Department of Clinical Therapies
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Final Year Project

Dysgraphia Therapy using iPad App with Adults who have Aphasia

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Abstract

Background: The use of electronic, computerised tablets specifically the iPad by people with aphasia is an exciting new route to explore (Van de Sandt-Koenderman, 2004). A recent survey conducted by the PSHA, (2012) found that a majority of clinicians are currently using iPads with their clients including people with aphasia (Atticks, 2012). In light of this, ever growing phenomena, it is essential that more research is carried out. In this study an iPad application using a genetic algorithm was explored as a therapy tool to improve writing skills.

Aims: The main objectives were to consider the feasibility of using this iPad app to deliver therapy and to investigate if the app improves writing skills of adults with aphasia at single word level.

Methods and Procedures: The design of the research project was a mixed methods approach. The Comprehensive Aphasia Test (CAT) was also used to assess receptive and expressive language skills. A dysgraphia assessment was designed to assess for successful word production. Baselines were recorded pre and post therapy. Pre and post qualitative interviews were conducted and analysed. The app uses a cueing hierarchy to help the participant access the target word and then type this using the iPad keyboard. Five adult participants with aphasia and dysgraphia impairment were recruited for the research project and three completed the therapy course.

Outcomes and Results: The quantitative data revealed no significant improvements in the participants writing skills (P = 1.000). One participant diagnosed with phonological dysgraphia showed an increase on number of target words achieved. However, those with a peripheral diagnosis of dysgraphia showed no improvement on written word output. This indicates that the app may be more suitable for those with a less severe diagnosis. Qualitative interviews revealed a number of positive outcomes from using the application; common themes included motivation and ease of use, which are a positive finding for this research.

Conclusion: Therapy delivered through the use of an iPad app is motivating for the participant. The app was well designed and easy to use. Further research into the use of iPad and apps to deliver dysgraphia therapy is clearly indicated.
Introduction

The use of high tech computerised communication aids by people with aphasia is a promising new route to explore (Van de Sandt-Koenderman, 2004). This paper aims to evaluate an iPad application as a therapy tool to improve writing skills in adults with aphasia. A cueing hierarchy will be implemented as part of the app to provide immediate feedback to the client on his/her response. Using an app which targets spelling and writing skills may increase residents’ motivation, participation and independence (Coburn, 2012).

What is Dysgraphia?

Written language is a major communication channel that is parallel rather than subordinate to spoken language (McNeil et al, 1990). The collective name given to disorders of written language is dysgraphia and it can be caused by neurological damage to the brain as a result of a stroke or severe brain injury. There are different types of dysgraphia such as Deep dysgraphia, Surface Dysgraphia, Phonological Dysgraphia and Peripheral Dysgraphia. Patients can have any one of these types and the severity of writing skills can depend on a number of factors. The author will briefly outline intervention approaches in this paper.

History of Intervention Approaches to Dysgraphia

Limited research into intervention approaches for writing disorders has led to clinicians focus more on speech production than on other modes of communication such as writing. Whitworth et al (2005) hypothesises that clinical priorities, resource constraints and possibly even lack of expertise may be some of the reasons for this neglect. Of the few writing treatments studies reported before 1985 there was only modest support for lasting change in written spelling following treatment (Hatfield et al, 1976, Seron et al, 1980) cited in Beeson et al (2003). More recent case reports provide stronger support for writing therapy for individuals with moderate and mild aphasia (Carlomagno et al, 1994, Hillis, 1989) cited in Beeson et al, (2003).
Intervention approaches for writing should take into account the person’s level of impairment, cognitive skills and motivation for therapy. Therapy may target the lexical writing route or the sub lexical writing route. Studies have been reported in the literature that target these routes but are the approaches successful. According to Beeson et al, (2002) ACT and CART are successful intervention approaches that target single word writing through the lexical route. ACT (Anagram and Copy Treatment) is a cueing hierarchy used to elicit correct spelling of target words. CART (Copy and Recall Treatment) is a strategy that requires the participant to copy target word and then recall the target word.

The outcomes of study clearly identified item specific learning where significant improvements were evident in treated words but no improvements to untreated words. A similar approach was implemented by Aliminosa et al (1993). Clients reported an improvement in target words but no generalisation occurred. Other studies such as Rapp and Kane (2002), Robson et al, (2001), Robson et al, (1998) and Beeson (1999) have reported successful outcomes with these approaches, that is participants gain the ability to perform written picture naming and writing to dictation of targeted words (Clausen et al, 2003). However, are these successful approaches to writing if no generalisation occurs? Also can such approaches be used on all clients with aphasia as these studies are case based with a limited number of participants? According to Beeson et al (2003) the limited treatment response demonstrated by 4 out of 8 participants suggests that not every individual with aphasia will be able to relearn written words using CART. Two types of factors appear to limit the likelihood of success; cognitive/linguistic impairments of the clients and failure to complete CART homework.

Both of these approaches are homework based programs. If participants were less motivated to complete the homework tasks then these approaches would not be suitable to improve dysgraphia in people with aphasia. People with severe aphasia who demonstrate limited cognitive abilities are also not suitable for these types of intervention. However, according to Papathanasiou (2012) it can be a highly functional and useful approach to improving communication as target words can be personally selected by the client such as names, favourite restaurants allowing for specific, meaningful exchange of information.
Beeson et al (2003) also corroborated with Papathanasiou and reported that CART is a useful approach to targeting written words which can be used in conversational communication.

There are also a number of intervention approaches which target therapy through the sub lexical writing route. These approaches aim to improve spelling by means of phoneme - grapheme correspondences where the client is able to say the word. Carlonagno et al (1994) report a substantial improvement in spelling in six cases when a non-lexical strategy was used. Pound (1996) also reports improvement in written spelling in a case where therapy focused on the use of phoneme-grapheme correspondences. Beeson et al, (2000) further developed this approach by introducing a spelling device that would enable participants to resolve spelling difficulties in a problem solving manner. Participants improved their spelling and the authors reported that generalisation occurred to untreated words. This is a significant study as it looks at the use of technology as a useful therapy tool in dysgraphia. However, the above studies have limited participants and therefore further research into this type of intervention is needed. Also there is a lack of rigour and validity evident in many of these studies which suggests’ that the therapy may not have had such an impact on writing as reported. Control measures were not clearly identifiable in any of the studies mentioned.

A common theme amongst the above intervention strategies is the implementation of a cueing hierarchy which serves to provide the client with a set of cues so as to improve their written communication. There is a strong consensus in the research that cueing strategies are effective in helping people with aphasia activate the word above threshold (Avila et al, 2001; Doesborgh et al, 2004; Howard et al, 1984 and Nichels et al, 2002.) Although much is known about the efficacy of different cueing techniques on naming it is not fully understood which cues are suitable for which individuals. Therefore, Nichels (2002) concluded that a combination of semantic and phonological cues may be most effective. There is also research available which concludes that orthographic cueing is also effective in writing therapy (Hicken et al, 2002; Basso et al, 2001).
Doesborgh (2004) implemented the cueing hierarchy at a different level by developing a computer based program that allowed participants to select any cues (Multi – cue). This study aimed to move traditional cueing therapies such as ACT, forward and implement computer technology as a more modern and conventional method of service delivery. In a similar way, this paper aims to provide an iPad application with an integrated cueing system to allow clients with aphasia improve their writing skills.

**App and Genetic Algorithm**

This paper aims to find out if an iPad app can improve writing skills in people with aphasia. The app incorporates a genetic algorithm which has only been previously researched in Katz et al (1989). They used complex branching algorithms to evaluate typing responses and provide patients with specific feedback on computerised confrontation naming and spelling task. Improvements were noted on spelling of target words. This small study is the only study available that incorporates algorithms into its computer system.

Speech and language therapists facilitate writing therapy by assessing the clients writing skills and determining what deficits/strengths the clients have. For example, is the client writing regular words but no irregular words? Can the client write non words to dictation or is this particularly difficult. What kind of spelling errors are they making? Based on these deficits the speech and language therapist carries out therapy to suit the particular needs of the client. The speech and language therapist provides a hierarchy of cues that aims to facilitate accurate written naming. These cues may be anagram sorting, semantic cues, initial letter cue and copying words (Beeson, 2002, Hillis 1989). The cues that are provided will depend on what area of deficit the client has such as irregular spelling errors.

The genetic algorithm attempts to imitate the speech and language therapist sessions by appointing genetic operators (crossover and mutation) to facilitate the cueing system based on the clients’ needs. The client uses the app several times at the initial stage and the GA’s fitness function assesses the clients’ writing needs, for example does the client require multiple cues or will the initial letter cue help the client spell the word correctly. Based on this assessment the GA will only facilitate the particular cue that the client is using successfully to spell the words.
The purpose of the GA is to progress speech and language rehabilitation for adults with aphasia using technology. As stated this app incorporates a genetic algorithm and the researchers hypothesise that this GA will facilitate the cueing hierarchy in accordance to the clients’ particular needs.

**Computer Technology and Dysgraphia**

Technology is quickly changing the landscape of the profession of speech-language pathology (Atticks, 2012). Clinicians are eager to introduce technology into the treatment session and their clients are requesting mobile devices and apps that they have heard of, typically by word-of-mouth. There are a number of limited studies available which has demonstrated that computers have been used with success for aphasia therapy (Aftonomous et al, 1999; Stachowiak et al, 1993). Of the studies published the authors aim to evaluate the advantages and disadvantages of computer technology and why we are moving towards technology as a means of intervention. According to Katz et al, (1997) computers can be powerful clinical tools to administer activities and increase the time patients are involved in treatment. Similarly, Wallesch (2004) reported that computers can be employed in different ways for aphasia rehabilitation more notably using it as an aid to communication.

