s difficulties were identified by SENCOs as impacting on their learning and all received some level of 1:1 support. All were in mainstream classrooms except one child who was taught in an ASD
resource classroom. Four children had a diagnosis of ASD and two had social communication difficulties, two were behind their expected learning levels due to absence from school (in one case due to serious illness, the other due to general non-attendance and moving school frequently), and the remaining seven had difficulties with learning with an unspecified cause.
Table 2. A description of the children’s difficulties and diagnoses.

<table>
<thead>
<tr>
<th>Child</th>
<th>Language</th>
<th>Difficulty or diagnosis</th>
<th>Visual*</th>
<th>Attention</th>
<th>Emotional and Behavioural</th>
<th>Motor/Physical</th>
<th>School year</th>
<th>Equivalent school year (based on achievement levels)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Arabic (EAL)</td>
<td>Autism Spectrum Disorder/Social communication difficulties</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>&lt;1</td>
</tr>
<tr>
<td>2</td>
<td>Somalian (BL)</td>
<td>ASD</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td>2</td>
<td>Numeracy &lt;1</td>
</tr>
<tr>
<td>3</td>
<td>Urdu (BL)</td>
<td>SCD</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>Literacy &lt;1 to 1</td>
</tr>
<tr>
<td>4</td>
<td>Chinese (EAL)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>English</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>Numeracy 2</td>
</tr>
<tr>
<td>6</td>
<td>Portuguese (EAL)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>Literacy 1</td>
</tr>
<tr>
<td>7</td>
<td>Kurdish (EAL)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>Numeracy 3</td>
</tr>
<tr>
<td>8</td>
<td>English</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>Literacy &lt;1</td>
</tr>
<tr>
<td>9</td>
<td>Bengali (BL)</td>
<td>ASD</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>English</td>
<td>SCD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td>Numeracy/Reading 4 Writing 3</td>
</tr>
<tr>
<td>11</td>
<td>English</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td>Numeracy/Writing 1 Reading 2</td>
</tr>
<tr>
<td>12</td>
<td>English</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td>Numeracy 3 to 4 Reading 3 Writing 2</td>
</tr>
<tr>
<td>13</td>
<td>English</td>
<td>ASD</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td>5</td>
<td>Exceeding Early Learning Goals (levels used in reception)</td>
</tr>
<tr>
<td>14</td>
<td>English</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>Numeracy/Writing 1 Reading 2</td>
</tr>
<tr>
<td>15</td>
<td>English</td>
<td>ASD</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td>5</td>
<td>2 to 3</td>
</tr>
</tbody>
</table>

EAL=English as an additional language. BL=Bilingual. *partially corrected by glasses.
The children completed the British Picture Vocabulary Scale Second Edition (BPVS-II) (Dunn, Whetten, & Burley, 1997) and the two-subtest form of the Wechsler Abbreviated Scale of Intelligence (WASI; Psychological Corporation, 1999) to provide a brief description of their abilities in key areas. The BPVS-II is a test of receptive vocabulary for 3 to 15 year-olds across the ability range that does not rely on reading. The WASI is a test for 6 to 89 year-olds that can provide a full-scale IQ score. The two-subtest version includes the Vocabulary subtest (measuring expressive vocabulary and verbal knowledge) and Matrix Reasoning subtest (measuring nonverbal fluid reasoning and general intellectual ability).

One child did not engage in either test and another did not complete the WASI due to concentration and motivation issues. On the BPVS-II, one child performed at the level expected for his age. One child's score was 6 months below where expected for his age. Nine children's scores were between 1 and 2 years below where expected, two children's were over 2 years below and one child's score was over 3 years below where expected.

On the WASI, one child performed in the 'average' range, six in the 'low average' range, five in the 'borderline' range and one in the 'extremely low' range. Caution is needed when interpreting the scores for the two children aged 5 years as the WASI norms start at age 6, and also for the five children who may have had a significant discrepancy between their Vocabulary and Matrix Reasoning scores (identified in table 3).
Table 3. The results of the BPVS-II and WASI tests.

<table>
<thead>
<tr>
<th>Child</th>
<th>Age (y:m)</th>
<th>Age equivalent (y:m)</th>
<th>FSIQ-2 score (95% CI)</th>
<th>Percentile rank</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1*</td>
<td>8:00</td>
<td>6:04</td>
<td>67 (62-77)</td>
<td>1</td>
<td>Extremely low*</td>
</tr>
<tr>
<td>2</td>
<td>6:08</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>7:09</td>
<td>5:06</td>
<td>78 (72-87)</td>
<td>7</td>
<td>Borderline</td>
</tr>
<tr>
<td>4*</td>
<td>7:04</td>
<td>5:03</td>
<td>72 (67-81)</td>
<td>3</td>
<td>Borderline</td>
</tr>
<tr>
<td>5</td>
<td>7:05</td>
<td>5:07</td>
<td>88 (82-96)</td>
<td>21</td>
<td>Low av.</td>
</tr>
<tr>
<td>6*</td>
<td>7:05</td>
<td>6:03</td>
<td>84 (78-92)</td>
<td>14</td>
<td>Low av.</td>
</tr>
<tr>
<td>7*</td>
<td>7:05</td>
<td>6:01</td>
<td>76 (70-85)</td>
<td>5</td>
<td>Borderline*</td>
</tr>
<tr>
<td>8</td>
<td>7:03</td>
<td>5:10</td>
<td>88 (82-96)</td>
<td>21</td>
<td>Low av.</td>
</tr>
<tr>
<td>9*</td>
<td>5:05</td>
<td>3:06</td>
<td>79 (73-88)</td>
<td>8</td>
<td>Borderline</td>
</tr>
<tr>
<td>10</td>
<td>10:05</td>
<td>6:07</td>
<td>85 (79-93)</td>
<td>16</td>
<td>Low av.*</td>
</tr>
<tr>
<td>11</td>
<td>9:10</td>
<td>8:09</td>
<td>87 (81-95)</td>
<td>19</td>
<td>Low av.</td>
</tr>
<tr>
<td>12</td>
<td>10:00</td>
<td>8:04</td>
<td>78 (72-87)</td>
<td>7</td>
<td>Borderline*</td>
</tr>
<tr>
<td>13*</td>
<td>5:02</td>
<td>4:08</td>
<td>86 (80-94)</td>
<td>18</td>
<td>Low av.</td>
</tr>
<tr>
<td>14</td>
<td>7:08</td>
<td>7:09</td>
<td>96 (89-104)</td>
<td>39</td>
<td>Average*</td>
</tr>
<tr>
<td>15</td>
<td>9:10</td>
<td>8:05</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

CI = confidence interval; FSIQ = full scale IQ.
*English as an additional language (EAL) norms used.
#Children aged 5 years (below the point at which the WASI norms start).
+Vocabulary and Matrix Reasoning standard scores differed by ≥15 points which may indicate a significant discrepancy.

**Measures**

Details of the iPad app assessment tool (‘This Much!’) and the PedsQL SF15 can be found in the larger study. There is no research describing the use of this questionnaire with children with SEN.
Procedure

Each child was seen once in a quiet, familiar room at school. Fourteen children were seen individually and one was initially accompanied by his 1:1 support to help him settle in. The researcher introduced herself and explained that she wanted to ask them some questions and asked whether the child agreed to this. The child was asked for agreement to make a video-tape or audio-tape of the session (all children agreed). The researcher said that she would tell the child's parent/s that they had taken part, as a simple way of explaining confidentiality. She said that the child could stop at any time and demonstrated a 'stop' hand gesture to explain this.

Once assent had been gathered (all children agreed to take part) each child answered pre-test questions. The likelihood of acquiescence was assessed as this has been frequently reported when assessing individuals with learning disabilities (Sigelman et al., 1981). The researcher referred to the child's school by the wrong name to see if the child corrected her. The children's ability to understand relative sizes (relating to the size of problems in the questionnaire) was assessed by asking them to select the biggest and smallest pile of three piles of bricks, and identify which was biggest of them and the researcher. For the introduction and pre-test questions described above, individually-presented Boardmaker® symbols were used to support understanding for all children (Appendix T). Boardmaker® symbols are standardised pictures for communicating with individuals with cognitive and language impairments, and are used in schools. Children then completed the BPVS-II and the WASI tests.

The children then completed the questionnaire using the iPad app as a response modality. The researcher read the questions aloud and followed the instructions as per the original version. To support children to respond in relation to the time-frame specified by the questionnaire, they were asked what they did at the weekend in order to identify a personalised anchor event. This was important as individuals with learning disabilities can have difficulties in judging time (Booth & Booth, 1996). This preceded the main questionnaire items. The practice question 'Is it hard for you to snap your fingers?' was supplemented with a demonstration as the word 'snap' was considered potentially confusing.
for children with ASD. They were asked to demonstrate a click to check the accuracy of their response, and to respond using the iPad to check they could use the touch-screen. Whilst completing the questionnaire, the researcher asked the children for further details to check their understanding. The researcher gave pre-defined additional explanations when children reported or appeared not to understand a question. Following the questionnaire the child selected a response using paper Boardmaker® symbols from 'I liked the iPad/I did not like the iPad/I don't know' and 'It was easy/It was hard/I don't know' (Appendix U). Following completion they chose a sticker to thank them. Children were offered breaks if they appeared to need them or asked for them.

Additional supporting Boardmaker® symbols were created for one 5 year-old participant (child 9) whose SENCO reported that he could not yet understand the concept of relative size or of a 'problem' (see Appendix V). The symbols were used in order that he might be enabled to understand the questionnaire. It was decided to use these symbols with four additional children in light of the exploratory nature of the study. These children represented an opportunity sample as they were all children seen on one day.

Twelve parents consented to their child being video-taped, two consented to audio-taping, and one did not provide consent to either. All sessions were timed with the exception of the one that was not recorded. Although children were told to respond by moving their picture to one of the three faces they were not dissuaded from placing their picture elsewhere on the line if they chose. The study was granted ethical approval by The University of Manchester (Appendix L).

**Statistical analyses**

The statistical analyses for each research question were as follows. Descriptive statistics, clinical observation (from video- and audio-recordings) and systematic comparison between children's verbal responses and iPad responses were used to examine the different aspects of children's understanding of the questionnaire; their use of the iPad app response modality; and their engagement with the iPad app. All children's comments were transcribed verbatim from the recordings. Content analysis, a qualitative approach to interpreting text that takes a systematic approach to identifying and coding themes (Hsieh & Shannon, 2005)
was selected for analysis to examine children’s understanding of the questions and examples of their engagement with the iPad app. Details of clinical observations of children’s understanding and engagement can be found in appendix W.

Descriptive statistics were used to examine children’s response times for the subscales of the questionnaire. Descriptive statistics were used to report children’s responses to whether they liked the iPad app and whether they thought it was easy to use, and a content analysis approach was taken to examine their reasons for this.

Results

Do children understand the questionnaire using the iPad app response modality (the use of pre-test questions, and their understanding of the questions, the scale and the time frame)?

Pre-test questions

The only child who responded incorrectly to the pre-test questions and the practice item on the questionnaire was the child who did not appear to understand the questionnaire questions at all. The remainder of the children responded correctly (although some needed prompts) to the pre-test questions (see table 4) and all responded correctly to the practice questions.

Table 4. Results from pre-testing questions.

<table>
<thead>
<tr>
<th></th>
<th>Acquiescence</th>
<th>Judgements of relative size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correct</td>
<td>12 (80.0%)</td>
<td>12 (80.0%)</td>
</tr>
<tr>
<td>Correct with prompt</td>
<td>3 (20.0%)</td>
<td>2 (13.3%)</td>
</tr>
<tr>
<td>Incorrect</td>
<td>0</td>
<td>1 (6.7%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Acquiescence</th>
<th>Judgements of relative size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is this [incorrectly named] school?</td>
<td>Who is bigger, you or me?</td>
</tr>
<tr>
<td>Correct</td>
<td>12 (80.0%)</td>
</tr>
<tr>
<td>Correct with prompt</td>
<td>3 (20.0%)</td>
</tr>
<tr>
<td>Incorrect</td>
<td>0</td>
</tr>
</tbody>
</table>
The questions

One child with ASD (child 2) could not engage with the cognitive testing or the questionnaire. He repeatedly asked the researcher if she was a doctor and sat at the table for only brief periods of time. He responded to very few questions and therefore the session was ended. The data about children's understanding therefore relates to 14 children (see table 5).

Eight children (57.1%) appeared to understand the questions and did not seek further clarification. Three children (21.4%) appeared to need, or asked for, clarification for between one and two questions per child (questions 10, 12 and 13). With clarification they appeared to understand these questions.

Two children (14.3%) appeared to understand all but one question (question 9 and 15) and one did not show understanding of the questions at all (7.1%). Understanding was judged by examining children's verbal responses and their responses on the iPad for discrepancies, for example saying "it's hard" but placing their picture on the happy face.

It was not possible to analyse the children's speech using content analysis due to sparse data, however a sample of typical quotes is presented in Appendix X to demonstrate examples of children's understanding.

The scale

Three children (21.4%) responded using only two of the three faces on the scale. Two of these children used only 'not at all' and 'sometimes'. However their explanations of their responses both showed understanding of the concepts of not at all, sometimes, and a lot. One child used only the two extremes of the scale and his understanding of the scale was queried. When asked clarifying questions about whether he ever felt sad or angry he denied this. The remaining 11 children (78.6%) used all three possible responses, although for the child who did not understand the questions this may not be meaningful.
**The time frame**

Children were asked to respond in relation to a recent time frame; however two children described events that had happened in the past. One related this to the ongoing impact of being bullied and therefore showed understanding of the time frame. The other child responded to one question based on past events yet in other questions he referred to more recent events.

Table 5. Description of children's level of understanding of the questionnaire.

<table>
<thead>
<tr>
<th>The questions</th>
<th>Frequency n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appeared to understand all questions without clarification</td>
<td>8</td>
</tr>
<tr>
<td>Appeared to understand all questions with clarification</td>
<td>3</td>
</tr>
<tr>
<td>Appeared to understand all but one question</td>
<td>2</td>
</tr>
<tr>
<td>Did not appear to understand the questionnaire</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The scale</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Used all three points on the scale</td>
<td>11</td>
</tr>
<tr>
<td>Used two points but demonstrated understanding</td>
<td>2</td>
</tr>
<tr>
<td>Used two points and their understanding was queried</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The time-frame</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Evidence of responding in relation to events in the distant past</td>
<td>1</td>
</tr>
<tr>
<td>No evidence of responding in relation to events in the distant past</td>
<td>13</td>
</tr>
</tbody>
</table>

In relation to children's understanding, only tentative hypotheses were made. As hypothesised the use of a self-report scale for young children appeared to give many of them the opportunity to understand the questions and the scale.

**Can children with SEN use the iPad app?**

All 15 children could type their name to label their picture, understood and could use the touch-screen, and understood that their picture could be moved along the scale. This included the two children with motor difficulties and the one child who could not engage with
any tasks. Three children needed prompts to respond using the iPad app rather than giving verbal responses, one needing prompts throughout the task (the child who did not understand the questions). Two children repeatedly moved their picture back to the centre by hand and needed prompts to leave their picture where they had placed it so it could be saved.

As hypothesised, children with SEN were able to use the iPad app. This may be because of its intuitive nature. For some children this was not affected by their difficulties whilst for others their difficulties impacted on their use.

**Do children appear to engage with the iPad app?**

Engagement was considered in terms of enjoyment and concentration (judged by clinical observation and systematic consideration of children's verbal comments). Thirteen children of 15 showed excitement when using the iPad app through clapping, waving at the iPad, smiling and laughing, and striking amusing poses for their photograph. This included the child who could not engage with the task. The remaining two children showed excitement for only specific aspects, one smiling when viewing their photograph and the other smiling when their photograph 'jumped back' (reset itself) to the centre of the screen. These two children did not smile at all during any other tasks. Of the 12 children whose parents had consented to a photo being taken, 10 agreed to this (83.3%) while two preferred to select an illustration.

It was not possible to analyse the children's speech using content analysis due to sparse data, however comments relating to this were identified by reading the transcripts. All six comments made by children relating to this are reported below and are summarised below at a basic level. All comments made were positive. The researcher's comments are italicised and additional information is in brackets.

1. "We've got something a bit different to do now. Is it on the iPad? It is on the iPad. Yessssss!" [gesturing excitement] (child 8, age 7).

2. [Got iPad out] "Let's see what we've got, ooh let's see what we've got!" (child 15, age 9).
3. "Easy peasy lemony squeezy, jump Mrs!" [in relation to the photo re-centring after clicking 'next'] (child 3, age 7).

4. "Can I see her jump back?...I want to see her jump" [giggling when this happened] (child 3, age 7).

5. [While he was inputting his name] "Woah thanks for letting me touch your iPad! Woah!" (child 15, age 9).

6. [When taking a photo, child was 'posing'] "Do you want this one with your arm up in the air? Yeah like I’m a wrestler!" (child 15, age 9).

The first two comments appear to demonstrate children's excitement about using the iPad in general. Comments three and four relate to children's enjoyment of how their picture moved along the line. Comment five referred to children's enjoyment of the touch-screen aspect. Comment six related to enjoyment of having his photograph taken in a way that he chose.

In terms of concentration, 12 children concentrated well and three were distracted by aspects of their environment, which was the case for all tasks they engaged in. Of these three, one child could not engage in any tasks and did not complete the questionnaire. One could engage with the questions with numerous prompts to help her focus and she provided responses that appeared to be valid. One showed decreased concentration and motivation when he reached a question he did not understand, which continued for the remainder of the questionnaire. Therefore his responses cannot all be assumed to be valid.

As hypothesised, children with SEN engaged with the iPad app. This may be because of its personalised nature and their general enjoyment of using tablet devices and technology.
Do children’s response times to the subscales of the questionnaire vary?

