



Inclusion in Digital Environments for People with Aphasia

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Abstract

Background: Individuals with aphasia may wish to engage with the Internet for work, communication, or leisure. Pre-stroke Internet skills will vary, as will other factors such as availability of equipment and support. This thesis aims to investigate how aphasia influences Internet use and skills. Further, it aims to explore and evaluate assessment, intervention, and outcome measurement to support Internet use with aphasia.

Method: A supported questionnaire was used to compare Internet and technology use between people with and without aphasia post-stroke (stage one). Forty-two participants were recruited, twenty-five of whom had aphasia. The two groups shared known risk factors for digital exclusion. A series of four experimental single case studies followed using a structured assessment and decision-making process with a focus on exploring interventions for participants with post-stroke aphasia who had particular goals around Internet use (stage two).

Results: There was a very broad spectrum of levels of independent and supported Internet use amongst people with and without aphasia. Age was a stronger predictor than aphasia for Internet use/non-use. People with aphasia were less likely to use linguistic tools such as emailing, text messaging, and e-readers. Level of education influenced self-perception of Internet skills. Case-study interventions differed according to individual needs and goals. Clinical decision-making and interventions were guided by a specific focus on cognitive and Internet skills alongside environmental factors relevant to Internet use. Assessment demonstrated that, for three of four participants, change was evident, with gains linked to their Internet related goals.

Discussion: This study adds to knowledge by enhancing understanding of how people with aphasia may face specific risks related to digital exclusion. It demonstrates that a holistic understanding of factors influencing Internet use and skills can support the design and evaluation of tailored interventions to enable

Internet use with aphasia. This provides guidance for clinical practice and for future aphasia research.

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Background and Personal Motivations

“Anyone who has lost track of time when using a computer knows the propensity to dream, the urge to make dreams come true and the tendency to miss lunch”. Tim Berners-Lee, June 1994

This section aims to provide some background for the reader on my reasons for carrying out a PhD and my motivations for this area of research, which emerged from my personal and clinical experiences.

I was interested in computers and technology from a young age. As a 10yr-old in primary school and a member of the ‘top’ maths set, I was put in the privileged position of being allowed access to the school’s newly acquired set of four Sinclair ZX Spectrum computers. I remember sitting on a bench with the tiny rubber keyed device placed on the school stage, plugged into a TV. In secondary school, I was editor of the school newspaper and was given access to ‘the Mac’, located in a tiny cupboard off one of the classrooms. I remember showing my teacher how it worked and spent many a happy hour inserting and removing various installation and software discs.

Despite my clear interest in and aptitude for all things technological, and because I liked reading books, as a girl it was expected that my future lay in the direction of arts and humanities. So, off I went to University to study English. I left for Glasgow armed with a brand-new Amstrad word processor, which was the envy of all my friends. There, I was drawn to the more scientific aspects of linguistics and developed an interest in language acquisition and impairment. This led to me Speech and Language Therapy, and to my qualification as an SLT at Reading University. During my time in Reading and my first SLT post in the South East, I spent a lot of my time with a good friend who had a background in computer science. His interests fuelled mine, and his hand-me-down gadgets gave me my first laptop, PDA, and mobile phone.

Others around me seemed to find my interest in technology unusual. This has continued throughout my working life, and colleagues are often amused about my

possession of the latest gadget or my tales of things I have found online. I even met my husband on the Internet, and in him (a software developer) I found someone who understood my geeky passions. I initially found most of my SLT colleagues didn't share these interests. However, during my twenty years in the profession, technology and the Internet have grown exponentially. Computers appeared in therapy offices, and technology began to be seen as something that could be of benefit to our profession and our clients.