Other advantages reported in the literature are; computer systems are dynamic and may be easily adapted to personal needs, a computer can produce speech output if needed, may also help the individual feel more confident in unfamiliar communicative contexts, it minimises therapists’ time and its more cost effective to all involved. (Van de sandt-koenderman, 2004; 2011; Ramsberger et al, 2007). The move towards technology in therapy sessions appears to be advantageous to both clients and therapists according to the literature.

However, computer systems are not without disadvantages also. Van de sandt-koenderman (2011) reported that many clinicians feared that computer therapy would affect the quality of aphasia therapy. By contrast, Wade et al, (2003) disagrees with this statement. Wade et al, (2003) describes the experiences and views of six people with aphasia and their partners on receiving therapy targeted at the level of impairment where therapy was delivered by computer and no therapy was carried out by the therapist.
All participants reported valuing the fact that they could use the computer as and when they wanted to and it increased their autonomy overall. However, it is important that these views be taken lightly as Wade et al, (2003) only reports the views of 6 people with aphasia. Also this study was based on interviews with clients and their partners rather than any statistical evidence.

Other disadvantages include; the client’s motivation to continue therapy at home, technology can and evidently will break down and also time needs to be spent training clients and their partners in the use of technology particularly those that have not accessed technology before (Atticks et al, 2012; Piper et al, 2011). Despite the concerns of some clinicians and the limited research available, computer technology and more recently iPads have changed the way speech and language therapists provide intervention for people with aphasia. Improvements in communication, social ability and overall self esteem have been noted in the literature because of the introduction of technology and clinicians need to explore this ever growing mode of service delivery (Alliano et al, 2012; Atticks, 2012)

**Introduction of iPad Therapy for Dysgraphia and Dysgraphia Apps**

Tablets, specifically the IPad, quickly are becoming a valuable therapy tool for clients with aphasia. According to Atticks (2012) speech therapists are beginning to introduce iPads into therapy in order to motivate their clients, gain their attention and empower them to be successful outside of the clinic. Other reasons for this type of intervention are that iPads are relatively inexpensive, they are mobile, easy to use, can be used alone or with support from others, switch accessible apps can be downloaded for patients with severe aphasia, they are interactive and engaging and they are also more socially appropriate than other devices (Sutton, 2012). However, clinicians need to consider such issues as their clients’ dexterity, vision, levels of support and also consider the iPad’s limitations for example battery life and size of the device. Clients who have dexterity issues can overcome them through the use of an iPad. How can this be achieved? The iPad provides rapid feedback and ease of navigation with the touchscreen options. The pinch-to-expand option on the iPad is also an important feature for people with aphasia as they can use just one hand to increase the size of the font and page they are viewing (Lappin, 2011).
These features on an iPad are what make it most valuable for people with dysgraphia. Limited research is available on the use of iPad and patients who have dysgraphia – Coburn et al, (2012). There are also limited apps available which seek to improve writing skills in people with aphasia. An app devised by Tactus Therapy called Writing TherAppy is available; however no literature has been published on its usefulness for clients with dysgraphia.

Conclusion

Computer technology has clear implications for speech and language therapists and how we provide intervention for clients with aphasia. iPads and other such tablets are now beginning to pave the way as successful therapy tools. It is clear from the literature that using computers and iPads have many benefits including increasing clients’ self-esteem, challenging social exclusion, improving clients’ overall communication skills and optimising clinician’s time and effort. However, it is important that clinicians fully assess each client and their suitability for an iPad as not all clients will be able to manage an iPad due to cognitive abilities and physical constraints.

Methodology

Research study design

The research study involved both quantitative and qualitative data therefore the design of the research project was a mixed methods approach. According to David et al (2004) the use of a mixed methods approach is an advantageous mode of conducting research as it allows for more in-depth exploration of the research topic and there is also greater reliability. The app aims to present target words which the participant will spell using a series of cues. The app is designed using a genetic algorithm that aims to provide a hierarchy of cues suitable to the client’s needs. These cues may be anagram sorting, semantic cues and initial letter cues. The client may require multiple cues or only need the initial letter cue to spell the word correctly. Based on the initial assessment the GA will only facilitate the particular cue that the client is using successfully to spell the words.
Participants

This research study was carried out both at the University of Limerick and in the participants’ homes. Two student speech and language therapists carried out the research project. Clinicians in the community were contacted and asked to select participants from their caseload based on the following criteria. Adult participants with aphasia and those that expressed an interest in improving their writing skills through technology were recruited for the research project.

Five participants were selected for the research. The researchers met each individual participant and clearly explained the research project. An information leaflet was provided to each client (appendix 1). Each participant was asked to sign a consent form (appendix 2) if they were happy to partake in the research. A brief case history was carried out by one researcher to gather information about each participant. A case history provided in-depth knowledge about the participants’ health, vision, hearing and computer skills that may have an impact on the outcomes of the research study. Early into the research project two participants withdrew from the research due to difficulties using the iPad and the app.

Several factors were involved in selecting the sample size. The researchers had a limited number of iPad’s available to carry out the therapy. Five iPADS were available so five participants were recruited. Other factors including limited time available to carry out the research, recruitment area was small and participants’ interest in taking part in the research affected the sampling size.

Materials

The researchers devised a baseline assessment which was carried out pre and post therapy. Five iPads with the dysgraphia app were also made available to the researchers. The researchers also devised an iPad user guide for the participants (appendix 3).
**Procedures**

Prior to the commencement of therapy, a language assessment and a dysgraphia assessment (appendix 4) were carried out on each participant. The CAT (Comprehensive Aphasia Test) was used to assess the participant’s receptive and expressive language abilities. From this assessment the researcher could also identify the type of aphasia the participants presented with. A visual scanning subtest from the Cognitive Linguistic Quick Test (CLQT) was also administered. This was to assess the participants’ visual scanning of a page. Difficulties in visual scanning a page from left to right and up/down may impact on the research for example if the participant was unable to scan the iPad screen. A simple dysgraphia assessment identified the pattern of dysgraphia in each participant. This assessment was implemented twice before therapy and once at the end of the 5 weeks of therapy.

The participant was asked to write/type/use an alphabet chart to spell or write 52 target words (appendix 4). The 52 words selected for the assessment were based on a number of variables including frequency, imageability, regularity and length of word. The assessment comprised of:

- 10 picture based words
- 22 words verbalised by the researcher
- 10 non words verbalised by the researcher
- 10 homophone words verbalised by the researcher.

Qualitative interviews were also implemented pre and post therapy (appendix 6). According to Turner (2010) interviews provide in-depth information pertaining to participants’ experiences and viewpoints of a particular topic. In this research study the interviews provided information on the participants’ experiences of using an iPad for therapy instead of face to face therapy with a therapist. Interviews were conducted using an unstructured approach (Turner, 2010). With this approach the researcher does not ask any specific types of questions, but rather relies on the interaction with the participants to guide the interview process (McNamara, 2008). Because of the lack of structure, there is a greater degree of flexibility and this can be more beneficial in gathering pertinent data that may have been missed in a structured interview.
Rigour and validity

Rigour and validity were considered during the assessment process. One researcher carried out the language assessment and the dysgraphia assessment whilst the other carried out the qualitative interviews. The researchers continuously reflected on their own values and beliefs so as to not interfere with the interpretation of responses.

Ethical Considerations

Ethical approval was granted from the local health service executive.

Statistical Analyses

Quantitative data was analysed using SPSS. Critical alpha probability values were calculated using McNemar tests. According to David et al (2004) the McNemar test evaluates the difference between two independent variables. The researchers found this test to be an appropriate tool to analyse the data as it investigated if any changes occurred between baseline 1 & 2 and also between baseline 1 & 3. The dysgraphia assessment results of each participant were carefully analysed. All 52 words on each baseline were scored. Each baseline had a total number of words correct and incorrect. The data was then entered into SPSS and a McNemar test was carried out. P values were derived from the McNemar tests and compared before and after therapy. P values need to be < 0.05 to be considered significant.

The qualitative interviews were coded according to Creswell’s phenomenological data analysis approach. According to Saldana (2012) a code in qualitative inquiry is most often a word or short phrase that symbolically assigns a summative, salient, essence-capturing, and/or evocative attribute for a portion of language-based or visual data. The qualitative interviews provided information for the researchers on the usability of the app for the participant and how they experienced the app as a form of therapy. Examples of the quotes from the participant are evident in the results section and in the appendix.
Results

The analysed data clearly indicated that performance on baseline assessments were similar for all participants. The results of the baseline assessments are presented for each client below.

Participant 1

P1 is a 50 year old male who presents with conduction aphasia as a result of a left CVA in 2010. The stroke resulted in right hemiparesis which has resolved. He uses his left hand predominately for writing. P1 scored above the cut off for all subtests except repetition of words (Table 1)

Comprehensive Aphasia Test (Table 1)

<table>
<thead>
<tr>
<th>Participant</th>
<th>Age (Yr, mths)</th>
<th>Time post CVA (yrs)</th>
<th>Gender</th>
<th>Comp of Spoken Words /30</th>
<th>Comp of Written Words /30</th>
<th>Repetition of Words /32</th>
<th>Naming Objects /48</th>
<th>Comp of Spoken Paragraphs /4</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>50;10</td>
<td>3</td>
<td>Male</td>
<td>29</td>
<td>29</td>
<td>28</td>
<td>43</td>
<td>2</td>
</tr>
</tbody>
</table>

Non aphasia cut off: 25 27 29 43 2

The dysgraphia assessment revealed a significant impairment in writing skills prior to therapy. P1 was given a diagnosis of phonological dysgraphia due to the errors he was making on the assessment. The following table (Table 2) outlines the P values obtained across the baseline assessments.