The questionnaire took an average of 11 minutes 2 seconds to complete (ranging from 9 minutes 30 seconds to 14 minutes, see table 6). The longest average response time per question was on the school functioning subscale and the shortest was on the physical functioning subscale. The median was calculated as a small number of questions had long response times (e.g. 90 seconds on the school functioning subscale). The median response time was longest for the social functioning questions (see appendix Y for response time per question). This was not consistent with the hypothesis that the emotional functioning subscale would have the longest response times.

The response times for two children were not included. One child did not understand the questionnaire and changed the majority of his responses in relation to any query or follow-up question, resulting in a lengthy completion time (19 minutes 4 seconds). The full completion time for the child with concentration and motivation difficulties was not recorded due to a technical error.

Table 6. Completion time for questionnaire overall and by subscale.

<table>
<thead>
<tr>
<th></th>
<th>Mean (Std.Dev)</th>
<th>Median</th>
<th>Min-Max (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total completion time</td>
<td>11 min 2 sec</td>
<td>10 min 29 sec</td>
<td>9 min 25 sec - 14 min (4 min 35 sec)</td>
</tr>
<tr>
<td>Subscale* (sec)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical Functioning</td>
<td>8.8 (2.9)</td>
<td>7.5</td>
<td>3-35 (32)</td>
</tr>
<tr>
<td>Emotional Functioning</td>
<td>10.5 (6.0)</td>
<td>7</td>
<td>3-57 (54)</td>
</tr>
<tr>
<td>Social Functioning</td>
<td>10.4 (3.1)</td>
<td>9</td>
<td>3-38 (35)</td>
</tr>
<tr>
<td>School Functioning</td>
<td>11.8 (11.7)</td>
<td>7</td>
<td>3-90 (87)</td>
</tr>
</tbody>
</table>

*Data is per question within the subscale.
**Do children like the iPad app and think it is easy to use?**

Ten children of 14 selected that the iPad app was 'Easy' to use and 12 that they 'liked it'. No child reported that they did not like the iPad app (see table 7). Two children reported 'I don't know' to both questions.

Table 7. Children's views of the iPad app.

<table>
<thead>
<tr>
<th>Was the iPad app easy to use?</th>
<th>Frequency n (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>It was easy</td>
<td>10 (71.4%)</td>
</tr>
<tr>
<td>It was hard</td>
<td>1 (7.1%)</td>
</tr>
<tr>
<td>I don't know</td>
<td>2 (14.3%)</td>
</tr>
<tr>
<td>Both easy and hard</td>
<td>1 (7.1%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Did you like the iPad app?</th>
<th>Frequency n (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I liked it</td>
<td>12 (85.7%)</td>
</tr>
<tr>
<td>I did not like it</td>
<td>0</td>
</tr>
<tr>
<td>I don't know</td>
<td>2 (14.3%)</td>
</tr>
</tbody>
</table>

It was not possible to analyse the children's speech using content analysis due to sparse data, however comments relating to this were identified by reading the transcripts. Two children gave explanations for thinking that the iPad app was easy to use, and five children explained why they liked it. All seven quotes, which were all positive, are shown below and the content of each comment is summarised at a basic level below. The children who identified that the iPad app was hard to use, or who did not know, did not comment on this.

Children thought the iPad app was easy to use:

1. “Cos the questions was a bit easy” (child 10, age 10).

2. “Because you just did have to do your feelings and put it on the face and think about your feelings” (child 14, age 7).
Children liked the iPad app:

3. "Games" (child 1, age 8).

4. "Because I don't really get to go on iPads a lot" (child 8, age 7).

5. "Because it's sad face and happy face" (child 4, age 7).

6. "Well I like it cos it had my picture on and I could move it to a smiley face and what my feelings are" (child 14, age 7).

7. "You can choose one of the people that you wanted to be and you can show how you're feeling" (child 11, age 9).

One child thought that the iPad app was easy to use because the questions were easy, and another related this to rating his feelings on the scale (comments one and two). One child liked iPads in general because of the games on them, and another said he liked using the iPad app as he rarely got to use iPads (comments three and four). Comments five, six and seven related to the faces on the line, the option to choose a face that represented their feelings, and the potential to personalise the scale with a photograph or illustration of their choice.

As hypothesised, overall children with SEN liked using the app, and many also thought it was easy to use, although this was a smaller number of children.

**Discussion**

This study explored the use of the iPad app as a response modality for the PedsQL SF15 questionnaire by children with special educational needs (SEN). In order to comment on children's use of the app it was necessary to examine their apparent understanding of the questionnaire. The study then examined their use of and engagement with the iPad app, the response times for the subscales, and whether they liked the iPad and thought it was easy to use.
In relation to understanding the questionnaire, the pre-test questions accurately identified the one child who did not appear to understand the questions. Eight children of 14 appeared to understand the questions and did not seek further clarification, whilst three appeared to need, or asked for, further clarification. With clarification they appeared to understand. The need for clarification of a small number of questions was observed in the larger study and is therefore not unusual. Two children appeared to understand all but one question and one child did not appear to understand the questions at all (based on the disparity between his verbal responses and iPad responses). One child could not complete any tasks. The majority of children appeared to be able to use the scale and respond in relation to the time frame.

One child only used the two extremes of the scale, and there are a number of hypotheses about why this was. Chambers and Johnson (2002) report that 5 to 6 year-olds respond in a more extreme way when rating emotional states compared to children aged 7 and over. Although this child was aged 7 years 4 months, it may be that his responses were more consistent with those of slightly younger children due to his learning delay. He may have had difficulty recognising or quantifying his feelings, or understanding the idea of 'sometimes a problem'. Two other children used only two faces of the three on the scale, however approximately half of children in the larger study also used only two faces (on both the iPad and paper modality) therefore this does not necessarily indicate a lack of understanding.

Some children provided additional information when asked to show their understanding, and a small number did so spontaneously. Importantly, even the children who spoke very little were able to use the iPad app to share their views. In response to an item on the questionnaire, one quiet child disclosed that she often did not understand her work and that she had not told her teacher this. Another child described feeling sad speaking about her recent experience of bullying but that she thought it was good to share this.

The child who did not appear to understand the questionnaire at all was aged 5, had a diagnosis of ASD and an identified language delay. It is unsurprising that he could not understand the questionnaire for two reasons. The questionnaire is designed for children aged 5 upwards (his score on the BPVS-II indicated a receptive vocabulary age equivalent
to 3 years 6 months) and his SENCO had reported that he was not yet able to understand the concept of relative sizes and of ‘problems’. The use of additional Boardmaker® symbols did not appear to support his understanding. This is also unsurprising as typically children need to learn to understand and use these symbols. Although this had potential to support his understanding to an extent it was unlikely to eliminate his difficulties. However, he engaged with and enjoyed using the iPad app, suggesting that it could be a helpful tool for engaging even young children with multiple additional needs.

In terms of children’s use of the iPad app, all children (regardless of their ability to understand the questionnaire and including the child who could not engage with any activities) were able to use the app and could use and understand the touch-screen. Two children repeatedly moved their picture back to the centre before their response was saved however with repeated prompts they ceased to do this, demonstrating learning about how to use the iPad app. The interactive nature of the iPad meant that some children’s pace-setting could appear impulsive with them rushing to click to the next screen, however from clinical observation others moved their picture along the line as they considered their answer.

In relation to engagement, all children showed some level of enjoyment when using the iPad app. For two children who appeared nervous, their only facial expressions of enjoyment in the process occurred when using the iPad app, suggesting its potential for helping even very anxious children to relax. Another child with ASD appeared to need fewer prompts to concentrate on the iPad app compared to the initial conversation and the cognitive tests however this needs more systematic observation. Two children spontaneously rated experiences that were not part of the questionnaire (e.g. bullying) which attests to the iPad’s value in facilitating conversation with young people. For one child with ASD the expression of physical pain was his idiosyncratic method of communicating emotional distress and he spontaneously used the app to rate this. Although his concentration and motivation decreased once he reached a difficult question, he nevertheless remained interested in the iPad app, taking photographs of himself and moving his picture along the scale. Despite his concentration difficulties he had remained engaged up to that point. Had he not already
completed lengthy cognitive testing, he may well have been able to engage with the questionnaire for longer as a result of his enjoyment of the iPad app.

With regards to response times, children took longer to respond to the emotional, social and school functioning subscales than the physical functioning subscale, which may have reflected the main difficulties of the children in the sample. It may be that these questions had greater significance and therefore prompted more thought. Two children had identified motor delay however this may have affected them in more subtle ways than would be identified by the physical functioning questions.

The majority of children indicated that they liked the iPad app and that it was easy to use, with no children identifying that they did not like it. This was reflected in their facial, physical and verbal expressions of excitement. It was the impression of the researcher that children smiled more when using the iPad app compared to the other aspects of the study, however more systematic observational work is needed to address this. This may have reflected greater enjoyment of the iPad app or because it was more distinct from schoolwork and had a less clear emphasis on right and wrong answers.

Limitations

The sample size was small and there are issues with considering children with disabilities, particularly those with ASD, as homogenous groups (Preece, 2002). Indeed, in this sample two children appeared to be below where expected due to having missed large amounts of school which is not equivalent to having difficulties with learning. However the combination of systematic methods (such as examining their apparent understanding of the questions based on agreement between verbal and iPad responses and their use of the scale) and clinical observations (from the video- and audio-recordings) enabled individual differences to be described. The exploratory nature of the study was designed to identify areas for further research.

There were issues with teachers accurately identifying children who met criteria, and this led to one child being inappropriately recruited. However this recruitment method was a practical necessity considering the number of schools involved and the large workloads of
SENCOs. Furthermore, direct contact with teachers enabled the researcher to engage teachers in efforts to prompt children to return questionnaires. Parents were asked to complete the parental version of the questionnaire, however only two of 12 who consented to this returned it, so it was not possible to examine the agreement between parent and child self-report.

For the children who were reluctant to speak, conclusions about their understanding of the questions and the time frame were drawn in the absence of information to suggest otherwise, which may not be an accurate reflection. However, other indicators were used to support these decisions, such as their ability to say that they did not understand a question when asked, and their correct response on the practice question. Judgements about children's understanding were made by the researcher who had collected the data. An independent rater could have checked the objectivity of these judgements. Some parental ratings of children's use of touch-screen tablet devices appeared inaccurate based on child self-report therefore teachers could also have rated this to ensure that the use in schools was included.

The additional supporting Boardmaker® symbols did not appear to be necessary for the four children who used them in addition to the child they were designed for. Through using this support it is not possible to conclude they could have understood the questionnaire without this. However, when all four children had receptive vocabulary skills equivalent to age 5 years 6 months upwards, and the questionnaire is designed from children from 5 years, it is unlikely that they would have needed these symbols to understand the items on the questionnaire.

The use of older versions of the BPVS-II and the WASI means that interpretation of scores requires caution. This was unavoidable for practical reasons and both versions continue to be used in published research (e.g. Ewing-Cobbs et al., 2014; Webb, DelDonno, & Killgore, 2014). There are criticisms of the concurrent validity of the WASI in comparison to more comprehensive scales (Axelrod, 2002), particularly the two-subtest form used here. Although the children with large discrepancies between scores on the two WASI subtests were indicated, the two-subtest form does not allow for formally interpreting scores
separately. Therefore their scores may not have accurately represented their ability profile. However the brevity of the WASI was required for this study as it was anticipated that children might lose concentration. It might have been preferable to conduct more comprehensive assessments on a separate visit, as children were often tired after even these briefer tests.

**Clinical implications and future research**

The potential for the iPad app's use more broadly was captured in the systematic and clinical observations that even the least talkative children could share meaningful insights into their experiences, in what was only a brief task with an adult they had never met. The use of the app by some children to spontaneously rate experiences not listed in the questionnaire shows their ability to engage with and use the app in a creative, idiosyncratic way. The easy use of the iPad app itself may have represented a relatively uncommon experience of mastery for children who had difficulties in a number of areas. Further exploration of how the children made decisions about their responses is important. Approaches such as cognitive interviewing (e.g. Cremeens, Eiser, & Blades, 2007; Eddy, Khastou, Cook, & Amtmann, 2011) could be used to explore their approach to using the iPad app as a response modality.

The three children who had more significant difficulties with the task all had a diagnosis of ASD. However these difficulties appeared more obviously related to language delay or to concentration issues for two of these children. The one child with ASD who did not appear to have difficulties with the questionnaire performed better on all cognitive tests than the other children with ASD, and was above expected levels at school. It may be that his relatively better verbal and non-verbal skills and lack of concentration difficulties enabled him to understand the questionnaire more easily however this needs further exploration with a larger sample. The benefits of computers for children with ASD, such as having a shared focus to take the emphasis away from the social interaction and the need for eye contact (Barrow & Hannah, 2012; Swettenham, 1996), need exploration with regards to using iPads. The presence of a known adult helped one child to settle into the interaction and it may that this would have benefited all children with ASD involved in the study (as recommended by
Preece, 2002). One child with ASD changed his iPad response following any follow-up question from the researcher (e.g. what kinds of sports do you like?). It may be that children with ASD would benefit from clear indicators about which questions require an iPad response and which are clarifying questions, as their social communication impairments might make this difficult. It may be that for children with ASD, individual social stories (as recommended by Barrow & Hannah) would enable them to better understand the format of an assessment, and therefore benefit more from the advantages of computer-based assessments. Research into the use of this iPad app by a larger sample of children with ASD would allow more specific exploration of these benefits.

It was difficult to draw conclusions about the benefit of the iPad app for concentration difficulties as it could only be compared against the cognitive testing (which may be less engaging for some children) and because they had not completed the paper version of the questionnaire. It is important to establish whether they can use the paper version; however their positive views about the iPad app, alongside the overwhelming preference for the app in the larger study, indicates that this might be their preference too.

**Conclusion**

The iPad app has value as a tool to facilitate and structure discussion with children with SEN, including those with ASD, and more research is warranted. The children’s ability to use the touch-screen and understand the concept of moving their picture on a scale, regardless of whether they understood the questionnaire itself shows promise for the use of this iPad app more widely with children with SEN. It successfully engaged children who in class could be difficult to engage or who struggled to focus. This study gave insight into the abilities of children with SEN to engage in completing questionnaires via iPads and through this to share meaningful information about their lives.
Paper 4: Critical Reflections

Critical reflections on
'Technology, Disability and Communication: User Views and Reliability'
Critical reflections on
‘Technology, Disability and Communication: User Views and Reliability’

Abstract

This paper describes the researcher’s critical reflections on the research process and as such uses the first person. It is not written for publication, but instead to provide a discussion of the research more broadly, including methodological issues, clinical and research implications, and personal reflections that were not included in the preceding papers. It presents an introduction to the research as a whole, then discusses the literature review (Paper 1), followed by the two empirical papers (Papers 2 and 3), which are considered together as they represent constituent parts of an overall study. Finally the research as a whole is discussed at the end in terms of implications and conclusions.
Introduction

The context

My experience of working with people with traumatic brain injury and learning disabilities (LD) prior to clinical training developed my interest in working with individuals with complex cognitive or communication difficulties. The people I worked with had important information to share about the impact of their difficulties on their lives, and about what would help improve this. It was important to think carefully about creative and engaging methods for gathering this information. It has been my experience that the voices of adults and children with LD may not be heard in the complex systems in which they live, therefore this felt like an important focus. When offered the opportunity to explore a new iPad app I was drawn to the breadth of possibilities available. Using the iPad app with children to offer a different experience of assessment and one that might facilitate them to share their views as well as being fun and enjoyable interested me.

An emerging focus

Through the course of this research the focus on individuals with LD has broadened to include individuals with a range of difficulties with learning. Within the meta-synthesis, the variation in terminology between countries and poor sample descriptions made it difficult to distinguish clearly between those involving individuals with LD and those with specific learning difficulties. Learning disabilities are defined as a "significantly reduced ability to understand new or complex information, to learn new skills...with a reduced ability to cope independently...which started before adulthood, with a lasting effect on development" (Department of Health, 2001, p.14). Specific learning difficulty (SLD) is an educational term used to describe difficulties such as dyslexia. It became apparent in the meta-synthesis that despite initial appearances, few of the papers that were identified obviously involved individuals with LD. The inclusion of studies involving people with SLD not only provided a context in which the few studies involving people with LD could be considered, but also allowed for comparisons between the themes that arose. These developments are examples of an evolving focus and a divergent rather than linear search direction which can occur over
the synthesis process (Noblit & Hare, 1988; Walsh & Downe, 2005). Within the empirical papers the focus shifted to children with special educational needs (SEN), in order to be more representative of children in mainstream schools in Manchester, many of whom struggle with learning and who represent a heterogeneous group.

**Paper 1: Literature Review**

What do people with learning difficulties and disabilities think about using technology? A meta-synthesis

**The value of consultation**

"Most people’s lives are still not what a non-disabled person would say was OK for themselves. Society is beginning to understand that people are equal citizens – but making this real is quite a long way off" (Valuing People Support Team, 2005, p.11)

Individuals with LD and their families are being increasingly involved in consultation on key issues. Examples include the government white paper *Valuing People* (Department of Health, 2001) and the Revised Code of Practice for Children with Special Educational Needs (Department for Education, 2014), due to be implemented in September 2014. Through my clinical work I have witnessed the importance of consulting with people about decisions that affect their everyday lives and in understanding their experiences. However, as the above quote suggests, when individuals with LD were consulted five years on from *Valuing People* in *The Story So Far* (Valuing People Support Team, 2005), they identified that there had not been the impact for everyone that had been hoped for. It is this belief in the value of consultation, and the need to act on what is learned from consultation, that underpinned the decision to focus on the views of individuals using technology.