I was almost entirely self-taught and never felt particularly skilled in any aspect of computing. Despite this, I was often considered 'the expert', and colleagues would ask my advice on aspects of technology from Office applications to AAC devices. As I progressed in my career and found my speciality in community neurorehabilitation, I found myself involved with AAC for numerous clients. One individual who will stay with me forever is a young man with motor neurone disease. My main involvement was to recommend and supply a high-tech communication aid. As part of a new range of devices, his communication aid could also access the Internet. Although extremely limited in mobility and communication, in the last years of his life he could select and play his own music, choose and buy his own clothes, and place a bet on his choice of football team. Most importantly, he could see and hear his children (who lived abroad) via Skype. The opportunities of the Internet for this brave, funny, and endlessly positive man felt so empowering to me. Here was technology that gave quality of life to an individual living out his life with a devastating disease; Opportunities that had not been present when I first qualified.

Technology became a common theme rather than a rarity. A vast amount of information was available online, but my colleagues and I recognised this was difficult for some clients to access, and we often visited people's homes bringing printed information from websites. Computer therapy for aphasia was becoming more available, but NHS information governance guidelines often made it difficult to bring these opportunities into the homes of our clients. The nature of communication had changed and was changing. Some people with aphasia chose not to embrace technology, but others wanted to email and to use mobile phones and social media. My SLT colleagues and I wanted to support our clients to communicate by whatever

means available to them, but I became increasingly frustrated at the barriers we experienced and the lack of evidence to support any interventions. I wanted to find ways to support people with aphasia to use technologies and to have access to guidance on providing interventions.

I eventually took the decision that so many questions and not enough answers meant I wanted to carry out research in this area, and I wanted to continue my passion for working with people with aphasia. I contacted Julie Morris who helped me to negotiate the many steps towards pursuing a research career. Those early ideas have grown and developed thanks to the support of the Stroke Association and the excellent research training I have received at Newcastle University. Research has allowed me to explore my questions, and to discover some (if not all) of the answers. The final result of this part of the journey is presented here in the form of my doctoral thesis.

Fiona Menger

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Chapter 1: Digital Exclusion, Aphasia, and Technology

1.1 Introduction

People with aphasia, like most people, live in an increasingly digital world. Everyday social interactions and access to information have changed exponentially in the past two decades due to the growth in digital technologies¹ (Dutton, Blank, & Groselj, 2013). The majority of adults (c.88%) in the UK use the Internet, which is intrinsic to everyday life (Office for National Statistics, 2016). There is evidence that technologies and the Internet are beneficial to individuals and society (Communications Consumer Panel, 2010; Green & Rossall, 2013; Pricewaterhouse Coopers LLP, 2009; UK Online Centres, 2008). They can help reduce social isolation, improve mental health (Koss, Azad, Gurm, & Rosenthal, 2012), improve perceptions of health, influence levels of health service use (Deetjen & Powell, 2016), and instil a sense of togetherness with others (Nyman & Isaksson, 2015). Evidence suggests that the Internet can have positive benefits for providing support with living with a long-term health condition (Eysenbach, Powell, Englesakis, Rizo, & Stern, 2004). There may also be advantages for quality of life (Oh, Ozkaya, & LaRose, 2014).

Aphasia researchers have previously expressed concerns that people with aphasia are at increased risk of failing to access the benefits of the Internet (Elman, 2001; Menger, Morris, & Salis, 2016; Van de Sandt-Koenderman, 2011). This is predominantly because, by its nature, aphasia entails difficulties with language and communication. Therefore, linguistic aspects of Internet use will present considerable challenges. The

¹ Throughout this thesis, a range of terms are used to refer to aspects of Internet use and technology. The words 'Internet', 'online', and 'the web' are used to refer to the domains where online communication and access to information takes place (definitions adapted from Barton & Lee, 2013). The term 'digital technologies' is used specifically to refer to Internet enabled electronic devices found within the home or workplace which have been designed to be part of everyday information, communication and leisure activities.