Dysgraphia Assessment (Table 2)

<table>
<thead>
<tr>
<th>Participant</th>
<th>Raw Scores Pre Therapy</th>
<th>Raw Scores Post Therapy</th>
<th>P Value (Baseline 1 vs Baseline 2)</th>
<th>P Value (Baseline 1 vs Baseline 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>Out of 52 words</td>
<td>Out of 52 words</td>
<td>P = 1.0000</td>
<td>P = 0.1250</td>
</tr>
</tbody>
</table>

Pre Therapy Assessment

Pre – therapy baselines revealed that P1 had difficulty writing long words, non-words and homophones. A P value comparing baseline 1 & 2 was calculated using SPSS and was found to be insignificant.
Post Therapy Assessment

P1’s response to treatment can be described as positive and he made some improvement in writing words, however there is no statistically significant change post intervention (see table 2). Table 3 shows examples of P1 moving closer to writing the target word. A pattern of change was observed on short words only.

Table 3

<table>
<thead>
<tr>
<th>Target Word</th>
<th>Baseline 1</th>
<th>Baseline 2</th>
<th>Baseline 3 (after therapy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tobacco</td>
<td>To</td>
<td>Tobb</td>
<td>Tobaco</td>
</tr>
<tr>
<td>Treason</td>
<td>Ma</td>
<td>Borm</td>
<td>Treson</td>
</tr>
<tr>
<td>Cone</td>
<td>0</td>
<td>Burme</td>
<td>Cone</td>
</tr>
</tbody>
</table>

Qualitative Interviews

P1’s pre therapy interview indicated that P1 had experience working with computers, but had not used an iPad before. He also reported that he would be comfortable using the iPad “I have never used one before (iPad) but I figure it out, and especially now everything is touch screen”. P1’s post qualitative interview indicated that P1 found the app to be useful and “very easy to use”. He reported that he was motivated to use the app “it was brilliant, you can do it yourself” (appendix 6, P1).

Participant 2

P2 is a 61 year old male who presents with Broca’s aphasia as a result of a left CVA in 2009. The stroke resulted in persistent right hemiparesis. He used his left hand predominately for tracing letters on the table with his finger. The Comprehensive Aphasia Test (CAT) scores revealed that P2’s receptive and expressive language skills were severely impaired as a result of the stroke.

Comprehensive Aphasia Test (Table 4)

<table>
<thead>
<tr>
<th>Participant</th>
<th>Age (Yr, mths)</th>
<th>Time post CVA (yrs)</th>
<th>Gender</th>
<th>Comp of Spoken Words /30</th>
<th>Comp of Written Words /30</th>
<th>Repetition of Words /32</th>
<th>Naming Objects /48</th>
<th>Comp of Spoken Paragraphs /4</th>
</tr>
</thead>
<tbody>
<tr>
<td>P02</td>
<td>61; 2</td>
<td>4</td>
<td>Male</td>
<td>26</td>
<td>22</td>
<td>24</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Non aphasia cut off:</td>
<td></td>
<td></td>
<td></td>
<td>25</td>
<td>27</td>
<td>29</td>
<td>43</td>
<td>2</td>
</tr>
</tbody>
</table>
The dysgraphia assessment revealed a significant impairment in writing skills prior to therapy. A diagnosis of peripheral dysgraphia was given due to the nature of the errors on the assessment. The following table (Table 5) outlines the P values obtained across the baseline assessments.

### Dysgraphia Assessment (Table 5)

<table>
<thead>
<tr>
<th>Participant</th>
<th>Raw Scores Pre Therapy Out of 52 words</th>
<th>Raw Scores Post Therapy Out of 52 words</th>
<th>P Value (Baseline 1 vs Baseline 2)</th>
<th>P Value (Baseline 1 vs Baseline 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P2</td>
<td>0</td>
<td>0</td>
<td>P = 1.0000</td>
<td>P = 1.0000</td>
</tr>
</tbody>
</table>

**Pre Therapy Assessment**

Pre – therapy baselines revealed that P2 had great difficulty writing long words, non-words, homophones and short words. A P value comparing baseline 1 & 2 was calculated using SPSS and was found to be insignificant.

**Post Therapy Assessment**

P2’s response to treatment can be described as optimistic. No statistical improvements were evident on the final baseline, however it can be stated that P2 is writing more letters in baseline 3 than in baseline 1 & 2 and is moving closer towards the target word. See the examples below in table 6

### Table 6

<table>
<thead>
<tr>
<th>Target Word</th>
<th>Baseline 1</th>
<th>Baseline 2</th>
<th>Baseline 3 (after therapy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coffee</td>
<td>0</td>
<td>0</td>
<td>Coff</td>
</tr>
<tr>
<td>Hospital</td>
<td>H</td>
<td>0</td>
<td>Hos</td>
</tr>
</tbody>
</table>

**Qualitative Interviews**

P2’s pre therapy interview indicated that P2 had experience of working with a computer but only used it on a few occasions. He reported that he found the app useful “How do you feel yourself about the use of the iPad app? Great great” “Did you find it difficult to get used to the app? no ok” He was motivated to use it “no, no, good”. He also reported that he found it difficult to remember the letters to write down “yeah, hard”. (Appendix 6, P2)
Participant 3

P3 is a 72 year old male who presents with Broca’s aphasia as a result of a left CVA in 2009. As a consequence of the stroke P3 has right hemiparesis and uses his left hand predominately. The Comprehensive Aphasia Test (CAT) scores revealed that P3’s expressive and receptive language skills were severely impaired (Table 7).

Comprehensive Aphasia Test (Table 7)

<table>
<thead>
<tr>
<th>Participant</th>
<th>Age (Yr, mths)</th>
<th>Time post CVA (yrs)</th>
<th>Gender</th>
<th>Comp of Spoken Words /30</th>
<th>Comp of Written Words /30</th>
<th>Repetition of Words /32</th>
<th>Naming Objects /48</th>
<th>Comp of Spoken Paragraphs /4</th>
</tr>
</thead>
<tbody>
<tr>
<td>P03</td>
<td>72; 1</td>
<td>4</td>
<td>Male</td>
<td>27</td>
<td>29</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Non aphasia cut off:</td>
<td></td>
<td></td>
<td>25</td>
<td>27</td>
<td>29</td>
<td>43</td>
<td>2</td>
</tr>
</tbody>
</table>

The dysgraphia assessment revealed a significant impairment in writing skills prior to therapy. A diagnosis of peripheral dysgraphia was given due to the nature of the errors on the assessment. The following table (Table 8) outlines the P values obtained across the baseline assessments.

Dysgraphia Assessment (Table 8)

<table>
<thead>
<tr>
<th>Participant</th>
<th>Raw Scores Pre Therapy Out of 52 words</th>
<th>Raw Scores Post Therapy Out of 52 words</th>
<th>P Value (Baseline 1 vs Baseline 2)</th>
<th>P Value (Baseline 1 vs Baseline 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P3</td>
<td>1</td>
<td>0</td>
<td>P = 1.0000</td>
<td>P = 1.0000</td>
</tr>
</tbody>
</table>

Pre Therapy Assessment

Pre - therapy baselines revealed that P3 had great difficulty writing long words, non-words, homophones and short words. A P value comparing baseline 1 & 2 was calculated using SPSS and was found to be insignificant.
Post Therapy Assessment

P3’s response to treatment can be described as optimistic. No statistical improvements were evident on the final baseline however there is one example in the data which shows is writing letters in the correct order. See example in Table 9.

Table 9

<table>
<thead>
<tr>
<th>Target Word</th>
<th>Baseline 1</th>
<th>Baseline 2</th>
<th>Baseline 3 (after therapy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loan</td>
<td>Lirm</td>
<td>Nay</td>
<td>Lond</td>
</tr>
</tbody>
</table>

Qualitative Interviews

P3 reported having no prior computer experience before commencing the research. He reported that he was happy to use the iPad in the pre therapy interview. He reported that the app was easy to use “P3 nodded yes” when asked this question and the pictures were good “P3 nodded yes”. When asked if there was anything he didn’t like about the app P3 said “no”. He along with his carer reported that the letters on the anagram would disappear sometimes and this made it difficult to complete the word. (Appendix 6, P3)

Participant 4

P4 is a 60 year old female who suffered a stroke in October 2012. She has right hemiparesis as a result of the CVA and presents with global aphasia. The Comprehensive Aphasia Test (CAT) scores revealed that P4’s expressive and receptive language skills were severely impaired (Table 10).

Table 10

<table>
<thead>
<tr>
<th>Participant</th>
<th>Age (Yr, mths)</th>
<th>Time post CVA (yrs)</th>
<th>Gender</th>
<th>Comp of Spoken Words/30</th>
<th>Comp of Written Words/30</th>
<th>Repetition of Words/32</th>
<th>Naming Objects/48</th>
<th>Comp of Spoken Paragraphs/4</th>
</tr>
</thead>
<tbody>
<tr>
<td>P04</td>
<td>60</td>
<td>4 mths</td>
<td>Female</td>
<td>14</td>
<td>11</td>
<td>26</td>
<td>16</td>
<td>0</td>
</tr>
<tr>
<td><strong>Non aphasia cut off:</strong></td>
<td><strong>25</strong></td>
<td><strong>27</strong></td>
<td><strong>29</strong></td>
<td><strong>43</strong></td>
<td><strong>2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The results of the CAT assessment clearly show impairment in both expressive and receptive language skills. A dysgraphia assessment was administered but P4 was unable to respond. Informal assessment was administered. A diagnosis of severe dysgraphia was given with poor grapheme and phonological awareness skills. P4 was trained in how to use the iPad however a week later, P4 withdrew from the research. No other baselines were taken and only a pre qualitative interview was conducted (Appendix 6, P4).

**Participant 5**

P5 is a 65 year old male who presents with transcortical motor aphasia as a result of a CVA in 2008. Transcortical motor aphasia is characterised by non-fluent speech, good comprehension of single words, good repetition and poor naming. The scores of the Comprehensive Aphasia Test (CAT) reflect the above characteristics in Table 11.