**Deciding on a meta-synthesis**

While conducting initial searches I identified a number of qualitative and quantitative papers on the views of people with LD on using technology. Although the quantitative papers identified factors such as social acceptability, preference, and the likelihood of continued use, there was no scope for further exploration of these topics, or for consideration of issues
not listed on the questionnaire or outside the scope of those considered by the researchers. This contrasted with the approach taken by Bunning, Heath and Minnion (2009), a paper that I read early on in the process. They utilised Talking Mats (Murphy & Cameron, 2002) to facilitate conversation and included within this a number of blank cards for ideas, views, and types of technology the researchers had not considered. They were able to gather meaningful information, with important implications for supporting people to use technology in ways that met their priorities. Therefore a meta-synthesis appeared to be the most appropriate and potentially powerful approach.

**Key debates within meta-synthesis**

*Can and should qualitative research be synthesised*

The decisions made in this meta-synthesis sit within ongoing debates about the appraisal and synthesis of qualitative literature, including disputes about whether qualitative studies should be synthesised at all. Sandelowski et al. (1997) identify concerns that the process of synthesis loses the uniqueness of individual studies and therefore repeats the failing of quantitative studies to produce findings that relate to individual cases. This contrasts with the idea that a failure to situate qualitative papers within a broader context means that they continue to represent "islands of knowledge" (Walsh & Downe, 2005, p.205) that are not able to contribute to policy development or interventions. Thomas and Harden (2008) suggest that the complexities and time involved in synthesising information is something that many people would avoid or struggle with and therefore attempts at synthesis enable findings to be shared with a broader audience. The latter view of these two positions was taken within this meta-synthesis based on my position of wanting to enable the voices of individuals with LD to be heard more widely. Through including summaries of each paper, this enabled readers to judge whether the contexts were similar to their own and therefore judge comparability themselves (as recommended by Thomas & Harden).

*The focus of the meta-synthesis*

There also exist debates about the breadth of the focus within meta-syntheses. Noblit and Hare (1988) recommend a relatively 'narrow' scope as the focus of a meta-ethnography
in order to avoid making generalisations across diverse populations that result in a lack of
richness. However in this relatively new field any insights could be valuable and would
represent a starting point to encourage more specific meta-syntheses. Furthermore, Britten
et al. (2002) suggest that the inclusion of studies based in different settings might be
“essential to achieving the higher level of abstraction aimed for in the meta ethnography”
(p.214), which could support the inclusion of more diverse studies in my review. I aimed to
preserve the rich understanding gained from each study by ‘tagging’ each theme in the
synthesis process with a description of the sample (their age, context and difficulties) and
the type of technology they were using.

At times this could be difficult to perform due to poor sample descriptions in some studies,
however a more positive perspective on this lack of detail is that the researchers did not feel
it was necessary to be impairment-focused in their descriptions of the participants. The
desire to classify people by their diagnoses (the medical model) or their level of functioning
(the functional model) has been criticised for not capturing the experience of people living
with disabilities, or for not accurately describing people’s functional abilities (McDermott &
Turk, 2011). Therefore the use of quotes and maintenance of the context in which people
were using technology was important in going beyond defining people by their disabilities.

*Quality assessment*

There are criticisms of the use of quality assessment tools for appraising qualitative
research. Whilst some researchers have included all studies that are relevant, there is an
argument that if meta-synthesis is to be given appropriate weight by researchers that there
needs to be an attempt to appraise the quality of studies included in reviews (Walsh &
Downe, 2005). There exists considerable disagreement about the best methods of
appraising quality, and it is important that quality appraisal is used as a guideline rather than
a formal checklist. Through conducting meta-syntheses with poorer quality research this can
draw attention to the need for better quality studies (Walsh & Downe, 2006), a conclusion
that I drew from my meta-synthesis.

In many ways the key issues with the studies reviewed were not with the approaches
taken but with their failing to include researcher reflexivity. Researchers tended to ask
people with LD only concrete questions and focus on predetermined topics, due to concerns about participant's abilities to understand or express more complex topics; however there was little reflection on the implications of this. This may have been due to limitations imposed on the length of published papers or out of concern that this could undermine the quality of the research. Some difficulties with understanding and communicating may have been unavoidable however in most studies researchers provided little additional support in the interview process. Few studies used the creative approaches to interviewing that have been successfully used in the past to interview people with complex communication and cognitive impairments (e.g. Brewster, 2004; Germain, 2004; Whitehurst, 2007).

**Searching the literature**

There are ongoing debates about whether a systematic approach that aims to identify all literature, or only a subsample of studies, is needed when conducting a meta-synthesis. This review employed a systematic search across a large number of databases and followed a number of recommendations (Walsh & Downe, 2005) such as increasing transparency though including a flow chart of the process of searching and excluding studies, and ‘backtracking’ through reference lists. The search may not have identified all relevant research as it specified that only papers published in peer-reviewed journals would be included. The exclusion of the grey literature meant that studies published in book chapters or unpublished theses, as qualitative research sometimes is (Walsh & Downe), were not included. The inclusion of grey literature was not possible within the scope of this research, as it would have involved searching material relating to people with LD, SLD, to technology, and to qualitative methodologies, which would have represented a huge undertaking.

**Alternative approaches**

A number of alternative approaches could have been taken. A narrative literature review could have been written that did not apply such stringent inclusion criteria and therefore could have included grey literature. If this identified a greater number of studies involving people with LD it could have enabled a more specific review of the views of people with LD. Despite this, a meta-synthesis was the approach of choice because of the specific value it can offer over general literature reviews. Britten et al. (2002) argue that the process of
translating studies into one another in a meta-synthesis enables new understandings and insights. They suggest this happens through the development of ‘third-order interpretations’. Although I took this approach, I could have taken a step further and, as Britten et al. recommend, consulted with the original authors of studies to explore the extent to which my third-order interpretations were supported by their original data. This was beyond the scope of this review however it would be an interesting avenue of exploration within a more specific meta-synthesis.

An alternative approach to appraisal could have been taken. In a synthesis approach termed ‘critical interpretive synthesis’ (Dixon-Woods et al., 2006), the authors appraised papers by relevance to their topic rather than methodological aspects, in which relevance is defined as the potential for contribution to the development of theory (Gough, 2007). However there was a need for me to use more widely-accepted methods of quality assessment to show methodological rigour in my approach considering the poorer methodological quality of some included papers and in light of the potential issues with having reviewed a diverse sample of papers.

Alternative approaches have developed and evolved since Noblit and Hare’s (1988) approach (Barnett-Page & Thomas, 2009). Thomas and Harden (2008) developed an approach called ‘Thematic Synthesis’ to address issues such as appropriateness, accessibility and need for interventions, and to consider the factors that influence this. They have used this approach to generate hypotheses against which quantitative research could be tested. I could have taken a similar approach which would have enabled consideration of the relationship between quantitative findings about effectiveness and outcomes of technology use, and the benefits, barriers and outcomes experienced by technology users. However Thomas and Harden (2008) note that their use of analytical themes might be best used when answering specific review questions whereas third-order interpretations (Britten et al., 2002) might be most suited to exploring an area with a broader review question in mind, as with mine.
The experience of meta-synthesis

The experience of synthesising the studies was one that evoked a number of reactions in me, the strongest being a feeling of anger at the injustice of some people's experiences. Arvidsson and Jonsson (2006) include a number of quotes that led to this feeling:

"My parents think I am lazy. They are really tired of telling me to hurry up".

"My mother keeps telling me I will never manage the time aid because I am too stupid..."

"The rehabilitation staff force me to look at the quarter hour watch".

Within these quotes the individuals' perception of being viewed negatively by others, and their lack of power in their own lives, was a powerful message. Set against this, however, was the empowerment that some individuals experienced through using technology and their pride in their technology skills. I had initially assumed that the papers involving people with SLD would have greater depth in terms of the quotes, however my experience was that it was the quotes from individuals with LD that were the most powerful.

Reflection on my strong belief in the value of consultation was necessary throughout the meta-synthesis process in relation to potential bias. During the process of quality assessment I recognised a desire to rate studies involving people with LD favourably. This arose for three main reasons. One of these is the small number of published papers interviewing people with LD about their experience of using technology, despite a wealth of studies focusing on the effectiveness of technology and on the views of others. It also arose from a respect for the researchers who included participants with more significant communication or intellectual impairments, who might typically have been excluded from qualitative research. Finally, it came from my desire that the meta-synthesis would give weight to these papers and through this, enable the voices of the participants to be heard in a larger interpretive context, therefore having greater impact (Sandelowski et al., 1997). It was through discussion with the independent rater, personal reflection, and systematic re-consideration of each paper in turn that I ensured the final appraisals reflected a more balanced view.
Empirical papers

Paper 2: A new iPad app assessment tool: Comparability, acceptability and children’s preferences

Paper 3: Feasibility and acceptability of an iPad app assessment tool with children with special educational needs

Innovative methods

“Disabled children are among the most marginalised in our society. Their influence has been negligible on policies and service practices that directly affect their lives. Empirical research using innovative methodologies can at least enable their voices to be heard” (Carpenter & McConkey, 2012, p.251)

The empirical papers report on two aspects of an exploratory study that examined a new iPad application (app) assessment tool with children in mainstream primary schools, therefore they are considered together in this section. Paper 2 reports on the comparability and acceptability of the app as a response modality for a validated paper-based health-related quality of life (HRQOL) questionnaire. Paper 3 reports on the feasibility and acceptability of the app with children with SEN. Both papers explored children’s preference or view of the iPad app.

As discussed above, the development of the focus of the empirical papers came from recognition of the need to hear the voices of individuals with disabilities and of meeting the needs of the heterogeneous group that represents children with SEN in mainstream schools. However it also arose from an interest in new technology and the world this can open up for individuals who might find more traditional methods of assessment or interview difficult to engage with. As captured in the quote above, it is through innovative methodologies that this can be achieved, and the rapidly developing field of apps and tablet devices is well suited to this.

Previous development of computerised versions of paper questionnaires has involved transferring an entire questionnaire onto a (usually hand-held) device as an alternative
method of gathering the responses. However the iPad app provides a new measurement method as it can be customised to the child and uses a sliding scale, thus potentially offering a more interactive and personalised approach which it was hypothesised would lead to benefits in children's engagement. The iPad app also differs from a computer-assisted interviewing approach as it is designed primarily for children to give ratings rather than to provide an in-depth assessment on a particular topic.

**The research process**

**The choice of methodology**

The decision to explore the use of the iPad app assessment tool through comparing it to an existing measure arose for a number of reasons. The iPad app is designed to gather children's responses about any topic, through the use of a sliding scale and a personalised assessment experience, and thus can be used to ask individual children about idiosyncratic topics. However when using questionnaires with individuals, for example to measure change over the course of an intervention, it is important that approaches are reliable and valid and therefore provide an accurate representation of what the questionnaire purports to measure. The initial stages of exploring a new method (e.g. the iPad app as a response modality) involve comparing it to an existing measure that has been explored with groups of children in the past and about which the psychometric properties are known.

The issue of 'comparability' was central as this relates to comparing two different measurement methods (e.g. response modalities) that purportedly measure the same concept. It was important to be careful with the use of terminology within the papers, as my initial thoughts were about reliability and validity. Types of reliability include parallel forms (two versions of the same test), test-retest (repeating the same measure on two occasions), internal consistency (of individual items on a questionnaire in relation to the subscale and the total score) and inter-rater (comparing two or more individuals completing the same measure) reliability (Sechrest, 1984). Reliability relates to whether a measure produces stable and consistent results through comparing it against itself. As this study involved comparing one response modality against another, reliability was not the appropriate focus. Validity relates to whether a questionnaire measures what it claims to measure. Validity has
a number of components (Sechrest), including content (whether it measures a range of areas within the area of interest), criterion (how it correlates with an existing measure) and construct (whether it measures what it intends to measure and not other constructs in addition) validity (Sechrest). Validity was not an appropriate focus as no other measures were being used simultaneously. This study was not examining whether the measure, the Pediatric Quality of Life Inventory Short Form (PedsQL SF15) (Chan et al., 2005) measured what it claims to measure, but instead how scores on the questionnaire obtained using the original paper response modality and the iPad app compared (the comparability; Altman & Bland, 1983). Comparability is important as it informs a decision about whether a new measurement method (e.g. the iPad app) can be concluded to gather comparable scores to the original questionnaire whilst offering additional or alternative benefits. It was these benefits that I was interested in both for children without SEN (paper 2) and with SEN (paper 3). Paper 2 identified that the iPad app was an engaging assessment tool for children aged 5 to 9 years however it was not a comparable response modality for the paper-based questionnaire. Paper 3 found the iPad app has value as a tool to facilitate assessment with children with SEN in an engaging and accessible way.

Methodological issues

The disadvantage of the methodology chosen was that it was difficult to establish why a lack of agreement was found. When measuring concepts in psychology (in contrast to measuring data such as blood pressure) the idea of a 'true value' is complex. Although conclusions can only be made against validated measures, with the value of the conclusions being based on the quality of the psychometric properties of the validated measure, it is unknown whether the iPad app might enable children to respond in a way that is somehow 'more true' to their experiences. It is through much more detailed examination of their responses and rationale for responses (as in cognitive interviewing methods discussed below) that this can begin to be examined. Apart from finding that comparability of scores was related to children's age, exploratory analyses did not identify other reasons for the disparity. The lack of test-retest reliability information means that it is unknown whether the paper version would produce comparable results over a two-week period.
One aspect of the research that I would have done differently involves the use of Boardmaker® symbols with a subsample of children in paper 3. The additional symbols were designed for one child to support him to understand the questionnaire as discussion with his SENCO identified that he was very unlikely to be able to understand the questionnaire in its existing format (this was separate from his ability to use the iPad app). However consultation with a Speech and Language Therapist and a Clinical Psychologist working with children with ASD and LD led to me being concerned that some children would not be able to understand the questionnaire, and therefore I chose to use the symbols with four additional children to explore the benefits of this. This meant that it could not be concluded that they could have understood the questionnaire without this additional support. Although they were only four additional children out of a total sample of 15, with this small sample size any variation in administration was not advantageous. However it was possible to gather evidence that these children would likely have been able to complete the questionnaire without this support, and with the main focus on their engagement and use of the iPad app this did not affect conclusions drawn about this. Although there are issues with grouping children with a range of difficulties, particularly those with ASD, as if they were homogeneous groups (Preece, 2002), the approach taken which involved systematic and clinical observations enabled these differences to be considered.

Another aspect I would have changed relates to the information gathered about the sample in Paper 2. Ideally I would have gathered information about the lower level additional needs of the children to explore whether the lack of agreement found between response modalities could have been in part due to confounding variables relating to children’s difficulties. A sample with no additional needs, whilst not being representative of children in mainstream schools in Manchester, might have enabled a more controlled examination of children’s understanding of the questionnaire. However when the focus was also on their use of and engagement with the iPad app, a more representative sample was considered to have greater value in addressing this question.
Recruitment

It was initially intended to recruit children with no additional needs to Paper 2 and those who had a diagnosis of Autism Spectrum Disorder (ASD) or LD to Paper 3. The intention was that through exploring the comparability of the iPad app and paper response modalities with children without identified difficulties; this would reduce the influence of confounding relating to their understanding of the questionnaire. However set against this was an interest in how children engaged with and used the iPad app regardless of their ability to understand the questionnaire, and a wish to gather a sample that was representative of children with SEN in mainstream schools in order that the findings would have broader applicability.

Furthermore, a SENCO identified concerns at an early stage about recruitment focusing on only a selection of children, and the experience of some children receiving an envelope to take home whilst others did not. Although it is important to make methodological decisions based on sound research principles, it is also important to conduct research that is acceptable in the settings in which it is being conducted. The terminology used on the participant information sheets also changed across the research process in consultation with SENCOs, from using terms such as LD and learning difficulties to 'additional needs', which was the school's choice of terminology.

The experience of recruitment was relatively positive and straightforward, particularly for Paper 2. The SENCOs who expressed interest on behalf of their school were people who were interested in the benefits of technology, particularly iPads, for learning in school, and through explaining the research to teachers when I visited schools this encouraged them to prompt children to return their envelopes. Parental recognition of the appeal of iPads to children was reflected in a response rate of 88 children for Paper 2 (22.4%) when I had initially intended to recruit 52 children based on power calculations.

Fifteen children were recruited to Paper 3 which was half of what had been intended. One third of schools approached agreed to take part in this study, and with a response rate of 11.3% it would theoretically have taken a much bigger recruitment effort to achieve a sample size of 30. However the smaller sample size allowed for a more 'case series' like approach in which children's individual differences were described, an advantage.
considering the diversity of the sample. The reason for a lower response rate for children in Paper 3 (11.3%) compared to Paper 2 (22.4%) is unknown, but could perhaps have related to parental concerns about their child missing lessons or 1:1 teaching, their child's potential anxiety about seeing a 'stranger', or reluctance for their child to complete cognitive tests that they might experience as difficult.

An area of recruitment that I would have changed if possible would be the production of participant information sheets and consent forms in other languages. This was explored and found to be prohibitively expensive, and the logistics considering the number of different languages spoken was also a barrier; however this could have made the research more accessible to families where parents spoke little English. For children who spoke little English, interpreters could have aided their understanding of the questionnaire; however any changes to the wording of a questionnaire require careful validations and therefore this was not feasible at this stage.

Measures

The PedsQL SF15 was selected as it met a number of pre-determined criteria. This included that it had a self-report version for young children (aged 5 years upwards), a simple response scale, it was brief, and its administration did not involve the use of toys (e.g. as in the TedQL; Lawford et al., 2001). It was the only questionnaire found that met these criteria but its psychometric properties were not as good as would be hoped for. It has comparable reliability to the original 23-item version and the short-form scales and subscales distinguished a healthy from a chronically ill sample as well as the original, but with lower effect sizes (Chan et al., 2005). However it is less sensitive to group differences, the physical health summary score is less reliable in group comparisons, ceiling effects have been reported (Chan et al.) and test-retest data is not available (Grange et al., 2007).