language of the Internet represents a period of evolution in language use (Barton & Lee, 2013; Crystal, 2011; Page, Barton, Unger, & Zappavigna, 2014). Writing for social media, email and text messaging is part of everyday practice. Therefore, language impairment is likely to have an impact on many of the skills required. For example, impaired reading or written language could affect ability to read or create online content. Impairment of spoken comprehension or expression may also affect the ability to use aspects of the Internet, as it is a multi-media environment, with the ability to interact with audio-visual content. Language and other cognitive functions are necessary skills across many other areas (e.g., comparing different broadband contracts, or reporting and describing problems). Beyond language, the possible impact of impaired cognitive (non-linguistic) skills, such as attention, memory, visual perception, problem solving, and integration of cognitive processing abilities also needs consideration (Brownsett et al., 2014; Fucetola, Connor, Strube, & Corbetta, 2009). There may also be other aspects of disability concomitant with aphasia (e.g., hemiplegia, visual field deficits, fatigue), or difficulties associated with normal ageing (e.g., deteriorating vision or hearing) or with other physical conditions (e.g., arthritis). These could have bearing on the ability to physically access computer equipment, or to reliably access Internet content.

Secondly, people with aphasia are likely to have characteristics in common with sections of the population thought to be at more risk of difficulties with accessing and using technologies. 'Digital exclusion' is the term used to describe differences between groups who are more and less equipped with the knowledge and skills to access and use the Internet (Van Dijk, 2012). Groups identified as being more at risk include healthy older adults, people with disabilities, those with lower levels of education, and those experiencing social deprivation (Helsper, 2008; Helsper & Reisdorf, 2013). Aphasia is a complex condition more common in older adults and often co-exists with other stroke-related or medical difficulties (Dickey et al., 2010). This means people with aphasia may cross categories of those known to be more vulnerable to digital exclusion. The impact of aphasia on digital exclusion and the provision of effective interventions to prevent exclusion is the primary focus of this thesis. However, because a range of factors contribute to effective use of the Internet (Communities and Local Government, 2008;

Helsper & Reisdorf, 2016; Van Dijk, 2012), the effect of aphasia cannot be viewed in isolation.

This introductory chapter serves firstly to provide a broad overview of literature which considers factors related to digital exclusion. This context will illustrate what might influence Internet use amongst the wider population and allows for consideration of factors which may occur alongside aphasia. To then provide a focus on how living with the acquired condition of aphasia might influence Internet use and skills, the chapter uses the framework provided by the International Classification of Disability, Functioning and Health (ICF) (World Health Organization, 2002) to consider possible factors influencing Internet use for individuals with aphasia. The chapter then moves on to discuss existing literature related to this field. It first presents a broad overview of research on aphasia and technology, followed by a critical appraisal of literature with a focus either on patterns of Internet use by people with aphasia or on interventions to support people with aphasia with everyday use of computers and the Internet. Critical examination of this literature identifies where there are gaps in current knowledge and enables identification of the aims and research questions related to this thesis.

1.2 Factors Related to Digital Exclusion

Previous research about digital exclusion outside of the aphasia literature has examined a range of possible factors influencing Internet use and skills. It was important to consider the digital exclusion literature as a key part of this research in order to illustrate how people with aphasia may be vulnerable to difficulties with Internet skills and use because of reasons beyond aphasia. Several possible influential factors are discussed below.

1.2.1 Age

People with aphasia are more likely to be older adults (Pedersen, Jørgensen, Nakayama, Raaschou, & Olsen, 1995). The most recent update from the Office for National Statistics reported that adults over 75 are the group least likely to use the Internet in the UK (Office for National Statistics, 2017b). However, there are indications that age-related gaps in Internet use are slowly reducing. The number of people who