**Comprehensive Aphasia Test (Table 11)**

<table>
<thead>
<tr>
<th>Participant</th>
<th>Age (Yr, mths)</th>
<th>Time post CVA (yrs)</th>
<th>Gender</th>
<th>Comp of Spoken Words /30</th>
<th>Comp of Written Words /30</th>
<th>Repetition of Words /32</th>
<th>Naming Objects /48</th>
<th>Comp of Spoken Paragraphs /4</th>
</tr>
</thead>
<tbody>
<tr>
<td>P05</td>
<td>65</td>
<td>5</td>
<td>Male</td>
<td>27</td>
<td>26</td>
<td>32</td>
<td>38</td>
<td>1</td>
</tr>
<tr>
<td><strong>Non aphasia cut off:</strong></td>
<td></td>
<td></td>
<td></td>
<td>25</td>
<td>27</td>
<td>29</td>
<td>43</td>
<td>2</td>
</tr>
</tbody>
</table>

The dysgraphia assessment revealed a significant impairment in writing skills prior to therapy. A diagnosis of peripheral dysgraphia was given due to the nature of the errors on the assessment. The following table (Table 12) outlines the P values obtained across the baseline assessments.

**Dysgraphia Assessment (Table 12)**

<table>
<thead>
<tr>
<th>Participant</th>
<th>Raw Scores Pre Therapy Out of 52 words</th>
<th>Raw Scores Post Therapy Out of 52 words</th>
<th>P Value (Baseline 1 vs Baseline 2)</th>
<th>P Value (Baseline 1 vs Baseline 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P5</td>
<td>0</td>
<td>0</td>
<td>P = 1.0000</td>
<td>N/A no final baseline taken</td>
</tr>
</tbody>
</table>
Pre Therapy Assessment
Pre – therapy baselines revealed that P5 had great difficulty writing long words, non-words, homophones and short words. A P value comparing baseline 1 & 2 was calculated using SPSS and was found to be insignificant.

Response to Treatment
P5’s response to treatment cannot be completely analysed as he withdrew from the research and a final baseline was not obtained.

Qualitative Interviews
P5 reported having prior computer experience before commencing the research and he also owned an iPad. He reported that he was happy to use the iPad in the pre therapy interview. He reported that the app was difficult to use. He reported that the anagram was useful “yes yes, that was ok” but he had difficulty remembering the letters and had to go back to the anagram again and again. He reported this was frustrating “no no it was hard”. He reported that he liked the pictures on the app “likes the pictures, they were fine”.

Discussion
The main objectives of the research project were to investigate if the app improves writing skills of adults with aphasia at single word level and to consider the feasibility of using this iPad app to deliver therapy. The research was exploratory in nature and as such raised issues that had not been considered prior to the research. The findings and the implications for future clinical practice will be discussed in turn under the following headings: analysis of results, does this particular app facilitate writing skills, the app and its ease of use, usability of an iPad with adults who have aphasia and the app as an appropriate intervention tool. The limitations of the research will also be evaluated alongside any notable implications for future research.
Analysis of Results

From the data presented it is evident that the participants did not significantly improve their writing skills. However, after further examining the data, it can be stated that one participant with a phonological dysgraphia increased his overall raw score but there was no statistical difference. Therefore it could be argued that this app improved written word output for one participant. Albeit, his final baseline assessment only showed that some letters of the target word were achieved, nevertheless it is important aspect to highlight. The remaining participants diagnosed with severe dysgraphia impairments showed no improvement on their final baselines however it is important to note that two participants did not complete final baseline measures as they withdrew from the research. The findings suggest that the app is not suitable for those with severe dysgraphia impairments but further research will need to be carried out to confirm this. In light of this information, the researchers pose the following question; does this app facilitate spelling and writing skills in adults with aphasia?

Does this app facilitate spelling and writing skills?

The statistical data presented does not indicate that this app improves writing in adults with aphasia. However, the data presented is from five participants two of which, withdrew. The sample size is too small to make such a strong statement. There are several other possibilities as to why the statistical data yielded no improvements in writing. Memory difficulties, period of intervention and difficulties with the app may have been casual factors that the researchers had not anticipated prior to the research and consequently impacted on treatment outcomes.

Memory Difficulties

The researchers did not take into account the impact of cognitive skills in using the app. With reference to the literature, intervention approaches for writing should take into account the person’s level of impairment and cognitive skills (Rapp, 2005). Intervention approaches for writing target either the lexical writing route or the sub lexical route and this is identified prior to the participant engaging in the therapy (Beeson et al, 2002, Aliminoa et al, 1993, Carlomago et al, 1994, Beeson et al, 2000). According to Patton (2008) all writing routes exit via the grapheme buffer.
The extent to which this buffer is impaired in each participant will inadvertently affect treatment outcomes. This app did not consider the participants’ working memory or how this would impact on written word output. All participants reported in their post qualitative interviews that remembering the words after completion of anagram was difficult and therefore were unable to type it out on the keypad.

As previously noted two participants withdrew from the research. It is not fully known as to the reasons why they withdrew, however participant 5 made reference to difficulties remembering the words in his post qualitative interview. A similar finding was also reported by participant 2 in his interview. According to Van de sandt-koenderman (2004) severe aphasia often occurs in combination with other neuropsychological deficits such as memory problems, visual-spatial problems and/or a disturbance in the executive control functions. If these factors do occur it may lead to difficulties in using technology. Light and Lindsay (1991) have pointed out that the role of cognition in the use of high tech and low tech devices has been largely ignored and further research is necessary in this field.

**Period of Intervention**

Another possible reason for non-significant treatment outcomes is the period of intervention given. Participants had the use of the iPad for 5 weeks. According to Mortley et al, (2002) a period of intensive intervention is essential when using computers to facilitate therapy. A period of 5 weeks may be considered too short particularly when compared to conventional therapy. According to RCSLT guidelines for Commissioning and Planning services for SLCN “The more intense the treatment, the greater the change and therapy is best provided on a 2-hour plus per week schedule”. Therefore it is important to consider the relatively short intervention period and how this may have impacted on treatment outcomes. Treatment outcomes may have changed if participants had the iPad for a longer period of time.
The App – ease of use

A pattern that emerged in some of the participants post qualitative interviews is that the app was functional and easy to use. Three participants reported that the app had good pictures and that the anagram was particularly helpful. One participant reported that he found the app challenging to use at the beginning but as he continued to use it, it became easier to manage it. However, not all participants found the app easy to use. Two participants reported that they found the app difficult to use. There is a lack of information available as to what aspect of the app they found problematic. One participant reported that the letters in the anagram would at times disappear from the screen if not positioned correctly. He reported being frustrated with this as he could not complete the anagram and would ultimately have to move to the next word. The findings suggest that this app is well designed and easy to use. It is clear, colourful and integrates the pictures very well. However, there are challenges with the app that will need to be addressed for further research. For example, is the app suitable for all adults with aphasia? One needs to consider if the app is appropriate for those adults with severe aphasia and if not, can the app be adapted to suit their needs?

Usability of iPad and App

Adults with aphasia particularly severe aphasia may experience hemiparesis in one side of their body as a result of their stroke. It is therefore important to consider this when carrying out therapy using an iPad and app. One participant found the iPad and app challenging to use as a result of right hemiparesis. It was difficult to hold the iPad and work with the app at the same time. Despite the fact that the app was well designed, issues arose in using the iPad and app for adults with hemiparesis. Therefore one can argue on the accessibility of this app for all adults with aphasia. Can the app be adapted to suit all adults with aphasia? Moffatt et al (2004) states clearly that this is a very challenging aspect “designing technology so that is has a proper fit with the individuals that are expected to use it is the fundamental challenge in research”. Clinicians working in this field need to be aware of accessible technology. If the app is not adaptable to suit all adults with aphasia, then is it a suitable mode of service delivery and how effective is it as a therapy tool?
The iPad app as an Intervention Tool

Motivation

A positive outcome reported by 3 participants is that the app serves as a very motivating tool to implement therapy. This concurs with earlier research as Katz et al (1997) also reported similar findings. Likewise Van de sandt-koenderman (2004) also reported that a client’s motivation may increase when a computer system is utilized in therapy. The fact that the app was motivating for the participants may have been linked to the design of the app and how it was presented. However, there is no evidence from the interviews that supports this argument. In order to fully ascertain how motivating this app is, further research will need to be carried out.

Independence

A common theme amongst the qualitative interviews is the level of independency experienced by the participant in using the app. Therapy was self-directed as participants chose when and how much time they invested in using the app. This is concurrent with the literature as Petheram (2004) reports that a major advantage of using computer programs in therapy is that they allow the client to work independently. A similar finding was reported in Mortley et al (2004).

This was reflected in post qualitative interviews. 3 out of the 5 participants reported using the app by themselves while one participant needed some assistance. The data clearly shows that the iPad is a valuable tool for increasing one’s level of independency. This is in line with current research as Van de sandt-koenderman (2004) states that “a device may be used as a powerful tool to reach communicative independency”. It is important to note however, that data presented is representative of five participants so further research with a larger sample size will need to be carried out to fully determine if the iPad increases independency in adults with aphasia. Nevertheless, these findings are favourable for clinicians who may be considering using an iPad to deliver intervention with clients who have aphasia.
Service Delivery Tool

As reported in the literature, computer programs that serve to act as mode of service delivery have been used with success for aphasia therapy (Aftonomous et al, 1999, Stachowiak et al, 1993). The researchers aimed to examine this app as an effective therapy tool for people with aphasia. The participants’ post qualitative interviews were investigated further to seek out any evidence of this. According to the data, there were mixed views on the use of the iPad as a mode of service delivery for speech and language therapy. Two participants stated they would like to use the app again but would also like to attend one to one therapy session. One participant reported he would prefer to use the iPad rather than attend speech and language therapy.

These findings have several implications for both future research and clinical intervention. While the findings suggest that the app has increased the participants’ level of independency, there is also a concern as to the quality of the therapy that is provided. For example, can an iPad deliver intensive treatment to the same degree as one to one speech sessions? According to Stachowiak et al (1993) intensive computer therapy has a positive effect on language and other modes of communication.