The use of the PedsQL SF15 by children with LD has not been explored and there may be issues with the use of the questionnaire with children with cognitive and language difficulties. Although general questionnaires have been used by children with LD without adaptation (e.g. Emerson, 2005; Thaler, Kazemi, & Wood, 2010) this has tended to be with children aged 11 years upwards. Adaptations may be needed for questionnaires to be
understandable to children with cognitive and language impairments; however this needs subsequent validation. The evidence regarding the ability of children with LD to use scales with varying numbers of response choices is sparse and mixed. Although some children with LD aged 6 years upwards can use four-point scales, some in the same study struggled to distinguish between the lower three points on the scale (Kramer, Smith, & Kielhofner, 2009). The authors concluded that a two-point scale may provide more reliable responses but that decisions should be made on an individual basis. Weng (2004) identified that although three-point scales can be used reliably by children without LD, a larger number of response choices can increase reliability. It is unclear from this study how reliably children were able to respond using a three-point scale, although evidence gathered from their verbal responses would suggest that many had an understanding of the concept of problems of relative sizes. Furthermore, 11 of 14 children used all three response options which may contrast with findings that individuals with LD choose the most positive response options on Likert-type scales (Hartley & MacLean, 2005). A number of recommendations for completing Likert-type scales with adults and adolescents with LD were followed (Hartley & MacLean, 2006) including providing additional clarifying information about questionnaire items, which may have supported children to respond more reliably.

One aspect of measurement I would change relates to the cognitive tests used. The Wechsler Abbreviated Scale of Intelligence (WASI; Psychological Corporation, 1999) does not allow for formal consideration of children's verbal and non-verbal skills separately, which meant that some children's scores did not reflect considerable discrepancies in their abilities according to these tests. It was not possible to make meaningful interpretations of children's use of the questionnaire in relation to their performance on the individual tests on the WASI, although the use of equivalent ages in the BPVS-II was helpful in this respect. The use of a more comprehensive test battery such as the Wechsler Intelligence Scale for Children (WISC) 4th edition (Wechsler, 2003) on a separate testing occasion could have enabled a more detailed exploration of this.
Alternative approaches

A number of alternative approaches could have been utilised, including cognitive interviewing approaches that are often used to understand aspects of the question-answer process (Bell, 2007). Cremeens, Eiser and Blades (2007) describe a qualitative approach to exploring how children aged 5 to 9 years answer quality of life questions. Children were asked to ‘think aloud’ while completing the questionnaire to investigate their understanding of the concepts behind items and to gain insight into children's thinking processes around answering questionnaire items, and their responses were analysed qualitatively. A similar approach could have been taken with children whilst completing the questionnaire to understand this and therefore make judgements about the reliability of their responses in a more formal way than was utilised in this research. However many children with SEN were reluctant or struggled to provide additional verbal explanations, therefore this may have been more difficult with the children recruited to Paper 3.

A questionnaire focusing on a different topic (perhaps with more robust psychometric properties or with more data available on this) could have been used, however it was important to use a questionnaire with broad applicability to children's lives, which more focused questionnaires may not have had. I could have chosen a measure that had already been used with children with LD, such as the Strengths and Difficulties questionnaire (Goodman, 1997) or the Multidimensional Anxiety Scale for Children (March, 1998). This would have meant that firmer assumptions could have been made about children's understanding of the questionnaire. However the Strengths and Difficulties questionnaire is for children aged from 11 years and has 25 items, and the Multidimensional Anxiety Scale for Children is for children aged from 9 years and is even longer, with 39 items. I was interested in whether younger children could use the iPad app to respond to a questionnaire, and in doing this identification of a more brief and age-appropriate measure was therefore necessary.

The research experience

The experience of designing and conducting the research was one of achievements and challenges. It involved having to sit with uncertainty, particularly prior to starting data
collection with children with SEN when I was anxious that they would not understand or would not want to engage in the task (especially children with ASD). However the experience overall was a positive one, with all but one child engaging with the task and the majority appearing to understand it.

I experienced an internal conflict between being a researcher and being a clinician during data collection. My natural instinct would be to provide extra support in helping children to understand, in developing individually-tailored tools to do this (perhaps using social stories) and to try a task a number of times. In a clinical setting, a child would complete an assessment as part of a piece of therapeutic work in which I might take a more active role, however being a researcher in this context meant hearing about their difficulties yet not being able to take a role in facilitating change. An example of this relates to one young boy who when praised for good concentration, said to me "Can you tell my teacher I did that?"
This gave an insight into the sense he might have had of himself, as someone who was viewed in terms of his difficulties. Although teachers clearly praised students and recognised their skills, he was described to me by one teacher as "very difficult". I reflected, from a narrative perspective (Epston & White, 1990), about the impact of the dominant story of him being "difficult" and a child who professionals needed to be 'warned about'. I wondered where the space for alternative stories about him, perhaps as a 'good concentrator in the right conditions', might be. One reason for the importance of examining the benefit of iPads in engaging young people might be the potential for finding more positive narratives about children who can present challenges to the people around them.

**The Research Overall**

*Clinical Implications and Future Research*

The meta-synthesis contributes in a number of ways. It highlights the need for more qualitative research on the views of individuals with LD on using technology to be published in peer-reviewed journals and within this for greater use of creative approaches to interviewing people with LD. It highlights the need for research into the experiences of using a much broader range of technology including social media and the Internet, mobile phones,
tablet devices and virtual environments. With two papers involving people being published in Sweden and one in the UK, there is a need to understand the experiences of people with LD living in other countries, including those where access to technology may be more difficult or where only more basic forms of technology are available. The results of the meta-synthesis highlight the importance of asking users about their priorities, and gathering consent to try using technology in the first place. The value of social interactions in people's lives cannot be underestimated, and when the influence of other's views is so often seen in the lives of people with LD, in access to health care, meaningful relationships, employment and the community, it is important to consider power differentials in people's lives. It cannot be assumed that students with SLD will be able to access online learning courses with the same ease of students without difficulties, and without careful consideration, students may be disadvantaged by technology. There is a need for more specific meta-syntheses involving only people with LD, or focusing only on particularly types of technology, or on specific qualitative approaches as recommended by Britten et al. (2002). Within the meta-synthesis, whilst technology for people with LD often focused on increasing their independence, for individuals with SLD it instead focused on the benefits for learning and for connecting people together to learn. There is a need to know more about the possibilities for technology to connect individuals with LD to others and their views about this experience, in light of the fact that people with LD often live socially isolated lives (Pockney, 2006).

Considering the benefits that were observed in using the iPad in the empirical studies there is a need to understand more about the experience of using tablet devices in everyday life. Children with and without SEN were able to engage with the iPad app in a way that held their attention and led to enjoyment and excitement. Children also took a serious approach, however, carefully considering their responses and discussing the rationale for their choices. There is a need to understand more about how children use tablet devices to respond to questionnaires and the specific benefits of these for children with a range of specific difficulties, such as ASD or language impairments. It would have been interesting to have asked children in Paper 2 to complete the paper version and iPad app version each twice to measure the test-retest reliability of the measure, and to have asked children in Paper 3 to
complete the paper version to determine if they would be able to do this, both of which are important areas of future research.

There is a need for services to work together, to listen to people's views in a meaningful rather than tokenistic way and to "keep asking ourselves what trust we can place in our methods and check that we have not overly predetermined the views that we have encouraged to be heard" (Lewis & Porter, 2004, p.169). It is this detailed consideration of methods that underlies my empirical papers and the need to gather people's views in a meaningful and open way that underlies the meta-synthesis. The papers together contribute to the broader picture of technology use by individuals with difficulties with learning. They do this by bringing together published qualitative studies, analysis of children's preferences, observations, description and analysis of children's quotes, and a more quantitative examination of their engagement with the iPad app and use of the questionnaire. Individuals with LD have communicated that technology has value to them in the right conditions and with the right support, and children with SEN have demonstrated and reported engagement with and enjoyment of using an iPad app.

Conclusions

I gained knowledge and new skills in the process of conducting this research. I have learned about what meta-synthesis is and how to synthesise qualitative research, a completely new experience. I have learned about the statistical approaches to examining comparability between methods and about the development and evaluation of new measures. I have experienced the benefits and challenges of engaging busy SENCOs and teachers in a research project, and needed organisational skills in order to see a large number of children, many twice, in busy schools. This research has further developed my interest in working with individuals with LD through reading about people's experiences and through meeting children and the professionals who work with them in mainstream schools.

It has been my choice to use a range of technologies at stages within this research, from word processing and data management and analysis, using the internet, making and watching videos, speaking to people on the telephone and of course using the iPad. I have been enabled to follow my interests and to express my views which is a privilege not
afforded to some of the people I have written about or worked with. In recognising this it has been important for me to try to express the views of people in the studies I have read, and the views of the children I have met, as truthfully and respectfully as possible.
References


Department for Education. (2014). *Special educational needs and disability code of practice: 0 to 25 years. Draft for approval by Parliament.*


Appendices: Paper 1


Word Count

While no maximum length for manuscripts is prescribed, authors are encouraged to write concisely.

Use of word processing software

It is important that the file be saved in the native format of the word processor used. The text should be in single-column format. Keep the layout of the text as simple as possible. Most formatting codes will be removed and replaced on processing the article. In particular, do not use the word processor’s options to justify text or to hyphenate words. However, do use bold face, italics, subscripts, superscripts etc. When preparing tables, if you are using a table grid, use only one grid for each individual table and not a grid for each row. If no grid is used, use tabs, not spaces, to align columns.

The electronic text should be prepared in a way very similar to that of conventional manuscripts (see also the Guide to Publishing with Elsevier: http://www.elsevier.com/guidepublication). Note that source files of figures, tables and text graphics will be required whether or not you embed your figures in the text. See also the section on Electronic artwork.

To avoid unnecessary errors you are strongly advised to use the ‘spell-check’ and ‘grammar-check’ functions of your word processor.

Article structure

Subdivision - numbered sections

Divide your article into clearly defined and numbered sections. Subsections should be numbered 1.1 (then 1.1.1, 1.1.2, ...), 1.2, etc. (the abstract is not included in section numbering). Use this numbering also for internal cross-referencing; do not just refer to ‘the text’. Any subsection may be given a brief heading. Each heading should appear on its own separate line.

Introduction

State the objectives of the work and provide an adequate background, avoiding a detailed literature survey or a summary of the results.

Material and methods

Provide sufficient detail to allow the work to be reproduced. Methods already published should be indicated by a reference: only relevant modifications should be described.

Results

Results should be clear and concise.

Discussion
This should explore the significance of the results of the work, not repeat them. A combined Results and Discussion section is often appropriate. Avoid extensive citations and discussion of published literature.

**Conclusions**

The main conclusions of the study may be presented in a short Conclusions section, which may stand alone or form a subsection of a Discussion or Results and Discussion section.

**Appendices**

If there is more than one appendix, they should be identified as A, B, etc. Formulae and equations in appendices should be given separate numbering: Eq. (A.1), Eq. (A.2), etc.; in a subsequent appendix, Eq. (B.1) and so on. Similarly for tables and figures: Table A.1; Fig. A.1, etc.

**Abstract**

A concise and factual abstract is required. The abstract should state briefly the purpose of the research, the principal results and major conclusions. An abstract is often presented separately from the article, so it must be able to stand alone. For this reason, References should be avoided, but if essential, then cite the author(s) and year(s). Also, non-standard or uncommon abbreviations should be avoided, but if essential they must be defined at their first mention in the abstract itself.

**Highlights**

Highlights are mandatory for this journal. They consist of a short collection of bullet points that convey the core findings of the article and should be submitted in a separate file in the online submission system. Please use ‘Highlights’ in the file name and include 3 to 5 bullet points (maximum 85 characters, including spaces, per bullet point). See http://www.elsevier.com/highlights for examples.

**Tables**

Number tables consecutively in accordance with their appearance in the text. Place footnotes to tables below the table body and indicate them with superscript lowercase letters. Avoid vertical rules. Be sparing in the use of tables and ensure that the data presented in tables do not duplicate results described elsewhere in the article.

**References**

**Citation in text**

Please ensure that every reference cited in the text is also present in the reference list (and vice versa). Any references cited in the abstract must be given in full. Unpublished results and personal communications are not recommended in the reference list, but may be mentioned in the text. If these references are included in the reference list they should follow the standard reference style of the journal and should include a substitution of the publication date with either 'Unpublished results' or 'Personal communication'. Citation of a reference as ‘in press’ implies that the item has been accepted for publication.

**Web references**

As a minimum, the full URL should be given and the date when the reference was last accessed. Any further information, if known (DOI, author names, dates, reference to a source publication, etc.), should also be given. Web references can be listed separately (e.g., after the reference list) under a different heading if desired, or can be included in the reference list.
References in a special issue

Please ensure that the words 'this issue' are added to any references in the list (and any citations in the text) to other articles in the same Special Issue.

Reference management software

This journal has standard templates available in key reference management packages EndNote (http://www.endnote.com/support/enstyles.asp) and Reference Manager (http://refman.com/support/rmstyles.asp). Using plug-ins to wordprocessing packages, authors only need to select the appropriate journal template when preparing their article and the list of references and citations to these will be formatted according to the journal style which is described below.

Reference style


List: references should be arranged first alphabetically and then further sorted chronologically if necessary. More than one reference from the same author(s) in the same year must be identified by the letters 'a', 'b', 'c', etc., placed after the year of publication.

Full details of information for authors can be found at:
http://www.elsevier.com/journals/computers-education/0360-1315/guide-for-authors
## Appendix B. The search terms used in the systematic literature search

<table>
<thead>
<tr>
<th>Terms for the technology</th>
<th>Terms for the participants</th>
<th>Terms for the use of/perspective on technology</th>
<th>Terms for the methodology</th>
</tr>
</thead>
<tbody>
<tr>
<td>technolog*</td>
<td>intellectual disabilit*</td>
<td>perspective</td>
<td>qualitative</td>
</tr>
<tr>
<td>computer</td>
<td>learning disabilit*</td>
<td>preference</td>
<td>phenomenolog*</td>
</tr>
<tr>
<td>computer assist*</td>
<td>learning difficult*</td>
<td>consult*</td>
<td>ethnograph*</td>
</tr>
<tr>
<td>computer based tablet</td>
<td>autism</td>
<td>opinion</td>
<td>narrative</td>
</tr>
<tr>
<td>hand held</td>
<td>special education*</td>
<td>view</td>
<td>discourse</td>
</tr>
<tr>
<td>touch sensitive</td>
<td>additional need*</td>
<td>voice</td>
<td>thematic</td>
</tr>
<tr>
<td>iPad</td>
<td>asperger</td>
<td>engag*</td>
<td>interpretative</td>
</tr>
<tr>
<td>apple</td>
<td>developmental</td>
<td>particip*</td>
<td>phenomenolog* grounded</td>
</tr>
<tr>
<td>smartphone</td>
<td>disabilit*</td>
<td>discuss*</td>
<td>theory</td>
</tr>
<tr>
<td>i0s</td>
<td>mental retardation</td>
<td>conversation</td>
<td>interview</td>
</tr>
<tr>
<td>android</td>
<td></td>
<td></td>
<td>focus group</td>
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<td></td>
<td></td>
<td></td>
<td>discourse</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>constant comparative</td>
</tr>
</tbody>
</table>
Appendix C. A flow diagram of the systematic search process

Records identified through database searching (n=742)  
Records identified through searching two specific journals and a Google Scholar search (n=479)  

Total records (n=1221)  
Records after 87 duplicates removed (n=1134)  
Records after 132 non-journals removed (n=1002)  
Records screened by title and abstract (n=1002)  

Records excluded as did not meet criteria (n=954)  

Full-text articles excluded (n=41)  
Reasons excluded:  
- Interviews were with significant others  
- No quotes provided  
- Focus was not at least partly on views on technology  
- No distinction between views of different groups being interviewed  
- No distinction between interviews & observations  
- No learning disability specified  
- Study described the development of a programme  
- Results were descriptive & involved no interpretation  

Full-text articles assessed for eligibility (n=48)  
Full-text articles kept (n=7)  
Studies to include in synthesis (n=10)*  

Articles identified from reference lists (n=3)  

* An additional study (Madaus, Banerjee, McKeown, & Gelbar, 2011) describing preliminary, descriptive results from one of the ten final studies was used to inform the quality assessment to ensure that the quality of the research, rather than the write-up, was assessed (Walsh & Downe, 2006). This was not included in the meta-synthesis process.
## Appendix D. Walsh and Downe (2005) Summary criteria for appraising qualitative research studies