have recently used the Internet aged between 65-74 has increased steadily and shows a reducing gap between older and younger people. However, in a 2016 report, the Office for National Statistics expressed concerns about the increased risk of exclusion of sub-groups of older people, such as women over 75 (Office for National Statistics, 2016). Friemel (2016) investigated Internet use amongst older adults. His research findings revealed a further divide within the older population, with the oldest experiencing the greatest exclusion. As a result, he suggested that any categorisation of 'older adults' into one large group should be interpreted with caution. Influential factors identified in Friemel's survey included whether a person had used a computer prior to retirement and the amount of encouragement they had from others. These findings suggest that age should not be considered in isolation. Hanson (2009) reported that many of the difficulties faced by older adults are related to the physical changes associated with ageing (e.g., reduced perceptual skills, decline in cognitive function). These findings were confirmed by Friemel who found those over 85 who did not use the Internet reported eyesight, hearing and dexterity as being greater barriers to use than lack of interest or motivation. Crabb and Hanson (2014) investigated the influences of age, technology experience and cognition in predicting Internet browsing experience. They found that cognitive ability and previous experience had the greatest influence on participants' levels of orientation when performing online tasks. Crabb and Hanson therefore recommended caution in using age as a predictor of Internet use and skills. Van Deursen and Helsper (2015) also argued that a dichotomous view of age is not helpful. They conducted telephone surveys with older adults and used regression analyses to explain the factors differentiating Internet non-users from users and to explain varying levels of engagement with the Internet. They found considerable diversity in their sample, extrapolating from their results that older adults are a varied group and that a range of psychological, environmental, and social factors can influence whether they use the Internet. Older adults are often motivated to engage with technologies following a need which sparks their interest (Gibson, Forbes, & Hanson, 2003). Thus, although age is a strong predictor of digital exclusion, being older does not necessarily equate to having difficulty with using technologies and older adults may be motivated to engage with the Internet through personal perceptions of need.

1.2.2 Disability

The relationship between specific disabilities and Internet use is poorly understood as large-scale sources of data such as the Oxford Internet Surveys (OXIS) (Oxford Internet Institute, 2014) or the Office for National Statistics (2017c) present statistics for those who self-identify as having a disability, and do not report on type of disability within that group. Therefore, it is difficult to determine the influence of specific disabilities when interpreting these larger studies. Official figures from The Office for National Statistics suggest numbers of people with a disability using the Internet are slowly increasing. However, only 34% of disabled people over the age of 75 were recent Internet users compared with 50% who were not disabled (Office for National Statistics, 2016). In the most recently published OXIS survey, Dutton et al. (2013) reported that people with a disability had lower levels of Internet use across all age groups. Dobransky and Hargittai (2006) attempted to provide more detail on the influence of type of disability on Internet use. They analysed census and large-scale survey data which asked participants to answer questions on their computer and Internet use and to give detail on type of disability. They found people with any type of disability were less likely to have Internet access but that this was lowest for those with multiple disabilities. When they examined Internet use by type of disability they found impairments more closely related to the skills needed to use a computer had a greater effect on Internet use. For example, visual impairment or difficulties with typing were more significant predictors of Internet use than limitations to walking. In drawing conclusions from these results, Dobransky and Hargittai discussed the need for more focused research on the influence of different conditions and advocated consideration of other factors which may correlate with disability, e.g., unemployment or lower income. Jaeger (2012) expressed similar concerns about lack of focus on issues specific to disability, and warned of the Internet emerging as a potentially marginalising environment for people with disabilities. Jaeger warned of a “*risk of segregation of people with disabilities as permanent second-class citizens of the information age*” (Jaeger, 2012, p. 34). There are several innovations that can facilitate computer access for people with physical and sensory disabilities (e.g., screen readers and haptic adaptations for blind users, or adapted keyboards or navigation methods for people with hemiplegia). However, with any type of disability,

including aphasia, there may be other factors influencing Internet use or the ability to benefit from technological innovations. Jaeger (2012) argued that people with disabilities have already faced barriers to equality of access in other aspects of everyday life, and the rapid growth of the Internet adds another exclusionary factor. Dobransky and Hargittai (2006) expressed similar concerns, noting that tools for people with disabilities can lag behind the fast pace of technological change.