However, one can argue about how much is intensive therapy and how it will be monitored if the clinician is not delivering the therapy. Mortley et al (2004) also raised this concern in their study. They reported that the computer is “simply an alternative mode of delivering therapy and as with any mode of therapy delivery independent computer therapy practice continues to need close monitoring by the therapist in order to be maximally effective”. Therefore it can be inferred that using an iPad as a mode for delivering therapy may only be effective if the clinician is involved to monitor intensity of treatment and quality of treatment. However further research into computer therapy as a mode of service delivery will need to be carried out to establish this statement.
App and Genetic Algorithm

The data collated does not provide enough evidence to suggest that the algorithm worked in providing the correct cues required by the participant. Further research will determine this aspect of the app.

Limitations of this research study

The limitations of this research study are acknowledged by the researchers and are described in this section. It is hypothesised that they will inform other researchers in the field who may undertake future research projects. First, it is important to bear in mind that the sample in this study was small. Although the research findings are important, the researchers acknowledge that due to the small number of participants who took part in the research, the findings are not representative of this population. Further research with a larger number of adults with aphasia is required.

Also data analysis was carried out by the interviewer and as such would be influenced by her beliefs and assumptions regarding the therapy process. During data analysis it became clear that the interviews could have been structured differently to obtain extra information on the app and how it was experienced by the participant. The participants have severe expressive language skills as a result of their CVA which affected their responses in the interviews. The interviews were more researcher led than participant led which resulted in the researchers only asking questions they felt were important. Visual aids or a visual scale to obtain more information from the participant may be more useful. This would also mean a more inclusive approach to the interview with the participant engaging in conversation rather than the researcher asking several questions. Furthermore the researchers recognise that validity and reliability did not play an important role in the research. This is due to the fact that the research was a feasibility study with a small number of participants. There were also no control measures.
Finally the limited treatment response demonstrated by 2 out of 5 participants suggests that this app may not work for all individuals with a writing impairment particularly those who have severe cognitive deficits. But this app has the potential to expand and develop through other research projects. A research study on memory and dysgraphia using this app would be very beneficial to clinicians working in the field. It would highlight the role memory plays in treating dysgraphia in adults with aphasia. Furthermore, research that determines if computer technology and in particular this app serves as an effective therapy tool in treating dysgraphia would be beneficial to clinicians and those with a diagnosis of aphasia.

Conclusion

This app sought to improve the writing skills of adults with aphasia. Although no statistical improvements were yielded as a result of carrying out the research, it proved to be a motivational tool for therapy. The well designed app was easy to use and delivered therapy to the participants as and when they chose to engage in it. Issues such as impaired memory and the suitability of the app for all adults with aphasia will need to be considered in future research projects.
Acknowledgements

The author wishes to express her gratitude to Ms Áine Kearns for providing valuable feedback throughout the research project and for reviewing this manuscript. The author would also like to thank Mr Conor Higgins for providing information on the algorithm and the app software. The author would like to acknowledge the participants who took part in the research and thank them for their time. Finally, the author would like to extend sincere gratitude to the second researcher in this project, Ms Cáit O Halloran for her valuable time and input into the project.
References


Atticks, A, H (2012). ‘Therapy Session 2.0 From Static to Dynamic with the iPad’ *Perspectives on Gerontology*, 17 (3) 84-93 Available at http://journals.asha.org/perspectives/terms.dtl [Accessed on 29 Nov 2012]


Title of study:
Speech and Language Therapy and Technology
(The use of IPAD and App to implement writing therapy in clients with aphasia)

Researchers:
Càit and Claire are the researchers. They are Student Speech and Language Therapists in University of Limerick.
Áine Kearns is the supervisor.

This information booklet tells you about the research and how you can help

Thank you for reading this!
Aim of Research:

- To improve writing skills by using an IPAD application

Participants:

- Adults who have aphasia and who are interested in improving their writing skills using an IPAD.

Benefits:

- The IPad is a user-friendly device.
- IPad Applications can be developed and changed
- These Applications can be used in speech and language therapy to improve writing skills
The IPAD can be used **anywhere** and at **anytime!!**

Who are the researchers?

- Aine Kearns (Speech and Language Therapist)
- Claire Mullally (UL Student)
- Cait O’Halloran (UL Student)

What will happen?

- You will attend the **Speech and Language Therapy Clinic in University of Limerick**

- **Information** will be given about the **IPAD application**

- The **UL students** will help you learn how to use the **IPAD** and provide support
The IPAD Application will be used for therapy activities instead of paper.

You can practice using the IPAD application at home for 5 weeks.

You can contact the UL clinic at any time if you need too.

At the end of the therapy programme you will be asked questions about using the IPAD.
What will the Speech and Language therapist do with the Information?

- **UL Students** and Speech and Language Therapist will write up the research as part of their course.

Confidentiality and Privacy

- All **information** is kept **private** and **safe**
- Your **name** will not be used

Taking Part in the Programme

- You are **free** to decide if you want to take part
- If you **agree** you need to sign a **consent form**
- If you **do not agree** you can still attend speech and language therapy

- You are **free** to **stop** at any time
- You **do not** have to give a **reason** for stopping

Further Information

- You can contact:
  - Áine Kearns
  - Phone: 061 233794/086 8090415
Appendix 2

Consent Form
SPEECH AND LANGUAGE THERAPY CLINIC  
University of Limerick  

Consent form for Research  

I _________________________ of ____________________ hereby, consent to participate in the Speech and Language Therapy and Technology Research Project. The purpose of the programme was explained to me by:

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Smiley Face]</td>
<td>![X]</td>
</tr>
<tr>
<td>![Smiley Face]</td>
<td>![X]</td>
</tr>
<tr>
<td>![Smiley Face]</td>
<td>![X]</td>
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<td>![Smiley Face]</td>
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</tr>
<tr>
<td>![Smiley Face]</td>
<td>![X]</td>
</tr>
<tr>
<td>![Smiley Face]</td>
<td>![X]</td>
</tr>
<tr>
<td>![Smiley Face]</td>
<td>![X]</td>
</tr>
</tbody>
</table>

I read the information leaflet

I had an opportunity to ask questions

I was satisfied with the answers to my questions

I understand the reason for the research study

I understand what is involved

I understand I can withdraw from the study at anytime

I understand that information is kept safe and private
Appendix 3

iPad User Guide
IPad User Guide

The Therapy

After a stroke many people have difficulty with communication. A problem that some people experience is **writing and spelling difficulties**

Aim of this therapy

To **improve writing skills** by using an IPAD application

An **application** to help you **improve your writing skills** is on the IPAD

You can tap this icon on the screen to use the app
This is what the **app will look like** when you **open** it.

On the screen you will see a **picture** of an item.

This **picture** will remind you of what the **item is called**.
Spell the word

When you think of the word, you will type it in

When you tap on the app, a keyboard will pop up

When you tap on the letters they will appear at the top
A green line underneath the letter means it’s a right letter for that word.

A red line underneath the letter means that it’s a wrong letter for the word.
When you get all green lines, you can move into the next picture.

You can do this by tapping this icon.

If you want to stop at any stage, you can tap this icon.
I can’t think of the word

If you cannot think of the name of the picture, you can tap this icon

This icon will help you remember the word by giving you a clue

For example:

This may help you to remember the word “Dog”
It may also give you the first letter of the word if you still cannot think of the name of the word.

The first letter is “d”

This will help you to remember the word “Dog”

You will also be able to hear the clues and can tap this icon to hear the clue again.
The **Help** button will also give you **another clue**

**This clue** will give you all the **letters of the word, jumbled up**

You must use your **finger** to **drag the letters** so that they are **in the right order**

You will **know** they are in the **right order** as a **green box with a tick** will appear **underneath each letter**

If a **red box appears with an x in it**, it means you have the **letter in the wrong place**
**Keyboard**

If the keyboard appears and you want to make it disappear then press this button:

![Keyboard Button Image]

---

**Exiting the App**

To exit the App click the ‘X’ at the top of the screen.

![Exit Button Image]
Diary

At the end of your session a screen will appear like this:

This is a diary page

You can fill it in at the end of each session

It tells us how long you were on the iPad

It also tells us how you were feeling throughout the session
Buttons
A few simple buttons make it easy to turn iPad on and off.

Sleep/Wake Button
You can lock iPad by putting it to sleep when you’re not using it. When you lock iPad, nothing happens if you touch the screen.

**Lock iPad:** Press the Sleep/Wake button.

** Unlock iPad:** Press the Home button or the Sleep/Wake button, then drag the slider.

**Turn iPad off:** Press and hold the Sleep/Wake button for a few seconds until the red slider appears on screen, then drag the slider.
**Turn iPad on:** Press and hold the Sleep/Wake button until the Apple logo appears.

**Home Button**

**To Return to the Home screen:** Press the Home button
Appendix 4

Dysgraphia Assessment
Dysgraphia Assessment

Contents:

Part A- (Semantics & access to OOL):

<table>
<thead>
<tr>
<th>Subtest name</th>
<th>Tick if completed:</th>
<th>Result:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Imageability, Frequency, regularity spelling <em>d &amp; p</em></td>
<td>B1 B2 END</td>
<td></td>
</tr>
<tr>
<td>2 Non word spelling *d</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Object naming *p</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*d= Dictated, *p= Picture based/ object based.

Note: Compare to Auditory picture naming (CAT).

Part B- (Access to OOL* & Semantics):

<table>
<thead>
<tr>
<th>Subtest name</th>
<th>Tick if completed:</th>
<th>Result:</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 Grammatical class spelling *d</td>
<td>B1 B2 END</td>
<td></td>
</tr>
<tr>
<td>5 Lexical Morphology spelling *d</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Reading aloud- word level</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Orthographic Output Lexicon. **Note**: Compare part B to written word comprehension.