<table>
<thead>
<tr>
<th>Stages</th>
<th>Essential criteria</th>
<th>Specific prompts</th>
</tr>
</thead>
</table>
| 1 Scope and purpose | Clear statement of, and rationale for, research question/aims/purposes | • Clarity of focus demonstrated  
• Explicit purpose given, such as descriptive/explanatory intent, theory building, hypothesis testing  
• Link between research and existing knowledge demonstrated  
Study thoroughly contextualised by existing literature | • Evidence of systematic approach to literature review, location of literature to contextualise the findings, or both |
| Design | Method/design apparent, and consistent with research intent | • Rationale given for use of qualitative design  
• Discussion of epistemological/ontological grounding  
• Rationale explored for specific qualitative method (e.g. ethnography, grounded theory, phenomenology)  
• Discussion of why particular method chosen is most appropriate/sensitive/relevant for research question/aims  
• Setting appropriate  
Data collection strategy apparent and appropriate | • Were data collection methods appropriate for type of data required and for specific qualitative method?  
• Were they likely to capture the complexity/diversity of experience and illuminate context in sufficient detail?  
• Was triangulation of data sources used if appropriate? |
| 3 Sampling strategy | Sample and sampling method appropriate | • Selection criteria detailed, and description of how sampling was undertaken  
• Justification for sampling strategy given  
• Thickness of description likely to be achieved from sampling  
• Any disparity between planned and actual sample explained |
<table>
<thead>
<tr>
<th>Stages</th>
<th>Essential criteria</th>
<th>Specific prompts</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Analysis</td>
<td>Analytic approach appropriate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Approach made explicit (e.g. Thematic distillation, constant comparative method, grounded theory)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Was it appropriate for the qualitative method chosen?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Was data managed by software package or by hand and why?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Discussion of how coding systems/conceptual frameworks evolved</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• How was context of data retained during analysis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Evidence that the subjective meanings of participants were portrayed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Evidence of more than one researcher involved in stages if appropriate to epistemological/theoretical stance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Did research participants have any involvement in analysis(e.g. member checking)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Evidence provided that data reached saturation or discussion/rationale if it did not</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Evidence that deviant data was sought, or discussion/ rationale if it was not</td>
</tr>
<tr>
<td>5</td>
<td>Interpretation</td>
<td>Context described and taken account of in interpretation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Description of social/physical and interpersonal contexts of data collection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Evidence that researcher spent time ‘dwelling with the data’, interrogating it for competing/alternative explanations of phenomena</td>
</tr>
<tr>
<td></td>
<td>Clear audit trail given</td>
<td>• Sufficient discussion of research processes such that others can follow ‘decision trail’</td>
</tr>
<tr>
<td></td>
<td>Data used to support interpretation</td>
<td>• Extensive use of field notes entries/verbatim interview quotes in discussion of findings</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Clear exposition of how interpretation led to conclusions</td>
</tr>
<tr>
<td>6</td>
<td>Reflexivity</td>
<td>Researcher reflexivity demonstrated</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Discussion of relationship between researcher and participants during fieldwork</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Demonstration of researcher’s influence on stages of research process</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Evidence of self-awareness/insight</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Documentation of effects of the research on researcher</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Evidence of how problems/complications met were dealt with</td>
</tr>
<tr>
<td>Stages</td>
<td>Essential criteria</td>
<td>Specific prompts</td>
</tr>
<tr>
<td>---------------------</td>
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<td>-------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| Ethical dimensions  | Demonstration of sensitivity to ethical  | - Ethical committee approval granted  
|                     | concerns                                 | - Clear commitment to integrity, honesty, transparency, equality and mutual respect in relationships with participants  
|                     |                                          | - Evidence of fair dealing with all research participants  
|                     |                                          | - Recording of dilemmas met and how resolved in relation to ethical issues  
|                     |                                          | - Documentation of how autonomy, consent, confidentiality, anonymity were managed  
| Relevance and       | Relevance and transferability evident    | - Sufficient evidence for typicality specificity to be assessed  
| transferability      |                                          | - Analysis interwoven with existing theories and other relevant explanatory literature drawn from similar settings and studies  
|                     |                                          | - Discussion of how explanatory propositions/emergent theory may fit other contexts  
|                     |                                          | - Limitations/weaknesses of study clearly outlined  
|                     |                                          | - Clearly resonates with other knowledge and experience  
|                     |                                          | - Results/conclusions obviously supported by evidence  
|                     |                                          | - Interpretation plausible and ‘makes sense’  
|                     |                                          | - Provides new insights and increases understanding  
|                     |                                          | - Significance for current policy and practice outlined  
|                     |                                          | - Assessment of value/empowerment for participants  
|                     |                                          | - Outlines further directions for investigation  
|                     |                                          | - Comment on whether aims/purposes of research were achieved  

Appendix E. The approach to meta-ethnography described by Noblit and Hare (1988)

The key parts of the synthesis process are summarised below, as described in Noblit and Hare’s (1988) seminal work *Meta-Ethnography: Synthesizing Qualitative Studies.*

They describe that

“A meta-ethnography starts, like all inquiries, with an interest in some setting, topic, argument, issue, controversy, or opportunity. This interest...need not be overly specific. Often it starts simply from seeing what different qualitative researchers have to say about something and being concerned with how to compare their accounts...Our comparisons of studies are usually the most problematic aspect of this research process” (Noblit & Hare, 1988, p.26)

They emphasise that, although the start may be open and unsystematic, the comparisons subsequently made are systematic. The process involves translating the studies into one another through a series of reciprocal and refutational translations.

Noblit and Hare (1988) describe a series of seven steps to describe this systematic comparison, the translations, and the combination of these comparisons and translations, into a meta-synthesis.

**Phase 1: Getting started**

This involves identifying an area of interest to the author and one that will have value more broadly, and will merit the synthesis effort. The focus within the area of interest may change over the synthesis process.

**Phase 2: Deciding what is relevant to the initial interest**

This involves deciding on the scope of the studies that are to be included and the justification for this. This requires understanding the interests of oneself as a researcher, the interests of the audience, and what accounts are available. There is often a need to be focused within this on particular settings in order to gain more detailed, meaningful insights, as broad generalisations often lead to understandings at surface-level only.

**Phase 3: Reading the studies**

This involves repeated readings of studies and noting down "interpretative metaphors" (p.28). This is a stage that is not clearly defined in a linear process, but rather one that continues throughout the process of synthesis. Paying careful and highly detailed attention to the accounts and how they relate to the topic of interest in the main part of this phase.

**Phase 4: Determining how the studies are related**

In this stage the "key metaphors, phrases, ideas, and / or concepts (and their relations)" (p.28) are recorded and compared, as part of understanding the relationship between the different studies. At this point, it is considered whether a reciprocal, refutational or line of argument approach will be taken. If the studies appear to be related in a reciprocal way (e.g. they do not contradict one another), a line of argument can be developed from this (Britten et al., 2002)

**Phase 5: Translating the studies into one another**

This stage involves making comparisons between studies, and between the metaphors, phrases and so on in each account. This process importantly preserves the context and
metaphors within each account, so that the particulars (and therefore the rich understanding of the experience of one group of people) are not lost in the process.

**Phase 6: Synthesising translations**

The translations made during phase five are then compared in order to understand the differences at a higher level. The separate parts of the synthesis are brought together to represent a meaningful understanding of how the studies fit together and how they relate to and refute one another, in reference to the context of each.

**Phase 7: Expressing the synthesis**

This final stage involves communicating the findings of the synthesis process more broadly, usually in written form, in an accessible format for the intended audience.
Appendix F. A table describing the details of the final papers included in the meta-synthesis

<table>
<thead>
<tr>
<th>Author and country</th>
<th>Scope and purpose*</th>
<th>Participant’s difficulties, context and demographic</th>
<th>Recruitment and sampling</th>
<th>Data collection</th>
<th>Approach and analysis</th>
<th>Quality Rating**</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Bunning, Heath &amp; Minnion (2009). UK</td>
<td>To explore the culture of ICT and the potential to support communication and empowerment, with young people with Intellectual Disabilities (ID).</td>
<td>n=20. Young people with ID, from a specialist secondary school (n=9) and a special needs unit in a further education college (n=11). Details provided on communication abilities (rated 1 to 5 by teachers on a 0 to 5 scale). Age 15-20 years. F=10 M=10. White British=12, British Asian=6, and Other=2 (this reflected the multi-ethnic mix of the region)</td>
<td>Participants selected via a purposive sampling framework by the lead investigator to ensure a representative sample (non-random). Recruitment was via information sheets for parents and students. Ethical approval was given.</td>
<td>Structured interviews using Talking Mats (Murphy &amp; Cameron, 2002). Participants organised pictures freely or using a 'yes-ok-no' format, and to elaborate on their decisions. Blank cards were provided for new topics/comments. Interviews were videotaped and finished mats were photographed. Question areas described but no details of questions/script. <strong>Additional data:</strong> For the three individuals with the most significant communication difficulties, interviews were supplemented by an interview with the teacher.</td>
<td>The specific approach was not named. Emden's (1998) method of analysis or 'core story creation' was used to analyse the data, which is used to address sparse linguistic content.</td>
<td>C</td>
</tr>
<tr>
<td>Author and country</td>
<td>Scope and purpose*</td>
<td>Participant’s difficulties, context and demographic</td>
<td>Recruitment and sampling</td>
<td>Data collection</td>
<td>Approach and analysis</td>
<td>Quality Rating**</td>
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<td>----------------------------------------</td>
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<td>--------------------------------------------------------------------------------</td>
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<td>-----------------</td>
</tr>
</tbody>
</table>
| 2. Arvidsson & Jonsson (2006). Sweden. | To explore the experience of adults with developmental disabilities (DD) using time aids (a cognitive device) and how this related to independence and autonomy. | n=10. Adults with DD. They had been using a time aid for at least a year (prescribed by an OT in a rehabilitation team) and could answer simple short questions. Details provided about where they lived, who with, daytime activities (day centre), and whether they were brought up at home or in care. Age 25-45 years. F=7 M=3. Ethnicity unknown. | 15 people met criteria and 10 were randomly selected as an appropriate number (no other justification). Recruitment procedures unclear. Ethical approval was given. | Semi-structured interviews using short simple questions. Interviews were audio taped. Details of some of the questions were included but not all. The interview protocol was piloted first.  
**Additional data:** Observations and impressions were included in the transcripts, and participants were asked ‘can you show me how...’ in relation to their time aid. | A phenomenographic approach was taken. The analysis is described but the specific analytical approach is not named. | B |
| 3. Chiang & Jacobs (2010). USA (one author in Taiwan) | To explore the experience of students with special educational needs (SEN) using Kurzweil-3000 (educational software for reading, writing and study support). Focused on reading, functional task performance and academic self-perception. | n=16. Students with SEN in an English language arts classroom at a public high school in a low socio-economic area of inner-city Boston. In 9th grade (14-15 years). Gender and ethnicity unknown. Some students had English as a second language. | A purposive sampling strategy was used (no justification given). Recruitment procedures unclear. Ethical approval not mentioned. | Each student focus group comprised 3 to 5 participants. Focus group questions were piloted with one group initially. Questions are detailed in the paper. Groups were audio-taped.  
**Additional data:** 6 teachers participated in 2 separate focus groups. | The approach was described as qualitative. Thematic analysis was used and the researchers used Bailey’s (1989) model of human performance to organise the themes. | B |
<table>
<thead>
<tr>
<th>Author and country</th>
<th>Scope and purpose*</th>
<th>Participant's difficulties, context and demographic</th>
<th>Recruitment and sampling</th>
<th>Data collection</th>
<th>Approach and analysis</th>
<th>Quality Rating**</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Wennberg &amp; Kjellberg (2013). Sweden.</td>
<td>To explore the experience of individuals with ID using cognitive assistive devices (CAD) in terms of its impact on participation.</td>
<td>n=9. Individuals with mild ID who were able to communication verbally and who had been prescribed a CAD in the last 2 years. Details provided on where they lived, who with, and whether they were employed/ unemployed/ at school. Age 17-37 years. F=5 M=2. Ethnicity unknown.</td>
<td>A purposive sampling strategy was used (no justification given). Individuals were recruited by Occupational Therapists via letter. Ethical approval was given.</td>
<td>Semi-structured interviews with concrete and follow-up questions were used. The questions are detailed. At the end participants were asked to give more information about their CAD. Interviews were recorded digitally.</td>
<td>The approach was described as qualitative. The data was analysed according to Malterud's (1993, 2009) four steps.</td>
<td>B</td>
</tr>
<tr>
<td>5. Graves, Asunda, Plant &amp; Goad (2011). USA.</td>
<td>To explore the experience of students with SLD and/or ADHD using Asynchronous Online Access (AOA) on a postsecondary STEM (Science, Technology, Engineering and Mathematics) course, focusing on whether it was an effective accommodation.</td>
<td>n=11. Individuals with SLD and/or ADHD. Students were recruited from 3 postsecondary institutions (one urban and one rural community college and one rural university). Ages unknown however likely 18 years or over as they were in postsecondary education. F=3 M=8. One student was described as black, 10 as white.</td>
<td>Participants were recruited via the Office of Disability Services. 24 individuals were approached, 14 consented and 11 participated (the only ones who could schedule interviews). Ethical approval not mentioned.</td>
<td>Semi-structured interviews with open ended questions were used, and the questions asked are detailed. Interviews were audio taped.</td>
<td>A qualitative approach with a constructionist grounding was taken. The analysis used the approach described by Miles and Huberman (1994). Interview data was analysed individually followed by a cross-case analysis.</td>
<td>B</td>
</tr>
<tr>
<td>Author and country</td>
<td>Scope and purpose*</td>
<td>Participant's difficulties, context and demographic</td>
<td>Recruitment and sampling</td>
<td>Data collection</td>
<td>Approach and analysis</td>
<td>Quality Rating**</td>
</tr>
<tr>
<td>--------------------</td>
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</tr>
<tr>
<td>6. Floyd &amp; Judge (2012). USA.</td>
<td>A mixed methods study exploring the impact of ClassMate Reader (a portable text reader) on reading comprehension in postsecondary students with reading difficulties, and exploring its social acceptability and validity.</td>
<td>n=6. Individuals with SLD who had difficulties with reading comprehension. Some individuals also had ADHD and/or anxiety disorder. Their full-scale IQ scores and reading levels were provided. Participants attended a public university in south-eastern region USA and were enrolled on a course for students with SLD who have potential to succeed in college but need support with this. Age 19-22 years. F=2 M=4. All Caucasian.</td>
<td>A convenience sample was used (no justification given). Individuals were identified by the course director. The researcher met 1:1 with individuals to recruit them. Ethical approval not mentioned.</td>
<td>Participants were asked 5 questions on a Likert-scale and 3 open-ended questions about the technology. The open-ended questions were not specified although they can be assumed. Interviews were audio-recorded. <strong>Additional data:</strong> A multiple baseline across participants design was used to determine the impact on reading comprehension.</td>
<td>The approach was described as qualitative. The constant comparative method by Glaser and Strauss (1967) was used to analyse the data.</td>
<td>D</td>
</tr>
<tr>
<td>7. Simoncelli &amp; Hinson (2008). USA.</td>
<td>A mixed methods study exploring the impact of course design modifications on student's performance and their views on these modifications, for postsecondary students with and without SLD enrolled on an online history course.</td>
<td>n=5 Individuals with SLD=2, without SLD=3. Students attended a small Southern university in the USA. Participants with SLD: Ages 21 and 43 years. F=1 M=1. Participants without SLD: Ages 21, 34 and 39 years. F=1, M=2. Ethnicities unknown.</td>
<td>Recruitment procedures unclear for students with SLD. Consent is not mentioned. Participants without SLD were selected 'based on their willingness to participate'. Ethical approval not mentioned.</td>
<td>Participants were asked open and closed questions at 3 time points (before the course, 3 weeks into the course and after receiving final grades). The topic areas are described but no details of questions are given. <strong>Additional data:</strong> Three students without SLD and the course tutor were interviewed to make comparisons. Virtual observation of students and reviews of coursework were mentioned although few details in the analysis.</td>
<td>The approach was described as qualitative. The analysis was not named and the only description was that it involved 'comparing patterns and themes'.</td>
<td>D</td>
</tr>
<tr>
<td>Author and country</td>
<td>Scope and purpose*</td>
<td>Participant’s difficulties, context and demographic</td>
<td>Recruitment and sampling</td>
<td>Data collection</td>
<td>Approach and analysis</td>
<td>Quality Rating**</td>
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<tr>
<td>Dolan, Hall, Banerjee, Chun &amp; Strangman (2005). USA.</td>
<td>A mixed methods study comparing computer based testing with text-to-speech (CBT-TTS) to pen-and-paper administration of a history test for school students with SLD, and exploring their views on this.</td>
<td>n=10 (n=6 interviewed). Individuals with SLD attending a suburban public high school who were partially or fully included in general education classes. In 11th and 12th grade (16-18 years). Gender and ethnicity unknown.</td>
<td>Teachers identified students with SLD who then volunteered. Teachers selected 6 students for in-depth interview (the most talkative and comfortable being interviewed. Ethical approval not mentioned.</td>
<td>Structured interviews in which participants were asked for their impressions, suggestions and feedback on the CBT-TTS. No specific details of questions are given. Additional data:</td>
<td>The approach and analysis was described as qualitative. No further details were provided.</td>
<td>D</td>
</tr>
<tr>
<td>Madaus, McKeown, Gelbar &amp; Banerjee (2012). USA.</td>
<td>To explore the experience of individuals with and without SLD or ADHD on online and blended courses at postsecondary level.</td>
<td>n=20 Individuals with SLD=7, with ADHD=3, without either=10. Undergraduate or graduate students at a public university or a community college in North-Eastern USA. Ages unknown however likely 18 years or over as they were in postsecondary education. Gender and ethnicity unknown.</td>
<td>Participants recruited through faculty and disability services via email. Ethical approval not mentioned.</td>
<td>Structured interviews were conducted, 18 face-to-face and 2 on the telephone (neither with students with SLD/ADHD). Details of questions are provided. Interview was piloted with students with SLD/ADHD. Additional data: Participants without SLD or ADHD were interviewed in order to make comparisons.</td>
<td>The approach was described as qualitative. The analysis took the form of an inductive analysis process (Patton, 1987).</td>
<td>C</td>
</tr>
<tr>
<td>Author and country</td>
<td>Scope and purpose*</td>
<td>Participant’s difficulties, context and demographic</td>
<td>Recruitment and sampling</td>
<td>Data collection</td>
<td>Approach and analysis</td>
<td>Quality Rating**</td>
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</tr>
<tr>
<td>10. Jeffs, Behrmann &amp; Bannan- Ritland (2006). USA.</td>
<td>To explore the experience of children with literacy difficulties using assistive technology (AT).</td>
<td>n=8 Most children had SLD but some also had LD, Down's Syndrome, Cerebral Palsy, ADHD, hearing/ visual/ speech/ behavioural issues. All had literacy difficulties (based on observation, writing samples and Individual Education Plans). Age 9-14 years. F=4 M=4. All children described as white.</td>
<td>Recruitment procedures unclear (although presumably through school as they were identified based on school documentation). Ethical approval not mentioned.</td>
<td>Parent-child dyads were interviewed and observed as part of a six-week period in which they used a variety of AT and Internet resources to complete literacy projects. No details were provided about the interviews. <strong>Additional data:</strong> Interviews were also conducted with parents (although no details were provided about the interviews) and observations were made.</td>
<td>No analysis section is included in the paper or referred to. It was included as the results section contained sufficient detail to show that interpretations had been made, and the sample was described in sufficient depth to suggest that the study would add richness.</td>
<td>D</td>
</tr>
</tbody>
</table>