Within the aphasia population, there are people who have additional cognitive disabilities beyond impaired language (Helm-Estabrooks, 2002; Suleman & Kim, 2015). Cognitive disability in the digital exclusion literature refers to a wide spectrum, from developmental learning disabilities to acquired impairments following neurological illness or injury. Blanck (2014) considered use of the Internet with cognitive impairment within such a broad definition. He discussed the likelihood that people with cognitive impairment may have multiple needs when it comes to using technologies. In addition, he suggested that barriers are likely to be structural (resulting from reduced expectations of others or lack of educational opportunities) as well as technological and environmental. Wild et al. (2012) discussed the impact of mild cognitive changes on ability to access a computer training programme in a cohort of elderly people with no formal diagnosis of dementia. Although participants' confidence improved after one year following the training, cognitively intact participants benefited more from the experience. This research demonstrates that other aspects of cognition outside of impaired language should be considered as possible additional influences on Internet use and skills.

Highlighting the specific needs of people with disabilities in relation to the Internet is clearly important. Recent UK government policy on digital skills and inclusion acknowledged that people with disabilities are more likely to be excluded and pledges help for the most vulnerable (UK Government, 2017). However, there is a lack of guidance on how people with specific disabilities should be supported.

Although there is a clear need to make the Internet universally accessible, recent research suggests that compliance to web content accessibility guidelines (World Wide Web Consortium, 2017) in both the UK and the USA is poor (Hanson & Richards, 2013). Easton (2013) describes how, in many cases of web design, accessibility issues are

addressed only after initial ideas and designs have been developed. Easton argues this is in conflict with the principles of universal design, which stem from the social model of disability (Oliver & British Association of Social Workers, 1983). The social model is based on the premise that disability is created by society, rather than from impairments experienced by an individual. Easton argues that a more favourable approach should consider the accessibility of web design at the very onset of the process. This allows for well-integrated inclusion, and moves focus “away from difference and towards the universal” (Easton, 2013, p. 106). However, making Internet content accessible to all is an ongoing challenge. Jaeger (2012) acknowledges the difficulties faced by web designers and developers, with the need to incorporate all possible adaptations that people with disabilities may find useful (e.g., text to speech, alternative means to input text, Braille, magnification, or text description of images).

1.2.3 Social exclusion

The UK government social exclusion unit defined social exclusion as when “*people or areas suffer from a combination of linked problems such as unemployment, poor skills, low incomes, poor housing, high crime, poor health and family breakdown*” (Social Inclusion Unit, 2004, p. 2). Helsper (2008) argued that those who face exclusion in society are at most risk of failing to access aspects of technology that could be of most benefit to them. In more recent research, Helsper and Reisdorf (2016) reported large-scale surveys of Internet use from the UK and Sweden. They found that belonging to a vulnerable group meant a person was considerably less likely to use the Internet. Helsper and Reisdorf warned of the likelihood that the most vulnerable in society will experience the greatest difficulties with the Internet, as there are strong links between social and digital exclusion. There is also a concern that the current drive towards digitisation of government services might compound social exclusion, with a significant section of the population unable to access services without support (Low Incomes Tax Reform Group, 2012). Initiatives such as the Tech Partnership UK (Tech Partnership, 2017) recognise the relationship between social and digital disadvantage and aim to promote the development of basic digital skills for those who lack them.

Parr (2007) explored social exclusion of people with aphasia in an ethnographic study documenting the day to day experiences of living with aphasia. People with aphasia commonly experienced exclusion in a variety of settings. In addition, research has shown that language difficulties can affect friendships and social relationships, making it harder to partake in activities and negatively affecting quality of life (Hilari, 2011). Such exclusion makes people with aphasia a highly vulnerable social group. Parr discussed different types of exclusion of people with aphasia as infrastructural, interpersonal, and personal and categorised access to information technology under the umbrella of infrastructural exclusion. However, the growing role of the Internet for communication and everyday interactions in the decade since Parr's study might mean that difficulties with using the Internet could lead to exclusion that crosses infrastructural, interpersonal and personal categories.