Part C-(OOL):

<table>
<thead>
<tr>
<th>Subtest name</th>
<th>Tick if completed:</th>
<th>Result:</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 Regular &amp; irregular word spelling *d</td>
<td>B1 B2 END</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 Homophone spelling *d</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Part D- (Graphemic Output Buffer):

<table>
<thead>
<tr>
<th>Subtest name</th>
<th>Tick if completed:</th>
<th>Result:</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 Copying written words &amp; non words</td>
<td>B1 B2 END</td>
<td></td>
</tr>
<tr>
<td>11 Mono-polysyllabic word spelling *d</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Part E-(Allographic Realisation):**

<table>
<thead>
<tr>
<th>Subtest name:</th>
<th>Tick if completed:</th>
<th>Result:</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 Oral Spelling Task</td>
<td>B1     B2     END</td>
<td></td>
</tr>
</tbody>
</table>

**Part F-(Graphemic Motor Planning):**

<table>
<thead>
<tr>
<th>Subtest name:</th>
<th>Tick if completed:</th>
<th>Result:</th>
</tr>
</thead>
<tbody>
<tr>
<td>13 Spontaneous writing description</td>
<td>B1     B2     END</td>
<td></td>
</tr>
</tbody>
</table>

**Part G-(Miscellaneous):**

<table>
<thead>
<tr>
<th>Subtest name:</th>
<th>Tick if completed:</th>
<th>Result:</th>
</tr>
</thead>
<tbody>
<tr>
<td>14 Typing iPad v's handwriting *d</td>
<td>B1     B2     END</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**

- Subtests *highlighted in red writing* must be carried out.
- Discontinue subtest after 5 consecutive zero scores.
- B1= Baseline 1, B2= Baseline 2, End= Final subtest administration post intervention testing.

**Participant Name:**

**Student Name:**

**Dates of test administration:**

<table>
<thead>
<tr>
<th>Baseline 1:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline 2:</td>
<td></td>
</tr>
<tr>
<td>End:</td>
<td></td>
</tr>
</tbody>
</table>
## Frequency, Imageability, Regularity & Length Word Spelling

<table>
<thead>
<tr>
<th>Reg &amp; Short</th>
<th>LI LF</th>
<th>HI LF</th>
<th>LF</th>
<th>HF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ear *p</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>arm</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>edit</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vast</td>
<td></td>
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**Total correct:**

**Notes:**

____________________________________________________________________
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## 3 Homophone Spelling

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Appendix 6

Transcripts of Interviews
Participant 1

Pre and Post Qualitative Interview
R1: So basically, (P1) this is to find out what you thought of the app.
P1: Ok
R1: Is it functional? – just to get an idea for us in terms of is it user-friendly?
P1: It’s very easy to use.
R1: Did you find when it changed did it help?
P1: Much better, you didn’t have go through it. Most of stuff I could do but couldn’t do the letters.
R1: Were you motivated by it?
P1: Last week possibly less but I was busy.
R1: The days you were busier you couldn’t do it?
P1: 20 mins/30 mins.
R1: You had more flexibility the fact that you could do it whenever! Did you find that was a good thing or a bad thing?
P1: it was brilliant you can do it yourself.
R1: Do you find it would be good in the future; people will be able to do it in their own time as opposed to attending session 3 times a week.
P1: Yeh I can tip away at it.
R1: Anything that frustrates you about the app that shouldn’t be there at all?
P1: No when you changed it, it showed the letters more easily – the rest of it is simple.
R1: They will be testing it again in the future. Do you find you have improved?
P1: I don’t think so, no probably a small bit.
R1: Did you write anything lately?
P1: I just don’t do it, I don’t write stuff in work.
R1: Would you go back to speech and language for writing - do you see it as important now
P1: Yeh
R1: Would you get back into XXXX?
P1: Yeh, I can talk but I can’t write. But if you keep going you get another bit and another bit.
R1: Keep up the skills. You were completely independent using the app, you didn’t need any help?

P1: No

R1: On a scale of 1-10, 10 being annoyed and 1 being good – how would you rate the app, let’s just say before it was updated?

P1: 5 at that stage as I had to keep going through the help. But then it changed, its back to a 3 (good).

R1: And what’s going through your head, would you be trying to think of the words?

P1: Don’t know what it is from the pictures, have to figure it out. I wasn’t too bad.

R1: Some of the pictures weren’t great.

P1: Exactly yeh

R1: Something in background makes it more difficult?

P1: Yeh yeh, thinks it’s grand but....

R1: Yeh, Yeh so changing it made a big difference?

P1: Yeh, Yeh

R1: Did you find particular letters hard?

P1: /r/, probably /n/ and /m/

R1: Did you still feel at the end they were catching you out?

P1: Yeh /k/ also.

R1: And when app was updated did you still go back to the letters (anagram)?

P1: Yeh I would get 3 letters but I would have to go back as I can’t remember the rest.

R1: So you would have to go back in?

P1: A few times but gets your brain working.

R1: Are you a lot faster getting the words?

P1: Yeh.

R1: Did you ever find saying a word aloud, breaking it down the word into sounds helped?

P1: I am poor enough anyway, you know, like kettle, it’s there, I can’t break it down. One of these days I will get there.

R1: Did you find you were getting faster at typing?

P1: No, maybe a bit.
R1: Most people find it ok to use it. Did you find some words easier than others e.g. shorter words as opposed to longer words?

P1: Yeh a bit.

R1: If /r/ was at the start you were fine but if it’s in the middle or at the end, it was hard

P1: Yeh.

R1: Would you recommend it?

P1: Yeh I would, it’s getting better yeh.

R1: Thanks.
Participant 2

Pre and Post Qualitative Interview
Pre Qualitative interview:

Researcher 1= Cait
Researcher 2= Claire

R1: Did you enjoy nursing?
P2: Yeah yeah, oh jes yeah good.
P2: 37 (traced on table with finger).
R1: Yeah you had a nice career.
P2: Yeah Yeah

R1: Do you have glasses just for reading?
P2: Yeah good yeah yeah
R1: and your hearing is good is it?
P2: Yeah oh yeah.
R1: and have you had any other major problems?
P2: No good no
Wife: He had the sarchoma.
R1: Yeah and have you had much Speech and Language therapy?
P2: Yeah good
Wife: Oh he has he goes to photography and gardening groups.
R1: So do you get a block every year?
Wife: More or less every year
P2: Very good haha
Wife: you missed a few weeks but they are very good we can’t complain about them really
P2: Yeah yeah

R1: Are you having any physiotherapy now?
P2: No
Wife: we don’t need it we go out for a walk, walks every day

P2: Jesus Christ almighty

R1: What are your interests P2?

P2: Dog, dogs
Wife: Greyhounds
R1: Do you have greyhounds?

P2: No no no
Wife: He follows them
R1: Very good. Would you put on a few bets aswell?

P2: Ah yeah

R1: What’s your daily routine like would you be up early in the morning?

P2: No, am 8 o clock
R1: would you usually be at home would you go out?

P2: Yeah yeah
R1: You go out?

P2: Yeah yeah

R1: How often would you use the ipad? People could use it in the morning time or the evening time depending on what suits them.

P2: Yeah, morning and evening, yeah.
R1: Maby alternate it?

P2: Yeah yeah.
R1: am and pm you can decide yourself anyway
R1: Are you right or left handed?

P2: Oh Jaz good (laughs)- gestures to right hand, obvious weakness in limb.
R1: before hand you were right handed?
P2: yeah

R1: The power is gone

P2: Yeah yeah

R1: Do you write with your left hand now?

P2: Oh jez, right hand good and left hand (gestures writing).

R1: So you use your right hand during the day and your left hand to write?

P2: Yeah good yeah

R1: Do you have any weakness in that hand (right hand)?

P2: Oh yeah

R1: Did you ever use a computer before?

P2: Yeah oh yeah, the...

R1: Was it easier to use before?

P2: oh yeah yeah

R1: Is it finding the letters?

P2: No good

R1: Do you use the internet?

P2: am good (traced IGB on the table)

R1: the I G B, is that for news?

P2: no dogs, dogs!

R1: oh the dogs! Ah that’s the Irish greyhound Board

P2: yeah yeah (laughs)

R1: It’s great to be able to get on and have the internet

P2: Oh yeah yeah!! (enthusiastically)

R1: How often would you use the computer a week?

P2: Well am

R1: would you go on 3 times a week?
P2: yeah yeah

R1: do you find your concentration goes?

P2: NO no no good, one two, gone.

R1: so do you find you write out one or two letters and it’s gone?

P2: Yeah

R1: Do you ever get somebody to type for you?

P2: Yeah oh yeah yeah

R1: You do everything for yourself?

P2: Oh yeah

R1: would you put on your own shoes?

P2: Oh jaysus Christ yeah yeah yeah

R1: great

P2: yeah good the car good

R1: great freedom your able to drive yourself to the dogs

P2: oh jes yeah yeah yeah

R1: How do you feel about using something like this?

P2: oh jes yeah yeah (nods approvingly)

R1: Do you feel happy?

P2: Oh jes yeah yeah

R1: It would be good to get familiar with using something like this

P2: Oh yeah yeah

R1: When you do start to type would you always know the letters that you want?

P2: Yeah but

R1: you get the first the second and maby the third and it’s gone

P2: Yeah yeah yeah

R1: would you remember what the word was you were spelling?

P2: No no
R1: It all goes?
P2: yeah yeah
R1: but would you know the word initially?
P2: Yeah yeah
R1: were you at a good level of writing and reading before you had the stroke?
P2: Ah yeah yeah yeah

Post Qualitative Interview:

R1: How do you feel yourself about the use of the iPad app?
P2: Great great.
R1: You can see there now, the difference in how much you have written.
P2: Great great
R1: How do you feel about doing this again?
P2: great good yeah
R1: Do you feel that it worked, that it benefited you?
P2: Oh God yeah
R1: We can see you have improved in your spelling from the test. Do you feel you have come on a bit?
P2: Oh yeah ahhh yeah, oh jes god almighty good good.
R1: Would it make you think about doing more writing in the future?
P2: Oh yeah but am
R1: It’s still kind of difficult
P2: Yeah
R1: Is it thinking of the words P2?
P2: Oh jes no b ut..
R1: Is it you know the word in your head and you are trying to think of the letters?
P2: Yeah yeah
R1: Do you find when you think of a letter another letter keeps coming up (gave example of the letter q being produced for p.