* The terminology SLD has been used as it is the term used in the UK however some papers actually used ‘LD’. ** Key to quality rating (Downe et al., 2007; adapted from Jackson, unpublished) 
A – No or few flaws: The study credibility, transferability, dependability, and confirmability is high 
B – Some flaws, unlikely to affect the credibility, transferability, dependability, and/or confirmability of the study 
C – Some flaws, which may affect the credibility, transferability, dependability, and/or confirmability of the study 
D – Significant flaws, which are very likely to affect the credibility, transferability, dependability, and/or confirmability of the study
## Appendix G. Additional information gathered during critical appraisal

<table>
<thead>
<tr>
<th>Study</th>
<th>Author</th>
<th>Was support provided in helping the participants understand the research?</th>
<th>Was support provided in helping the participants understand the interview questions?</th>
<th>Were details provided about the definition/nature/level of participant’s difficulties?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bunning, Heath and Minnion (2009).</td>
<td>Yes - information was provided to participants in plain language and using graphics. Consent forms were completed with young people, parents and teachers together.</td>
<td>Yes - Talking Mats (Murphy &amp; Cameron, 2002) were used to support the interview procedure and individuals were given the opportunity to review their mats. Prior to interviews, the researchers gathered information on participants’ individual abilities and needs e.g. communication ability and preference, sensory status and motor abilities.</td>
<td>No - ‘intellectual disability’ was the only description, although participants’ communication was rated on a scale from 0 to 5 which was helpfully detailed.</td>
</tr>
<tr>
<td>2</td>
<td>Arvidsson and Jonsson (2006).</td>
<td>None specified</td>
<td>Yes - questions were piloted with two participants first, and simple questions were used.</td>
<td>No - ‘developmental disabilities’ only. They were able to understand and answer simple short questions although no formal measure was provided.</td>
</tr>
<tr>
<td>3</td>
<td>Chiang and Jacobs (2010).</td>
<td>None specified</td>
<td>Yes - questions were piloted initially with a group and all participants were found to understand the questions. The questions were projected onto a screen during the focus groups.</td>
<td>No - participants were described as having SEN and the only details provided concerned the percentage of time they spent in the resource room compared to the mainstream classroom.</td>
</tr>
<tr>
<td>4</td>
<td>Wennberg and Kjellberg (2013).</td>
<td>Yes - an easy-to-read information letter and consent form was sent to potential participants, asking for permission to telephone them. Researchers met face-to-face with individuals who were interested and provided them with easy-to-read information and verbal information about the purpose of the study and their right to withdraw.</td>
<td>Yes - questions were concrete in nature and in a logical time order to aid participants’ memory and help them describe their experiences. The researchers kept checking their understanding with participants and gave them the option of asking questions themselves. The researchers were trained in communicating with people with LD.</td>
<td>Some - participants were described as having ‘mild ID’. They were able to communicate verbally although no measure of this was provided.</td>
</tr>
<tr>
<td>Study</td>
<td>Author</td>
<td>Was support provided in helping the participants understand the research?</td>
<td>Was support provided in helping the participants understand the interview questions?</td>
<td>Were details provided about the definition/nature/level of participant’s difficulties?</td>
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<tr>
<td>5</td>
<td>Graves, Asunda, Plant and Goad (2011).</td>
<td>None specified</td>
<td>None specified</td>
<td>Yes - by 'learning disability' they specify that they mean dyslexia, dysgraphia or dyscalculia. Some participants had a diagnosis of ADHD.</td>
</tr>
<tr>
<td>6</td>
<td>Floyd and Judge (2012).</td>
<td>Yes - researchers met face-to-face with potential participants to discuss the risks, benefits and time commitment.</td>
<td>None specified</td>
<td>Some - one participant had dyslexia but the remaining 5 were described as having a 'learning disability' with no further detail, although all had difficulties with reading. ADHD and anxiety disorder are also listed. Their full-scale IQ scores on the WISC (Wechsler Intelligence Scale for Children) were given ('average' to 'superior' range). Their reading levels on the Basic Reading Inventory were given (between 5th grade (10-11 years) to 8th grade (13-14 years)).</td>
</tr>
<tr>
<td>7</td>
<td>Simoncelli and Hinson (2008).</td>
<td>None specified</td>
<td>None specified</td>
<td>No - 'learning disability' only, no details were given about the definition of this or the level of their difficulties although their Grade Point Average is provided.</td>
</tr>
<tr>
<td>8</td>
<td>Dolan, Hall, Banerjee, Chun and Strangman (2005).</td>
<td>None specified</td>
<td>None specified</td>
<td>A little - 'specific learning disability' only, no further details were given about the nature of their difficulties or level of difficulty. They completed the WIAT-II (Wechsler Individual Achievement Test) and were categorised as 'low average' or 'average' readers (no scores were given).</td>
</tr>
<tr>
<td>Study</td>
<td>Author</td>
<td>Was support provided in helping the participants understand the research?</td>
<td>Was support provided in helping the participants understand the interview questions?</td>
<td>Were details provided about the definition/nature/level of participant’s difficulties?</td>
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<td>--------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>9</td>
<td>Madaus, McKeown, Gelbar and Banerjee (2012).</td>
<td>None specified</td>
<td>None specified</td>
<td>No - ‘learning disability’ only, no details were provided about the definition of LD of the nature of their difficulties. Some participants also had a diagnosis of ADHD.</td>
</tr>
<tr>
<td>10</td>
<td>Jeffs, Behrmann and Bannan-Ritland (2006).</td>
<td>None specified</td>
<td>None specified</td>
<td>Yes - participants had SLD plus other diagnoses (all had literacy difficulties which were quantified as being at least 2 school years below their current grade level). No definition of LD/SLD was given or indication of level of difficulties other than in relation to reading.</td>
</tr>
</tbody>
</table>
Appendix H. The themes and sub-themes present in each study

<table>
<thead>
<tr>
<th>Participant's difficulties</th>
<th>Paper number</th>
<th>The outcomes of using technology</th>
<th>The process of using technology</th>
<th>Technology &amp; the people around me</th>
</tr>
</thead>
<tbody>
<tr>
<td>LD</td>
<td>1, 2, 4</td>
<td>It helps my learning</td>
<td>Helpful versus unhelpful features</td>
<td>Connected versus disconnected</td>
</tr>
<tr>
<td>SLD*</td>
<td>3, 6, 8, 10*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5, 7, 9</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Below the dotted line=online courses for individuals with SLD.

# Difficult to classify with confidence in terms of participant's difficulties
## Appendix I. The sub-themes and second-order and third-order interpretations

The letters A) to K) show the development of the line of argument

<table>
<thead>
<tr>
<th>Themes and sub-themes</th>
<th>Second-order interpretation * (paper number)</th>
<th>Third-order interpretations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The outcomes of using technology</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>It helps my learning</td>
<td>Assistive technology enhances the learning process and provides new opportunities and experiences (10)</td>
<td></td>
</tr>
<tr>
<td>Independence &amp; autonomy</td>
<td>Asynchronous online access enhance the learning experience and enables students to successfully cope with their disability (5)</td>
<td></td>
</tr>
<tr>
<td>The role of technology in my life</td>
<td>ICT contributes to self-concept and inclusive communication. It is experienced positively but there can be issues with operational aspects (1)</td>
<td></td>
</tr>
<tr>
<td><strong>Helpful versus unhelpful features</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A support mismatch</td>
<td>A) Computer-based instruction improves student's self-perception of their reading abilities due to factors such as helpful features (3)</td>
<td><strong>D) The helpfulness of intrinsic features combined with the appropriateness / availability of support can determine the relational experience of using technology</strong></td>
</tr>
<tr>
<td>Connected versus disconnected</td>
<td>A) Assistive technology specifically benefits the learning process of students (6)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A) Specific benefits of computer-based relate to computers being easier and more enjoyable to use (8)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B) Some important modifications to online courses are inaccessible to students due to technical problems and a lack of support (7)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C) Communication and connection to others on online/blended courses can be barriers and opportunities for students (9)</td>
<td></td>
</tr>
<tr>
<td><strong>The process of using technology</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The influence of other's views</td>
<td>F) Cognitive assistive devices can increase participation for people with LD but attitudes to participation from significant others and towards technology are barriers to this (4)</td>
<td><strong>G) For people with LD, unlike those with SLD, the interaction between technology and the people around them is a key determinant</strong></td>
</tr>
<tr>
<td>I have to rely on others</td>
<td>H) For people with LD independence and autonomy are influenced by the level of support provided (2)</td>
<td></td>
</tr>
<tr>
<td>I choose to have help from people</td>
<td>J) For people with LD choice is crucial if technology is to increase independence and autonomy (2)</td>
<td><strong>I) Younger people may not identify a distinction between help from technology and from people because reliance on others is a more typical part of being younger</strong></td>
</tr>
</tbody>
</table>

Some second-order interpretations support more than one sub-theme, the advice is used to demonstrate that all second-order interpretations are captured in the sub-themes.
Appendices: Paper 2


Instructions for Authors

Style of Manuscripts. Manuscripts should be prepared according to the guidelines in the Publication Manual of the American Psychological Association (6th edition; see www.apastyle.com). Typing instructions, including format, organization, and the preparation of figures, tables, and references appear in the Manual. Manuscripts may be submitted as Regular Articles, Brief Reports, or Future Directions. A Regular Article may not exceed 11,000 words (i.e., 35 pages), including references, footnotes, figures, and tables. Brief Reports include empirical research that is soundly designed, but may be of specialized interest or narrow focus. Brief Reports may not be submitted in part or whole to another journal of general circulation. Brief Reports may not exceed 4,500 words for text and references. These limits do not include the title page, abstract, author note, footnotes, tables, and figures. Manuscripts that exceed these page limits and that are not prepared according to the guidelines in the Manual will be returned to authors without review. Future Directions submissions are written by leading scholars within the field. These articles provide a brief summary of important advances that are needed within a specific research or practice area pertinent to clinical child and adolescent psychology. Future Directions submissions are by invitation only and undergo peer review.

All Regular Article and Brief Report submissions must include a title of 15 words or less that identifies the developmental level of the study participants (e.g., children, adolescents, etc.). JCCAP uses a structured abstract format. For studies that report randomized clinical trials or meta-analyses, the abstract also must be consistent with the guidelines set forth by CONSORT or MARS, respectively. The Abstract should include up to 250 words, presented in paragraph form. The Abstract should be typed on a separate page (page 2 of the manuscript), and must include each of the following label sections: 1) Objective (i.e., a brief statement of the purpose of the study); 2) Method (i.e., a detailed summary of the participants, N, age, gender, ethnicity, as well as a summary of the study design, measures, and procedures; 3) Results (i.e., a detailed summary of the primary findings that clearly articulate comparison groups (if relevant); 4) Conclusions (i.e., a description of the research and clinical implications of the findings). Avoid abbreviations, diagrams, and reference to the text in the abstract. A list of up to five keywords that describe the central themes of the manuscript should be included below the abstract on page 2. JCCAP will scrutinize manuscripts for a clear theoretical framework that supports central study hypotheses.

In addition, a clear developmental rationale is required for the selection of participants at a specific age. The Journal is making diligent efforts to ensure that there is an appropriately detailed description of the sample, including a) the population from which the sample was drawn; b) the number of participants; c) age, gender, ethnicity, and SES of participants; d) location of sample, including country and community type (rural/urban), e) sample identification/selection; f) how participants were contacted; g) incentives/rewards; h) parent consent/child assent procedures and rates; i) inclusion and exclusion criteria; j) attrition rate. The Discussion section should include a comment regarding the diversity and generality (or lack thereof) of the sample. The Measures section should include details regarding item content and scoring as well as evidence of reliability and validity in similar populations.
All manuscripts must include a discussion of the clinical significance of findings, both in terms of statistical reporting and in the discussion of the meaningfulness and clinical relevance of results. Manuscripts should a) report means and standard deviations for all variables, b) report effect sizes for analyses, and c) provide confidence intervals wherever appropriate (e.g., on figures, in tables), particularly for effect sizes on primary study findings. In addition, when reporting the results of interventions, authors should include indicators of clinically significant change. Authors may use one of several approaches that have been recommended for capturing clinical significance, including (but not limited to) the reliable change index (i.e., whether the amount of change displayed by a treated individual is large enough to be meaningful, the extent to which dysfunctional individuals show movement to the functional distribution).

All manuscripts should conform to the criteria listed in Table 1 of the 2008 APA Publications and Communications Board Working Group on Journal Article Reporting Standards (published in American Psychologist). These reporting standards apply to all empirical papers. In addition, JCCAP requires that reports of randomized clinical trials conform to CONSORT reporting standards (http://www.consort-statement.org/index.aspx?o=2965), including the submission of a flow diagram and checklist. Nonrandomized clinical trials must conform to TREND criteria (see http://www.cdc.gov/trendstatement/docs/AJPH_Mar2004_Trendstatement.pdf) and meta-analyses should conform to MARS standards (see Table 4 in 2008 American Psychologist article).

Full details of information for authors can be found at: http://www.tandfonline.com/action/authorSubmission?journalCode=hc20&page=instructions
Appendix K. Participant Information Sheet and Consent Form for Paper 2

Participant Information Sheet

How do children’s responses on an iPad compare to pen-and-paper questionnaires?

I’m inviting your child to take part in my research study as part of my Doctorate in Clinical Psychology at The University of Manchester. I’d like you to understand why this research is being carried out. I’d be very grateful if you would read the information below and decide if you would be happy for your child to take part. If you have any questions please don’t hesitate to contact me on the details at the bottom. Thank you for reading.

Who will conduct the research?

Ruth Seed (Trainee Clinical Psychologist) and Professor Rachel Calam (Research Supervisor).
The University of Manchester, School of Psychological Sciences, The Zochonis Building, Brunswick Street, Manchester, M13 9PL.

What’s the aim of this research?

We’re interested in knowing if a new iPad app gets the same responses as using pen-and-paper when children fill in a questionnaire. However, iPads are much more fun to use and lots of research is now exploring the benefits of using iPads with children. The questionnaire we’ve chosen has been used with many children before and it asks about their well-being (a Quality of Life questionnaire). This will help us to develop this app for children who can’t read and write.

Why have you written to me?

Your child’s school is one of a number who have agreed to take part in this research. We’re writing to all parents with a child aged 5 to 8 years who doesn’t receive additional support with learning above a certain level.

What would my child be asked to do if they took part?

How long does it take and where is the research being conducted?

The research will happen in your child’s school on a convenient day. Your child would join the researcher Ruth in a quiet, friendly room and she would explain the task and ask if they wanted to have a go. It’s up to them and they won’t be in trouble if they choose not to!

If they’re happy to have a go, Ruth will read them the questions and support them to answer using either pen-and-paper or the iPad. It takes about 15 minutes to complete. Two weeks
later Ruth will return and ask them to answer the questionnaire again using either the iPad or pen-and-paper (the one they didn’t do first). The iPad has a picture of a child that can be moved along a line between a sad face and a happy face, and children can choose where to put the child on the line. It can even take a photo of them that they can place on the line to make it more personalised. However your child can still take part even if you do not agree to their photo being taken. Ruth will ask whether they liked the iPad or pen-and-paper best. All children will be given a sticker to say thanks for taking part, even if they chose not to have a go.

A few questions ask the child if they ever feel sad, worried, or if other children tease them. Ruth is experienced at working with children, being supportive and explaining things in child-friendly language, and she will be looking out for signs that they’re feeling worried or upset. Our experience is that children really enjoy using iPads so we’re hoping this will be fun to do.

**How will we keep your child’s responses safe and private?**

We will keep all of your child’s information confidential and secure. This includes their name, age, the school they attend, and their responses on the questionnaire. All information on paper will be stored in locked filing cabinets. All information stored electronically (e.g. their iPad responses and their photo) will be encrypted (password-protected). Your child will be given a participant number which will be used instead of their name so they can’t be identified. The information will only be shared with the research team, in anonymised form.

**What if I don’t want my child to take part, or if I change my mind?**

It’s completely up to you to decide if you would like your child to take part. If you decide to take part you’re still free to withdraw your child at any time without giving a reason and without any consequences to you or your child.

**Will the outcomes of the research be published?**

Yes, we’re planning on writing up the research and publishing it in a journal, and this will also form part of the Trainee’s doctoral thesis.

**Criminal Records Check**

Ruth holds a current and satisfactory criminal records check. Any other researchers involved will only see anonymised data.

**What if we feel worried about a child?**

It might be that a child’s responses on the questionnaire make us feel worried about them in terms of their well-being. This is unlikely, but what we’ll do in this situation is let parents know about our concerns and we’ll speak to the school nurse so they are aware too.

**Contact for further information**

Ruth Seed (Trainee Clinical Psychologist) – please do contact me to discuss any questions. Telephone: 07526 233736
Email: ruth.seed@postgrad.manchester.ac.uk

If you wish to make formal complaints about the conduct of this research please contact: Head of the Research Office, Christie Building, University of Manchester, Oxford Road, Manchester, M13 9PL.
Consent Form

How do children’s responses on an iPad compare to pen-and-paper questionnaires?

If you are happy for your child to participate please complete this consent form by initialising in the boxes, and sign at the bottom. Please return it to school (along with the ‘information for us’ sheet) in the envelope provided.

1. I confirm that I have read the Participant Information Sheet and I have had the opportunity to consider the information and ask questions and have had these answered satisfactorily.

2. I understand that my child’s participation in the study is voluntary and that I am free to withdraw/to withdraw my child at any time without giving a reason and without consequences to myself or my child.