P2: Yeah oh yeah yeah yeah

R1: with using the app how did you find using it?

P2: Yeah good good (in general) but gone (gestures to head). One two three four five.

R1: longer words then you couldn’t remember all the letters

P2: Yeah

R1: When we updated the app

P2: No one two three four five six seven

R1: so when you go beyond 5 letters is it more difficult?

P2: Yeah

R1: and did you still find you had to go to the help again?

P2: Yes yeah

R1: three times maby?

P2: no twice

R1: so you had to go to the cues every time aswell?

P2: Yeah

R1: Did you find it difficult to get used to the app?

P2: Oh no ok oh no

R1: you were fine with it?

P2: oh yeah

R1: and putting your finger down and pressing on the ipad? You were ok with that?

P2: Oh yeah yeah

R1: With this then you were saying it was hard to remember the words to type them. Did you find it got harder as you were going along to remember the words or did it get easier.

P2: first, gone

R1: yeah you would get the first letter

P2: Yeah
R1: When we changed it did it make it easier?

P2: Oh yeah yeah

R1: How did you find using the internet? Did you find you were doing more typing on the internet?

P2: Ah yeah good

R1: did you do more?

P2: oh god almighty good yeah

R1: Did you look up bits for the photography class?

P2: am no

R1: Email?

P2: No

P2: (PLACE)

R1: oh you were looking up about (PLACE)

P2: oh Christ yeah yeah yeah

R1: Did you actually type in the word?

P2: oh god yeah yeah yeah

R1: would you have been able to type out (PLACE) before?

P2: ah good yeah

R1: do you think P2 by working with the iPad, did it make you want to go on the computer more?

P2: Yes

R1: Did you feel more confident about your typing on the computer?

P2: Oh yeah yeah yeah

R1: Did your spelling improve?

P2: no but

R1: looking for the letters on the keyboard?

P2: Yes

R1: because I know that can be hard.

R1: Would you ever have gotten frustrated when going on the computer before the ipad?
P2: Oh jesus Christ almighty yeah oh god almighty

R1: Looking for the letters?

P2: Yeah

R1: Would you be trying to think of the letter and the word?

P2: Yeah yeah, jesus Christ yeah

R1: You were probably practicing your spelling

P2: oh yeah

R1: Did you feel you wanted to use the iPad?

P2: Yeah

R1: did you ever feel you weren’t very interested in it?

P2: No no

R1: be honest now

P2: no no good

R1: would you prefer to work on an iPad with something like this (pointed to app) or work individually with a therapist?

P2: oh jes no no

R1: You would prefer the individual or group therapy

P2: oh jes yes yes yes, sss

R1: (Name of SLT)

P2: Yeah

R1: would you use this again?

P2: oh jes yeah (points to anagram cue)

R1: this jumbling up the letters cue is it this your talking about?

P2: No (draws on table: h...o)

R1: H..O...N

P2: no

R1: is it to do with the app?

P2: No
R1: Is it to do with yourself?
P2: yeah one
R1: one hour?
P2: yes good
R1: is it how long you used it for?
P2: yes good?
R1: is it for the internet?
P2: yes
R1: one hour on the internet?
P2: Yeah good good.
R1: and you find you can use it anywhere does that help?
P2: oh yeah yeah yeah
R1: it’s very interesting to hear how it’s helped you
P2: ah yeah yeah yeah
R1: How much time in the day including working on the app and the internet?
P2: 3 hours
R1: is that more or less than when you started 5 weeks ago?
P2: more
R1: would you have spent an hour on it 6 weeks ago?
P2: no no
R1: half an hour a day?
P2: yeah yeah
R1: so do you feel it’s kind of opened up a lot of new things to you using the internet?
P2: Yes but the... ah.. good.. am the hospital the
R1: Is it typing out hospital?
P2: oh yeah yeah
R1: and is it gone then?
P2: yeah yeah

R1: the internet gives you help to spell and get the word?

P2: oh yeah good yeah

R1: some letters are harder than others are there any letters that catch you out?

P2: one two three four five six

R1: oh so the 6th or the 7th letter is gone?

P2: yeah

R1: are there any letters you find difficult?

P2: No

R1: Do you find it helps to say the word out loud before spelling it. Because I hear you sometimes practicing the letters before spelling. Like earlier you said ‘rope rope’. Does that help you to spell it then?

P2: Oh yeah yeah the good

R1: so it does help you?

P2: yeah

R1: do you think of it as one word when you say it out loud ‘rope rope’ or do you break it up into sounds r-o-p-e?

P2: One

R1: you think of it as all one word?

P2: Yeah

R1: so you say ‘rope and think the first letter is r?

P2: Yeah

R1: I do think you have come on with your spelling. I think you are really aware whe you have the letter wrong.

P2: Oh yeah yeah

R1: I think you can practice alone too in the future

P2: yeah but

R1: Do you find your better at typing or writing?

P2: gestures to table. Good yeah
R1: is it that you are better at tracing out on the table?

P2: yeah

R1: Is there anything you would like to tell us about using the app?

P2: ah yeah good
Pre Qualitative Interview

Researcher 1: Claire

Researcher 2: Cait

Pre Intervention Interview

R1: Can I ask your date of Birth? Do you want a pen to write it down?

Can you give us your age? You are in your 70’s yes?

P3 nods

R1: 71, 72, 72 yes

P3 nods

R1: Great

R2 (Cait): You tried really hard there

R1: Can I ask you about your stroke, when did it happen? Do you know when it happened?

R1: Was it more than 3 years?

P3 nods

R1: More than 5?

P3: no

R1: Less than 5

R1: 2008/2009?

R2: You can let us know next week P3. It’s hard to remember these things

R1: How is your hearing, is it ok?

R1: It is. Both ears ok?

P3 nods

R1: And your vision, you wear glasses. Is it for watching tv?

P3 nods

R1: but not for anything else?

P3 shows 2 pairs of glasses

R1: 2 pairs of glasses P3, is it one for reading and one for tv
R2: Are you fairly healthy P3?
P3 nods

R2: You weren’t in hospital recently?
P3: No

R2: healthy really the last few years yeh yeh

R1: Can I ask you P3 have you had speech and language therapy before?
P3 nods

(carer): He sees SLT but its 7/8 months since P3 was there. SLT to assess again and was to send out speech and language stuff in the post. SLT will see him every Friday

Note: P3 receives a phone call

R1: Can I ask you about family P3 – have you family living around?

In (Place), yeh a sister or a brother

P3 nods then a no

Carer: some in (Place) P3 don’t you

R1: What do you like to do P3? I think you like to dance am I right?
P3 nods and laughs

R1: And what about your daily routine P3, do you get up early?
P3: No

R1: Maybe 9 or 10 or is it 11 (P3 nods)

R1: 11, not too early

R1: Do you stay here during the day P3?
P3 nods

Carer: He has home help 3 times a day with 3 different ladies

R1: Have you ever used a computer before P3?
P3: no

P3: When do you think you will use the IPAD - Morning?
P3: No
R1: Afternoon?

P3 nods

Carer: Evening maybe also

R1: I see your left hand is weak P3, can you move it?

P3 nods

Carer: he can shake hands with it too. We have been doing some physio exercises to strengthen the hand and we are going back again in 2 months

R1: You used to write plays and you used to read a lot before the stroke, Yes?

P3 nods

R1: Do you read now?

P3: no

R1: Do you look at the pictures in the newspapers maybe?

R2: a couple of words P3, yeh

Carer: he was in printing at one stage weren’t you P3? But never used a computer

R1: Do you think you will be able to use the IPAD tom?

P3 nods

R1: You are happy enough to use it, that’s great!

Post Qualitative Interview

R1: P3, today I want to find out how you felt about the app and the IPAD now that you have been using it for 5 weeks.

R1: Did you find the app easy to use?

P3 nods

R1: Did you find the pictures ok to use?

P3 nods

R1: You did not find some of the pictures confusing?

P3: no
R1: That’s great P3.
R1: Did you find the IPAD difficult to use at the start P3?
P3: yes (nods head)
R1: Well you have never used an IPAD before P3 so it was difficult for you, and how do you find it now after 5 weeks? Is it easier to use
P3 nods
R1: Did it get easier as the weeks went by?
P3 nods (thumbs up)
R1: Did you get faster using the IPAD as in turning it on and off and getting onto the app?
P3 nods
Carer: Yes P3 I think you did also, every week he got much faster and knew where the buttons were.
R1: That’s good P3
R1: On a scale of 1-10, with 10 being good and 1 being poor, how would you rate the app P3?
R1: (hold out my hand) 5
P3: no (gestures up)
R1: 7/8
P3 gestures up
R1: 10
P3 nods
R1: 10 yes, that’s great P3, it seems you enjoyed working with the app
Carer: Yes P3 really enjoyed working with the IPAD and he did nearly an hour every day with me and sometimes in the evening by himself
R1: Well done P3.
P3: So you used it by yourself sometimes also?
P3 nods
Carer: yes he used it in the evenings but he had the problem of the screen getting bigger and it was hard to figure out how to get it back to normal. You have to tap on the screen a few times which took a while to figure out. I think he would have used it more if that didn’t happen as often
R1: So the screen increased in size? Oh yes the homepage can be expanded and you have to tap on it to reduce it to normal size. Did this happen often P3?

P3 nods

Carer: yes as he can only use one hand he found it difficult to hold it and try to reduce the size at the same time and it happened a few times

R1: Ok that is something that I can say to the developer. Were you happy to use it by yourself P3?

P3 nods

R1: Were you motivated to use it P3?