3. I agree to the use of anonymous quotes made by my child.

4. I agree to the researcher taking a photo of my child using the iPad in order to personalise my child’s responses. This will be password protected as with all their data, and will not be stored with their name. Your child can still participate even if you do not want their photo taken.

Please Initial Box

Name of child

Name of parent/guardian Date Signature

Name of researcher Date Signature

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Information for us

If you consent to your child taking part please fill in the following information and return it in the envelope provided (along with the consent form). Thank you.

Parent/guardian’s name: Mr / Mrs / Miss / Ms / other (please circle)

________________________________________________________________________

Child’s name: __________________________________________________________

________________________________________________________________________

Child’s gender: Male / Female (please circle)

________________________________________________________________________

Child’s date of birth: ........../........./........

________________________________________________________________________

Contact telephone number for parent/guardian: ______________________________

________________________________________________________________________

What school does your child attend: _________________________________________

________________________________________________________________________

What school year are they in: _______________________________________________

________________________________________________________________________

How often does your child use an iPad or a similar touch-sensitive tablet device? This might be at home or at school (Please tick):

Never  A few times ever  Once a month  Once a week  Every day

________________________________________________________________________

Thank you.
Appendix L. Documentation of ethical approval for all empirical work

Secretary to Research Ethics Committee 5
Faculty Office - Devonshire House
Tel: 0161 275 0288
Email: jared.ruff@manchester.ac.uk

Dr Ruth Seed
School of Psychological Sciences

4th March 2013

Dear Dr Seed

Research Ethics Committee 5 (Flagged Humanities) - Project Ref 12358

Seed, Calam, Hare, Bromley: Does the use of an iPad application help children with learning disabilities to report on their quality of life? An exploratory study (ref 12358)

I am writing to thank you for coming to meet with the University Ethics Committee 5 (flagged Humanities) on 4th February 2013 and for submitting the requested amendments to the project. This letter formally confirms approval for the above project and that no further changes are required to the documentation submitted to the committee.

This approval is effective for a period of five years and if the project continues beyond that period it must be submitted for review. It is the Committee’s practice to warn investigators that they should not depart from the agreed protocol without seeking the approval of the Committee, as any significant deviation could invalidate the insurance arrangements and constitute research misconduct. We also ask that any information sheet should carry a University logo or other indication of where it came from, and that, in accordance with University policy, any data carrying personal identifiers must be encrypted when not held on a university computer or kept as a hard copy in a location which is accessible only to those involved with the research.

Finally, I would be grateful if you could complete and return the attached form at the end of the project.

I hope the research goes well.

Yours sincerely

Jared Ruff
Senior Research Manager
Faculty of Humanities and Secretary to UREC 5 (Flagged Humanities)
0161 275 0288 jared.ruff@manchester.ac.uk
Appendix M. A flow diagram showing the process of recruitment and data collection

Parents written to (n=393)

Parents who consented (n=88, 22.4%)

Children still at school at point of data collection (n=84)

Children not considered in analysis as they were only seen once / not seen at all for practical reasons e.g. illness, child was busy at time of visit (n=6)

Children considered in analysis (n=78)

Children who did not understand the questionnaire sufficiently to complete it at all / complete it reliably (n=8, 10.3%).

Reasons:
- Insufficient English language (n=8)
- Additional language delay (n=1)

Children who moved to another school during the holidays (n=4)

Children who completed and were judged to understand the iPad and paper modalities (n=70, 89.7%)
Appendix N. The proportion of scores differing by a clinically acceptable amount

<table>
<thead>
<tr>
<th></th>
<th>Acceptable difference (≤ ±10)</th>
<th>Non-acceptable difference (&gt; ± 10)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency n (%)</td>
<td>Frequency n (%)</td>
</tr>
<tr>
<td>All data</td>
<td>43 (62.3%)</td>
<td>26 (37.7%)</td>
</tr>
<tr>
<td><strong>Which first</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>iPad first</td>
<td>21 (30.4%)</td>
<td>11 (15.9%)</td>
</tr>
<tr>
<td>Paper first</td>
<td>22 (31.9%)</td>
<td>15 (21.7%)</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>23 (33.3%)</td>
<td>14 (20.3%)</td>
</tr>
<tr>
<td>Male</td>
<td>20 (29.0%)</td>
<td>12 (17.4%)</td>
</tr>
<tr>
<td><strong>Age (years)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>8 (11.6%)</td>
<td>7 (10.1%)</td>
</tr>
<tr>
<td>6</td>
<td>12 (17.4%)</td>
<td>7 (10.1%)</td>
</tr>
<tr>
<td>7</td>
<td>13 (18.8%)</td>
<td>10 (14.5%)</td>
</tr>
<tr>
<td>8</td>
<td>9 (13.0%)</td>
<td>2 (2.9%)</td>
</tr>
<tr>
<td>9</td>
<td>1 (1.4%)</td>
<td>0</td>
</tr>
<tr>
<td><strong>Previous use of touch-sensitive device</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>3 (4.6%)</td>
<td>0</td>
</tr>
<tr>
<td>A few times ever</td>
<td>6 (9.2%)</td>
<td>7 (10.8%)</td>
</tr>
<tr>
<td>Once a month</td>
<td>4 (6.2%)</td>
<td>1 (1.5%)</td>
</tr>
<tr>
<td>Once a week</td>
<td>11 (16.9%)</td>
<td>8 (12.3%)</td>
</tr>
<tr>
<td>Every day</td>
<td>17 (26.2%)</td>
<td>8 (12.3%)</td>
</tr>
<tr>
<td><strong>Administration gap</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 week</td>
<td>6 (8.7%)</td>
<td>4 (5.8%)</td>
</tr>
<tr>
<td>2 weeks</td>
<td>37 (53.6%)</td>
<td>22 (31.9%)</td>
</tr>
</tbody>
</table>

Both show unacceptably wide limits of agreement. Males' scores were slightly closer together however they have a wider limit of agreement. For males and females the difference between scores are seen in both directions (positive and negative).
Appendix O.2. Bland and Altman graphs comparing children by previous use of touch-sensitive tablet devices

All show unacceptably wide limits of agreement (particularly for children who used touch-sensitive devices daily) and difference between scores are seen in both directions (positive and negative).
Appendix O.3. Bland and Altman graphs comparing children by whether they completed the iPad or paper version first.

Both show unacceptably wide limits of agreement and difference between scores are seen in both directions (positive and negative).
Appendix O.4. Bland and Altman graphs comparing children by whether there was a one or two week administration gap between administrations

Both show unacceptably wide limits of agreement and difference between scores are seen in both directions (positive and negative) although it is only possible to draw tentative conclusions about those who had a one-week gap due to the small number of children this related to (n=10).
Appendix P. Bland and Altman graphs comparing children by age (See Results for interpretation).

*Includes one 9 year old
Appendix Q. Bland and Altman graphs excluding children aged five years (See Results for interpretation).
Appendix R. The frequency of comments for each category and sub-category within the content analysis if children’s reasons for preference (See Results for interpretation).

<table>
<thead>
<tr>
<th>Preference</th>
<th>Category (Sub-categories)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>iPad (n=57)</td>
<td>I like iPads and technology</td>
<td>Total=23</td>
</tr>
<tr>
<td></td>
<td>I like technology and iPads</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>iPads are fun/good for games</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>My experience with iPads</td>
<td>Total=9</td>
</tr>
<tr>
<td></td>
<td>I’ve got an iPad at home</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>This iPad is better than mine/my iPad is broken</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>I’ve not used an ipad before</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>It’s personalised and individualised</td>
<td>Total=11</td>
</tr>
<tr>
<td></td>
<td>It's got my photo/I can choose a picture</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>I can choose an answer in between the faces</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>I have control over it</td>
<td>Total=32</td>
</tr>
<tr>
<td></td>
<td>I get to move it to different faces</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>I get to touch/move it to choose/it does what I tell it to</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>My hand will get tired with the paper*</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>The experience of using the app</td>
<td>Total=9</td>
</tr>
<tr>
<td></td>
<td>It like it when the picture jumps back to the middle</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>The iPad has more colour</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>It's easier to use / It's quick</td>
<td>5</td>
</tr>
<tr>
<td>Paper (n=5)</td>
<td>The paper version was easier and quicker</td>
<td>Total=10</td>
</tr>
<tr>
<td></td>
<td>I just had to point so it was easier/quicker</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>The person was not easy to move*</td>
<td>2</td>
</tr>
</tbody>
</table>

* A negative view of the alternative format.
Appendices: Paper 3

Appendix S. Participant Information Sheet and Consent Form for Paper 3

Participant Information Sheet

Does an iPad app help children to tell us about their Quality of Life?

I’m inviting you and your child to take part in my research study as part of my Doctorate in Clinical Psychology at The University of Manchester. I’d like you to understand why this research is being carried out. I’d be very grateful if you would read the information below and decide if you would be happy for your child to take part. If you have any questions please don’t hesitate to contact me on the details at the bottom. Thank you for reading.

Who will conduct the research?

Ruth Seed (Trainee Clinical Psychologist) and Professor Rachel Calam (Research Supervisor).

The University of Manchester, School of Psychological Sciences, The Zochonis Building, Brunswick Street, Manchester, M13 9PL.

What’s the aim of this research?

We know that many children, including those who need support with learning, can find it hard to complete questionnaires that use traditional pen-and-paper methods. There is more and more evidence that using iPads can be really helpful – children find them fun to use and they can help support children in responding to questions. The questionnaire we’ve chosen has been used with many children before and it asks about their well-being (a Quality of Life questionnaire). We’re interested in whether a new iPad app helps children to respond to this questionnaire - do they understand the questions and what do they think about the iPad? We’re also asking parents to complete the questionnaire if they’re happy to.

Why have you written to me?

Your child’s school is one of a number who have agreed to take part in this research. We’re writing to all parents with a child aged 5 to 11 years who receives additional support with learning. This might be for a range of possible reasons.

What would my child be asked to do if they took part?

How long does it take and where is the research being conducted?

The research will happen in your child’s school on a convenient day. Your child would join the researcher Ruth in a quiet, friendly room and she would explain the task and ask if they wanted to have a go. It’s up to them and they won’t be in trouble if they choose not to.
If they’re happy to have a go, first they will do two brief tasks which look at their vocabulary and word knowledge. In one they have to describe the meaning of some simple words and the other involves choosing a picture of a word from a selection of pictures. Then they will do a task that involves choosing a shape to complete a pattern. These tasks are to check that they will understand the questionnaire and to get a general measure of some of their abilities. There are also some fun and quick tasks to check that they don’t say ‘yes’ to all the questions. In total this will take about 30 minutes.

Next, Ruth will read them the questions and support them to answer the questionnaire using the iPad app. Ruth will ask them for an example for each question and ask them how much they enjoyed using the iPad and how easy it was to use. This part will take 15 – 20 minutes. The iPad has a picture of a child that can be moved along a line between a sad face and a happy face, and children can choose where to put the child on the line. It can even take a photo of them that they can place on the line to make it more personalised. However your child can still take part even if you do not agree to their photo being taken. All children will be given a sticker to say thanks for taking part, even if they chose not to have a go. Each child will be videoed doing these tasks. This is to check that Ruth is not being ‘leading’ in supporting children to answer questions and to look for signs of children’s engagement. If you don’t want your child to be videoed this is fine, you can choose for them to be audio-taped instead, or you can choose for no taped recordings to be made at all. Your child can take part even if you do not want them to be video- or audio-taped. All the comments each child makes will be typed up and looked at to see their understanding of the questions.

A few questions ask the child if they ever feel sad, worried, or if other children tease them. Ruth is experienced at working with children, being supportive and explaining things in child-friendly language, and she will be looking out for signs that they’re feeling worried or upset. Our experience is that children really enjoy using iPads so we’re hoping this will be fun to do.

What would I be asked to do if I took part?

If you agree to take part yourself we would post the parental version of the questionnaire to you and ask you to complete it. You could then bring it into school in a sealed, confidential envelope that would be provided. You can fill in the questionnaire by yourself or jointly, for example with your child’s other parent/guardian. Although it’s important for us to receive as many parental questionnaires as possible, it’s absolutely fine if you wish to consent for your child’s participation but don’t wish to take part yourself.

How will we keep your child’s responses safe and private?

We will keep all of your child’s information confidential and secure. This includes their name, age, the school they attend and any other information we have, and their responses on the questionnaire. All information on paper will be stored in locked filing cabinets. All information stored electronically (e.g. their iPad responses and their photo) will be encrypted (password-protected). Your child will be given a participant number which will be used instead of their name so they can’t be identified. The information will only be shared with the research team, in anonymised form.

What if I don’t want my child to take part, or if I change my mind?

It’s completely up to you to decide if you would like your child to take part. If you decide to take part you’re still free to withdraw your child at any time without giving a reason and without any consequences to you or your child.
Will the outcomes of the research be published?

Yes, we’re planning on writing up the research and publishing it in a journal, and this will also form part of the Trainee’s doctoral thesis.

Criminal Records Check

Ruth holds a current and satisfactory criminal records check. Any other researchers involved will only see anonymised data.

What if we feel worried about a child?

It might be that a child’s responses on the questionnaire make us feel worried about them in terms of their well-being. This is unlikely, but what we’ll do in this situation is let parents know about our concerns and we’ll speak to the school nurse so they are aware too.

Contact for further information

Ruth Seed (Trainee Clinical Psychologist) – please do contact me to discuss any questions, worries or comments you might have when thinking about whether to participate.
Telephone: 07526 233736
Email: ruth.seed@postgrad.manchester.ac.uk

If you wish to make a formal complaint about the conduct of this research please contact:
Head of the Research Office, Christie Building, University of Manchester, Oxford Road, Manchester, M13 9PL.
Consent Form
Does an iPad app help children to tell us about their
Quality of Life?

If you are happy for your child to participate please complete this consent form by initialling in the boxes, and sign at the bottom. Please return it to school (along with the 'information for us' sheet) in the envelope provided.

Please initial next to each point if you agree:

1. I confirm that I have read the Participant Information Sheet and I have had the opportunity to consider the information and ask questions and have had these answered satisfactorily.

2. I understand that our participation in the study is voluntary and that I am free to withdraw/to withdraw my child/for my child to withdraw themselves at any time without giving a reason and without consequences to myself or my child.

3. I agree to the use of anonymous quotes made by my child.

4. I agree to the researcher gaining information from school about the additional support with learning that my child receives and the reason for this.

5. I agree to the researcher taking a photo of my child using the iPad in order to personalise my child's responses. This will be password protected as with all their data, and will not be stored with their name. Your child can still participate even if you do not want their photo taken.

Next, please choose one option:

1. I agree for my child to be video-taped

2. I do not consent to my child being video-taped, but I agree for them to be audio-taped.

3. I agree for my child to take part but I do not consent to them being video- or audio-taped.

Next, please choose one option:

1. I agree for my child to take part and I agree to take part in the above project:

2. I agree for my child to take part but I do not wish to take part myself:

Name of child

Name of parent/guardian

Date

Signature

Name of researcher

Date

Signature
Information for us

If you consent to your child taking part please fill in the following information and return it in the envelope provided (along with the consent form). Thank you.

Parent/guardian’s name: Mr / Mrs / Miss / Ms / other (please circle)

........................................................................................................

Child’s name: ...........................................................................

Child’s gender: Male / Female (please circle)

Child’s date of birth: ........../........./...........

Contact telephone number for parent/guardian: ..................................................

What school does your child attend: ...........................................................

What school year are they in: .................................................................

How often does your child use an iPad or a similar touch-sensitive tablet device? This might be at home or at school (Please tick):

Never  A few times ever  Once a month  Once a week  Every day

........................................................................................................

Thank you.
Appendix T. Boardmaker® symbols used for all children to introduce the research and for pre-test questions (all symbols originally printed on larger individual cards).

My name is Ruth

I'm going to ask you some questions

Is that ok?

To help me remember
I'm going to make a film of us
Is that ok?

OR

To help me remember
I'm going to make a tape of what we say
Is that ok?
Is that ok?

If you want to stop say stop

Who's bigger, you or me?

Look at these shapes.

Which is biggest?

Which is smallest?

(wooden shapes provided)
Appendix U. Boardmaker® symbols used for all children to ask questions about using the iPad app.

What we did today on the iPad

- It is easy
- It is hard
- I don't know

What we did today on the iPad

- I like it
- I don't like it
- I don't know
Appendix V. Boardmaker® symbols used for five children to support understanding of the scale and questions.

I’m going to ask you about problems

Small problem

Medium problem

Big problem
| This is Mary. | Mary can clap her hands.  
| | It is easy for Mary to clap her hands.  
| | Mary is good at clapping her hands.  
| | Mary moves her picture to the smiley face.  |

| This is Hassan. | Sometimes Hassan finds it hard to read.  
| | The pink book is easy to understand.  
| | The orange book is difficult.  
| | Hassan moves his picture to the middle face.  |

| This is Joe. | Joe cannot ride a bike.  
| | Every time Joe gets on his bike he falls off.  
| | Joe moves his picture to the sad face.  |
1. To walk
   walk

2. To run
   run

3. To play sports or exercise
   exercise  net ball  football

4. To pick up big things
   pick up  big things

5. To do chores like pick up your toys
   pick up toys
6. Do you feel scared
   scared

7. Do you feel sad
   sad

8. Do you feel mad or angry
   angry

9. Do you worry about what will happen to you
   worried

10. To get along with other kids
    argue with people

11. Do other kids say they do not want to play with you
    no one to play with
12. Do other kids tease you
   Mean to you

13. To pay attention in school
   listen
class

14. Do you forget things
   forget

15. To keep up with schoolwork
   school work
   finished
Thank you for working with me
### Appendix W. Clinical observations from video- and audio-recordings

<table>
<thead>
<tr>
<th>Child</th>
<th>Apparent understanding</th>
<th>Communication</th>
<th>Apparent engagement/Concentration/Practical use</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Overall understanding but he needed clarification for questions 10 and 13.</td>
<td>Very little verbal communication. He pointed to indicate his responses and used only single words when he needed to speak. However he could agree and disagree when asked if he understood the question showing that he was not acquiescing.</td>
<td>He appeared nervous but smiled when introduced to the iPad. He concentrated well. Initial difficulties moving the picture on the iPad (too quick and light a touch) however this improved. Needed prompts initially to respond using the iPad.</td>
</tr>
<tr>
<td>2</td>
<td>The questionnaire was stopped after the practice item as he could not engage in the task. He had difficulties in understanding and tolerating the social situation consistent with his diagnosis of ASD. When asked to sit down he made crying noises with his hands over his face, saying &quot;Miss is shouting at me&quot;. He repeatedly asked if he was at the doctors and if the researcher could check his heart, placing their hand on his chest.</td>
<td>He responded to very few questions, appearing to not be able to concentrate on the majority.</td>
<td>He found it difficult to engage in a 1:1 interaction with the researcher. He could not engage with any task presented. He was distracted by other items in the room and repeatedly asked to play games on the iPad, frequently exiting the programme to look for these. Prompt to focus on the task did not appear to help.</td>
</tr>
<tr>
<td>Child</td>
<td>Apparent understanding</td>
<td>Communication</td>
<td>Apparent engagement/Concentration/Practical use</td>
</tr>
<tr>
<td>-------</td>
<td>------------------------</td>
<td>---------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>3</td>
<td>She appeared to understand all questions</td>
<td>She gave many spontaneous examples although her conversation was also tangential. She showed some rigid thinking when she questioned the researcher about if she was married (asking &quot;why not, are you still a child?&quot;) consistent with her social and communication difficulties.</td>
<td>She showed enjoyment of the interaction throughout, waving and smiling at the camera and the iPad and laughing when her photo re-centred itself. She appeared tired half-way through the questionnaire and wanted to play games instead. She repeatedly asked to watch the video back and was distracted by items in the room, however with prompts she was able to focus.</td>
</tr>
<tr>
<td>4</td>
<td>Overall understanding but he needed clarification for question 12. He used only two points on the scale and his understanding of the scale, or his ability to recognise and rate his feelings, was queried.</td>
<td>Very little verbal communication. He nodded to indicate his responses where possible, and used only single words when he had to speak. However he could agree and disagree when asked if he understood the question showing that he was not acquiescing.</td>
<td>He concentrated well. He did not show enjoyment apart from smiling when his photograph was taken. He appeared nervous throughout. Needed prompts initially to respond using the iPad.</td>
</tr>
<tr>
<td>5</td>
<td>He appeared to understand all questions. Evidence of responding in relation to events in the distant past. For question 12 he responded that children 'sometimes' tease him but then said &quot;it was ages ago&quot;.</td>
<td>He was quiet but did offer extra information for some questions and described his decision process when responding.</td>
<td>He concentrated well, smiling and waving at the camera and making excited gestures when using the iPad.</td>
</tr>
<tr>
<td>Child</td>
<td>Apparent understanding</td>
<td>Communication</td>
<td>Apparent engagement/Concentration/Practical use</td>
</tr>
<tr>
<td>-------</td>
<td>------------------------</td>
<td>---------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>6</td>
<td>She appeared to understand all questions. Evidence of social desirability bias with question 10. She responded 'not at all' and said &quot;I bet everybody said that they get along with people&quot;. When told this was not the case she changed her response to 'sometimes' a problem. Appeared to answer question 6 ('scared') in relation to her anchor event (a sleepover) however this was not apparent for other questions.</td>
<td>She was able to express her views and give spontaneous examples for several questions.</td>
<td>She concentrated well. She smiled and made excited gestures when her photo re-centred itself.</td>
</tr>
<tr>
<td>7</td>
<td>He appeared to understand all questions</td>
<td>He was quiet and responded mainly yes/no however he elaborated a little when prompted.</td>
<td>He concentrated well, showing some excitement for the iPad through smiling.</td>
</tr>
<tr>
<td>8</td>
<td>She appeared to understand all questions</td>
<td>She offered detailed information relating to current bullying, spontaneously using the iPad to rate this problem. However the emotive nature of this topic meant that her subsequent responses related to the bullying.</td>
<td>She concentrated well, and made excited gestures and smiled when using the iPad.</td>
</tr>
<tr>
<td>Child</td>
<td>Apparent understanding</td>
<td>Communication</td>
<td>Apparent engagement/Concentration/Practical use</td>
</tr>
<tr>
<td>-------</td>
<td>------------------------</td>
<td>---------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>9</td>
<td>He did not appear to understand the questions and therefore his responses were not taken to be valid. The supplementary Boardmaker® symbols did not appear to help. He changed the majority of his answers when the researcher made any comment and he frequently repeated the researcher's comments. He typically selected the last option given for any question, regardless of the question or order of options. It was unclear what his responses referred to e.g. whether 'sometimes' meant it was 'sometimes hard to run' or that he 'ran sometimes'.</td>
<td>He was able to read the words on the screen but his SENCO reported that his reading was good but that he often did not understand what he read.</td>
<td>He made excited gestures about using the iPad and having his photograph taken. He concentrated on the task. Needed prompts for every question to respond using the iPad.</td>
</tr>
<tr>
<td>10</td>
<td>She appeared to understand all questions</td>
<td>She offered a great deal of spontaneous information.</td>
<td>She made excited gestures about using the iPad. She concentrated well (in contrast to cognitive testing during which she struggled to concentrate and wanted to stop when it became difficult).</td>
</tr>
<tr>
<td>11</td>
<td>Overall understanding but she needed clarification for questions 10 and 12.</td>
<td>She was quiet but able to provide additional information when asked and spontaneously for one question.</td>
<td>She concentrated well. She did not show enjoyment of any tasks completed except for smiling when her photo re-centred itself ready for the next question.</td>
</tr>
<tr>
<td>Child</td>
<td>Apparent understanding</td>
<td>Communication</td>
<td>Apparent engagement/Concentration/Practical use</td>
</tr>
<tr>
<td>-------</td>
<td>------------------------</td>
<td>---------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>12</td>
<td>He appeared to understand all questions. He used only two points on the scale but demonstrated understanding of the concepts of 'not at all', 'sometimes' and 'a lot' through the additional verbal information he provided.</td>
<td>He was quiet although did offer spontaneous information for two questions.</td>
<td>He concentrated on the iPad. He appeared to smile more when using the iPad compared to the testing, and particularly when having his photo taken.</td>
</tr>
<tr>
<td>13</td>
<td>He appeared to understand all but question 15, based on incongruence between his verbal response and his iPad response. He perseverated on the question about feeling scared, continuing to describe things he was scared of several questions later however he appeared to understand that the question had changed when prompted.</td>
<td>He offered spontaneous information for two questions. Consistent with his diagnosis of ASD throughout the tests and questionnaire he asked how many minutes we would do each activity for. He repeated many of the researcher’s phrases and discussed fixed interests.</td>
<td>He appeared to need fewer prompts to concentrate on the iPad compared to during testing and in the initial conversation. He appeared to enjoy all the tasks, laughing and smiling at the questions. He made little eye contact unless asked to look at the researcher, and tended to look away when they responded. He repeatedly moved his photo back to the centre and needed constant prompts to leave it to be saved.</td>
</tr>
<tr>
<td>14</td>
<td>He appeared to understand all questions. He used only two points on the scale but demonstrated understanding of the concepts of 'not at all', 'sometimes' and 'a lot' through the additional verbal information he provided when questioned.</td>
<td>He offered some spontaneous information although mainly when asked.</td>
<td>He concentrated on the iPad. He smiled little but appeared enthusiastic to use the iPad and shared knowledge of tablet devices.</td>
</tr>
<tr>
<td>Child</td>
<td>Apparent understanding</td>
<td>Communication</td>
<td>Apparent engagement/Concentration/Practical use</td>
</tr>
<tr>
<td>-------</td>
<td>------------------------</td>
<td>--------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>15</td>
<td>He appeared to understand all but question 9. He had difficulties with concentration and motivation from question 9 onwards which may have impacted on the validity of his responses. He did not want to hear an explanation of question 9, discussion led to increasing disengagement. He then began describing back pain which was his way of communicating that he was feeling stressed.</td>
<td>He provided some spontaneous information although mainly when asked. He spontaneously used the iPad to rate pain in two painful experiences.</td>
<td>He appeared excited about the iPad and appeared to enjoy posing for the photo. He was distracted by things around him. Initially prompts helped him to concentrate but beyond question 9 this no longer helped and he responded hurriedly to finish the task. He appeared tired after lengthy cognitive testing. He repeatedly exited the app to watch himself on the camera, and kept turning the iPad away from the researcher so they had to guess his response. He repeatedly moved his photo back to the centre and needed constant prompts to leave it to be saved.</td>
</tr>
</tbody>
</table>
Appendix X. A selection of children’s quotes to demonstrate their understanding of the questionnaire and the meaningful information they could provide.

<table>
<thead>
<tr>
<th>Question</th>
<th>Quote</th>
<th>Researcher’s comments italicised, explanations in brackets.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Walk</td>
<td>&quot;Not at all cos I've got these shoes on [showed shoes]...mummy said you'll go really fast in them&quot; (child 13, age 5)</td>
<td></td>
</tr>
<tr>
<td>2. Run</td>
<td>Are you good at running?</td>
<td>&quot;Yeah!&quot; [demonstrated running] (child 15, age 9)</td>
</tr>
<tr>
<td>3. Play sports or exercise</td>
<td>&quot;It's not, but sports, I don't...I do play but it's just that it's hard to play in front of other people&quot; (child 11, age 9)</td>
<td></td>
</tr>
<tr>
<td>4. Pick up big things</td>
<td>&quot;It's not at all, it's not at all actually. Oh that's good, how come? I'll show you how come&quot; [demonstrating] (child 15, age 9)</td>
<td></td>
</tr>
<tr>
<td>5. Do chores</td>
<td>&quot;Boring...it's easy but its boring aww boring. I need my mum to do that. Does your mum do it for you? When she's cooking nope, sometimes she does actually when I'm very tired or when I'm ill&quot; (child 3, age 7)</td>
<td></td>
</tr>
<tr>
<td>6. Feel scared</td>
<td>&quot;Sometimes. What kind of things make you feel scared? Bees, only some bees. And wasps. Oh really! Because they sting me...Monsters!&quot; [laughing] (child 13, age 5)</td>
<td></td>
</tr>
<tr>
<td>7. Feel sad</td>
<td>&quot;How come you feel sad sometimes? Err I don't know. Aww [holding his back] What kind of things make you feel sad? When I get beated up loads of times. Aww when you get beated up you feel sad? Ahhh yeah my back's aching enough&quot; (child 15, age 9)*</td>
<td>*(child with ASD who expresses distress through reporting back pain)</td>
</tr>
<tr>
<td>8. Feel mad</td>
<td>&quot;Erm sometimes. What kind of things make you feel like that? When people...cos last time I got angry cos my friend yeah flipped a pencil then and cos he's on my table the teacher said it was me&quot; (child 12, age 10)</td>
<td>&quot;Angry a lot, especially when I go near [name of child]. I see. For some reason she's always jealous when it's people's birthday, every single birthday every single Christmas, it's my life is gone, she's always grasping it up on me so I always have to get grounded, oh she acts like she's a good kid but she isn't, OH no&quot; (child 8, age 7)</td>
</tr>
<tr>
<td>9. Worry about what will happen to you</td>
<td>&quot;Lots and lots, I might fall over again. I'm getting bullied! Have you told your mum? She knows but she won't stop sending me here. Aww, do you think maybe you should tell [teacher] about it? But then he's gonna tell me off&quot; (child 3, age 7)</td>
<td></td>
</tr>
<tr>
<td>Question</td>
<td>Quote</td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>-------</td>
<td></td>
</tr>
<tr>
<td>10. Get along with other kids</td>
<td>&quot;A lot? Can you tell me a bit about it? Cos I don't have much friends in this school as well...I was a popular girl then but then after when I had this [pointed at where had a cold sore] after like it was the next day when they started calling me names and being mean to me. Oh no! And then after that I've really had to stand up for myself, I've been a bit mean to them but they've mostly been mean to me&quot; (child 10, age 10)</td>
<td></td>
</tr>
<tr>
<td>11. Other kids say they do not want to play with you</td>
<td>&quot;I don't like playing. You don't like playing, why not? I just don't&quot; (child 13, age 5)* *(child with ASD)</td>
<td></td>
</tr>
<tr>
<td>12. Other kids tease you</td>
<td>...The only girls who is not my friend are [name] and [name]. Oh right, why are they not your friends? [Name] makes me angry... What do they do to make you angry? They like take mick of my name&quot; (child 12, age 10)</td>
<td></td>
</tr>
<tr>
<td>13. Pay attention in school</td>
<td>&quot;I don't know my work sometimes and I need help but but nobody helps me, sometimes I get help the people on my table...And sometimes I don't understand on the carpet. Do you tell anybody about that? [shook head]&quot; (child 11, age 9)</td>
<td></td>
</tr>
<tr>
<td>14. Forget things</td>
<td>&quot;I forget things that I'm thinking of something and then I forget it. When does that happen? Well sometimes when I'm talking in my head it just happens I forgot what I'm talking about&quot; (child 14, age 7)</td>
<td></td>
</tr>
<tr>
<td>15. Keep up with schoolwork</td>
<td>&quot;I'm good at that, that's what even my teacher says&quot; (child 3, age 7) &quot;I don't like school I only like home&quot; (child 13, age 5)</td>
<td></td>
</tr>
</tbody>
</table>
**Appendix Y. Completion time per question**

<table>
<thead>
<tr>
<th>How much of a problem is this for you?</th>
<th>Time (secs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (Std. Dev)</td>
</tr>
<tr>
<td>Physical functioning</td>
<td></td>
</tr>
<tr>
<td>1. Walk</td>
<td>9.3 (3.1)</td>
</tr>
<tr>
<td>2. Run</td>
<td>6.6 (1.8)</td>
</tr>
<tr>
<td>3. Play sports or exercise</td>
<td>8.8 (4.0)</td>
</tr>
<tr>
<td>4. Pick up big things</td>
<td>10.0 (7)</td>
</tr>
<tr>
<td>5. Do chores</td>
<td>10.0 (9)</td>
</tr>
<tr>
<td>Emotional functioning</td>
<td></td>
</tr>
<tr>
<td>6. Feel scared</td>
<td>12.0 (8)</td>
</tr>
<tr>
<td>7. Feel sad</td>
<td>6.0 (2)</td>
</tr>
<tr>
<td>8. Feel mad</td>
<td>9.0 (6)</td>
</tr>
<tr>
<td>9. Worry about what will happen to you</td>
<td>14.0 (16)</td>
</tr>
<tr>
<td>Social functioning</td>
<td></td>
</tr>
<tr>
<td>10. Get along with other kids</td>
<td>13.0 (9.7)</td>
</tr>
<tr>
<td>11. Other kids say they do not want to play with you</td>
<td>10.0 (5.4)</td>
</tr>
<tr>
<td>12. Other kids tease you</td>
<td>8.0 (3.6)</td>
</tr>
<tr>
<td>School functioning</td>
<td></td>
</tr>
<tr>
<td>13. Pay attention in school</td>
<td>17.0 (26)</td>
</tr>
<tr>
<td>14. Forget things</td>
<td>6.6 (2.8)</td>
</tr>
<tr>
<td>15. Keep up with schoolwork</td>
<td>12.0 (12)</td>
</tr>
</tbody>
</table>
Inside Back Cover
Instructions for interviewer:

I am going to ask you some questions about things that might be a problem for some children. I want to know how much of a problem any of these things might be for you.

Show the child the template and point to the responses as you read.

If it is not at all a problem for you, point to the smiling face

If it is sometimes a problem for you, point to the middle face

If it is a problem for you a lot, point to the frowning face

I will read each question. Point to the pictures to show me how much of a problem it is for you. Let’s try a practice one first.

<table>
<thead>
<tr>
<th>Is it hard for you to snap your fingers</th>
<th>Not at all</th>
<th>Sometimes</th>
<th>A lot</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Ask the child to demonstrate snapping his or her fingers to determine whether or not the question was answered correctly. Repeat the question if the child demonstrates a response that is different from his or her action.
Think about how you have been doing for the last few weeks. Please listen carefully to each sentence and tell me how much of a problem this is for you.

After reading the item, gesture to the template. If the child hesitates or does not seem to understand how to answer, read the response options while pointing at the faces.

<table>
<thead>
<tr>
<th>Physical Functioning (PROBLEMS WITH…)</th>
<th>Not at all</th>
<th>Sometimes</th>
<th>A lot</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Is it hard for you to walk</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>2. Is it hard for you to run</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>3. Is it hard for you to play sports or exercise</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>4. Is it hard for you to pick up big things</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>5. Is it hard for you to do chores (like pick up your toys)</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

Remember, tell me how much of a problem this has been for you for the last few weeks.

<table>
<thead>
<tr>
<th>Emotional Functioning (PROBLEMS WITH…)</th>
<th>Not at all</th>
<th>Sometimes</th>
<th>A lot</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Do you feel scared</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>2. Do you feel sad</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>3. Do you feel mad</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>4. Do you worry about what will happen to you</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Social Functioning (PROBLEMS WITH…)</th>
<th>Not at all</th>
<th>Sometimes</th>
<th>A lot</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Is it hard for you to get along with other kids</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>2. Do other kids say they do not want to play with you</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>3. Do other kids tease you</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>School Functioning (PROBLEMS WITH…)</th>
<th>Not at all</th>
<th>Sometimes</th>
<th>A lot</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Is it hard for you to pay attention in school</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>2. Do you forget things</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>3. Is it hard to keep up with schoolwork</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>
How much of a problem is this for you?

Not at all  

Sometimes  

A lot