P3 nods

R1: You did not think it wasn’t worth your time?

P3: no no

Carer: Yeh I think he really enjoyed it and as the weeks went on and he was making progress he wanted to do it every day.

R1: that’s great P3. I am glad you enjoyed the app and what you gained from it over the weeks

R1: P3 did you find it hard to think of the name of the word when the picture was showing or was it more difficult to write it

P3 gestures writing

R1: So you could think of word?

P3 nods

R1: but you just couldn’t write it down

P3 nods

R1: Did you find longer words were more difficult?

P3 nods

Carer: yes he was getting the hang of the short words and was remembering the letters of the short words after he did the anagram but the longer words were a lot more difficult. But we did what you suggested and I wrote the letters down for p3 after he had arranged them in order. That really helped him to find the letters faster and he did not get frustrated

R1: That good to know and p3 did find the anagram helped where you had to put the letters in order?

P3 nods

Carer: sometimes the letters disappeared though when he tried to move them
R1: yes I remember you telling me this P3 and it happened in some of our sessions too

Carer: yes that happened a lot and we would just move on to the next word

R1: Did it happen every day?

Carer: yes at least once a day if not more

R1: ok, I need to feedback this information to the developer

Carer: It was fine we just moved on to the next word but it did happen quite a bit

R1: ok thanks for making me aware of this.

R1: P3 would you prefer the IPAD or would you rather attend speech therapy every day?

P3 points to the IPAD

R1: So you would prefer the IPAD

P3 nods

R1: is that because you can use it at any time you want?

P3 nods

R1: yes and you don’t have to travel you can use it in your home

P3 nods

R1: what did u not like about the IPAD P3?

P3 gestures moving action with fingers like he is swiping across

R1: Is it to do with the letters

P3 nods

R1: is it where the letters are all jumbled up?

P3 nods (Takes IPAD and uses swiping motion across screen and off the IPAD

R1: is to do with the letters disappearing P3

P3 nods (thumbs up)

R1: ok yes P3 if that was happening a lot it would become frustrating

Carer: Also when the screen got bigger and we couldn’t get it back to normal is that right p3?

P3 nods

R1: that’s great feedback thanks P3 as this information will be brought back to Aine so we can make the app much better in the future, so it’s good to know these things.
R1: P3 did you find some of the letters difficult

P3 nods

Carer: Yes I think he found /l/ and /t/ difficult at the start but he is much better with them now particularly if you sound them out now. He can get them if you sound them out whereas before at the start he didn’t know that /t/ (makes t sound) is actually /t/

R1: P3 do you think you have improved a bit since starting with the IPAD

P3 nods

Carer: yes he really has, as he is getting the first letter of a lot of the words now whereas at the start he couldn’t do that. I think Cait said he had improved in this area too after she did the assessment with him. He is also putting the right letter at the start when the anagram comes up so I think he improved in that area too.

R1: that’s fantastic progress P3. Well done, you did a lot of practice with the app and I am glad you are progressing.

R1: would you recommend the app P3?

P3 nods

R1: you would

P3 nods (Thumbs up)

R1: Finally P3, did you like the diary bit at the end?

P3 nods

R1: you didn’t mind filling it in?

P3: no no

Carer: no I think it gave him satisfaction as he can see he completed an hour on the app

R1: That’s great P3, Thanks so much for participating in our research and I am glad you enjoyed it too.
Participant 4

Pre Qualitative Interview only

(withdrew)
Pre Qualitative Interview

Left CVA resulting in right hemiplegia in Nov 2012

Family Support: sister-in-law

Marital Status: Not married

Hearing is reported to be good

Uses glasses for reading/looking at television

Rehab: Is attending physiotherapy and speech and language therapy twice a week

Is receiving SLT input and this is on-going – private with SLT (every week)

Rehabilitation appoints are a preference for P4 at this time.

Used to enjoy art and was interested in the property market

Daily Routine: is receiving home help every day and stays at home mostly. P4 enjoys being at home

| Support and activities | Attends Speech and language therapy every week and physiotherapy. Good family support. – home help and sister-in-laws  
Activites:
Used to enjoy art and used to refurbish houses and sell them on as a hobby before CVA. |
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<tr>
<td>Literacy</td>
<td>Is not able to read at present. Can look at pictures</td>
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| Physical mobility      | Right hand hemiplegia. Is supported with sling.  
Right leg hemiparesis uses a stick to walk and needs assistance getting in/out of chairs. Is able to use left hand.                                                                    |
| Attitude               | No experience of IPAD. But has a history of typing. Will possibly use IPAD in morning.                                                                                                        |
Participant 5

Pre and Post Qualitative Interview

(withdrew)
Pre Qualitative Interview

R2 = Researcher 2, P5 = Participant 5.

R2: Can I ask you how long is it since you had your stroke?
P5: Am am.....

R2: Is it less than five years?
P5: Am yeah....

R2: That’s ok we can come back to it. Your hearing is pretty good?
P5: Am yes.

R2: Do you wear glasses?
P5: No no.

R2: So you said you were having rehabilitation P5, is that OT?
P5: Yeah and headway aswell.

R2: Oh great. Have you had speech and language therapy for a while?
P5: Yeah XXXX [P5 named his community therapist]

R2: Oh yeah I don’t think I’ve met her. Do you still go to the Speech therapist now?
P5: No, no.

R2: Yeah and your from XXXX [names county]. Have you family around?
P5: Yeah, XXXX [names partner] and XXXX [names another county].

R2: Ah did you grow up there?
P5: House... house

R2: And did you sell the house above?
P5: No no.... the young fella... he’s.... am

R2: They are living in the house above there now is it?
P5: Yeah yeah.

R2: You have very good family support?
P5: Ah yeah yeah.
R2: That’s great and what are your interests what do you do?

P5: Am... well I am.... I do the bike....

R2: Oh the exercise bike?

P5: Yeah yeah!

R2: Do you do any bit of reading?

P5: Oh yeah.

R2: Would you have a look at the newspaper?

P5: Yeah... you know I ... headlines.

R2: Yeah you get the gist of it?

P5: Yeah yeah.

R2: I just want to ask you about your daily routine to see what time suited you to use the iPad. Would you be up early in the morning?

P5: Well am....eight.

R2: What time would suit you best to use the iPad?

P5: Morning.

R2: Would you get a bit tired in the evening?

P5: Yeah yeah.

R2: Do you have weakness in the arm?

P5: Yeah it’s you know..

R2: Yeah a small bit maby?

P5: Yeah yeah.

R2: Yeah and you do a lot of OT. Before the stroke were you right handed or left handed?

P5: Right, yeah yeah yeah.

R2: How do you find using the left hand?

P5: Ok.

R2: Did you type a lot in your job in the past?

P5: Yeah....

R2: Would you have used a computer?
R2: Would you have typed regularly?
P5: Ah no but... ah... bang bang bang bang [gestured typing using one finger at a time].
R2: Yeah I use three fingers sometimes!
P5: So with the job like... type a problem...
R2: Ah so you were typing regularly really?
P5: Yeah yeah.
R2: Your reading and writing was ok before the stroke was it?
P5: Yeah yeah.
R2: How would your family be with technology?
P5: See XXXX [names a lady] in rehab.
R2: Oh ok great, she would be very good with helping you?
P5: Yeah and eh... but I.... [points to his own iPad].... I text I suppose.
R2: So your pretty good with technology really?
P5: Yeah I suppose, I dunno.
R2: Is it a phone like this one? [points to nokia phone on desk]
P1: No I am use.... Nokia
R2: Oh yeah I use a Nokia myself and would you surf the internet?
P5: Yeah yeah yeah.. I well... amns... amm
R2: Amazon?
P5: Yeah [laughs]
R2: Yeah ebay is another one people like to use.
P5: Oh yeah yeah yeah.
R2: It’s very easy to go on and find things [laughs].
P5: Oh yeah yeah yeah [laughs].
R2: How do you feel about taking part in the study?
P5: It’s ok.
Post Qualitative Interview

R1: P5, I would like to ask you some questions about the app and how you found it, if that was ok with you

P5: yeh yeh

R1: Great, and thanks for agreeing to take part in this interview. Did you find the app difficult to use?

P5: Yeh yeh

R1: Was it to do with the remembering the letters?

P5: yeh it was (points to head)

R1: Did you find that you couldn’t remember the letters to write them down

P5: yes the… could do the…. The…. (makes a swiping gesture)

R1: is this the anagram you are taking about P5, where the letters were all jumbled up?

P5: yes yes, that was ok

R1: Ok so was it after that you couldn’t remember

P5; yeh and had to go back in again and again

R1: Did you find that frustrating or ok

P5; No no it was hard

R1: P5, did you remember any of the letters

P5: no no

R1: ok, Would you use it again if it was changed/

P5: yes yes (nods head) its .. just.. I was in XXXX and ..... XXX

R1: Yes you had a lot of appointments so you were very busy. Did you find that there was very little time to use the IPAD

P5: Yes, hard to get time

R1: Did you like the app

P5: Yes app was good…. Likes the pictures

R1: Did you find the user guide much help or did you need it

P5; No didn’t need it

R1: Did you use it by yourself a lot P5?
P5: Yes, just me
R1: And would you have liked someone else to help you?
P5: no no
R1: Do you prefer to work by yourself P3?
P5: yes
R1: what did you think of the diary at the end, did you like it?
P5: ..... yeh I suppose
R1: Did you find it wasn’t useful?
P5: no it was ok
R1: Did you find the pictures were ok?
P5: yeh they were fine
R1; were any of them not ok?
P5: a few yeh ......bath one
R1: was this confusing?
P5: yeh
R1: Were you motivated to use it P5?
P5: ah yeh but am.... Yeh yeh
R1: Did you enjoy using it?
P5: a bit yeh, but ..... 
R1: but you found it difficult to remember the words
P5: yeh yeh
R1: Ok thanks P5 for this information, I can bring this back to Aine and hopefully it will be better for you in the future.