1.2.4 Access to support

Many older adults have access to a proxy who uses the Internet on their behalf (Dutton et al., 2013). Researchers have also shown that peer support is valuable in the context of aiming to improve Internet skills (Forbes, Gibson, Hanson, Gregor, & Newell, 2009). For people with aphasia, the sudden onset of stroke-related disability may affect relationship dynamics and disrupt previous roles (Northcott, Moss, Harrison, & Hilari, 2016). This may impact the ability of those around a person with aphasia to provide support in many areas, including with Internet use. Hilari and Northcott (2016) investigated the type and amount of support received by people with aphasia in comparison with people who had experienced stroke without aphasia and with healthy older adults. Their comparisons of two measures of social support revealed that people with aphasia had significantly fewer friendships. The likelihood that people with aphasia lose friends may have implications for their access to support with technologies. One of the scales Hilari and Northcott used was the Medical Outcomes Survey Social Support Survey (Sherbourne & Stewart, 1991), which included subdomains on different types of support (emotional, informational, tangible, positive social interaction, and affectionate). This level of detail may be needed to clarify differences between different types of support with using the Internet because support might take several different forms; for

example, encouragement to engage with technologies, practical help with equipment and software, commitment to regular online interactions, or assistance with seeking information. Hilari and Northcott acknowledge that their analysis did not compare these different support functions separately and that this would have been beneficial in providing more detailed information for their study.

There is limited information on how proxies provide support with technologies to older adults, or whether such support is beneficial. Quan-Haase, Martin, & Schreurs, (2016) conducted a qualitative study on the everyday practices of Information and communication technology (ICT) use by older adults. They found that older adults were more likely to adopt technologies that were beneficial to their way of life. However, many expressed feeling a degree of pressure to develop digital skills because of encouragement from friends and family. This insight is valuable in considering the role of providing support with technologies for people with aphasia. There is a careful line to tread between imposing use of technologies others believe the person will find valuable and helping a person to use technologies for which they perceive a need.

1.2.5 Geographical location and education

The factors related to digital exclusion described in this section are not explicitly linked to aphasia. However, because people with aphasia are a diverse population, there are likely to be subgroups who fall into the two categories discussed below.

Geographical location

Worldwide, some countries have higher levels of digital skills than others. For example, African nations have considerably lower levels of Internet use than Europe or the Americas (Internet Society, 2016). Within the UK, regional comparisons have been attributed to differences in demographic characteristics of certain areas (Blank, Graham, & Calvino, 2017). Blank et al. combined OXIS data with information from the 2011 UK Census and found that cities in the North East of England (where this research was conducted) had the lowest levels of Internet use in the UK. They used data on regional inequalities of Internet use to argue that the most vulnerable areas should be targets for funding to support inhabitants with digital skills.

Education

Level of education has also been discussed in the literature as a factor related to Internet use and skills. For example, Dutton et al. (2013) reported only 40% of those with no educational qualifications were using the Internet compared with 84% with basic qualifications, 92% with further education and 95% with higher education. However, in a report commissioned by Age UK, Green and Rossall (2013) drew on a large publicly available dataset and found educational attainment was not a significant predictor of whether someone used the Internet. Helsper and Reisdorf (2013) examined survey data from a previous OXIS report (Dutton & Blank, 2011) which asked people to give reasons for their disengagement with the Internet. They found that those with all levels of education reported lack of interest. However, those with basic education reported the most barriers to Internet use. The cost and the level of skills required were significantly related to previous or non-use of the Internet. The authors concluded that disengagement was likely explained by several indicators of disadvantage. Helsper and Reisdorf (2013) suggested that while those with higher levels of education could benefit from initiatives to increase interest in the Internet, those with less education may be disengaged due to several levels of disadvantage. Interventions for these groups would need targeted interventions to tackle multiple barriers.

1.2.6 A multi-factorial problem

Digital exclusion is a complex phenomenon and researchers suggest that it is likely to be related to an interaction of 'cultural, social and attitudinal factors' (Helsper, 2008, p. 15). The sections above only give a broad overview of some of the possible factors involved. The issue of what might influence engagement with the Internet also shows some lack of agreement. Green and Rossall (2013) were commissioned by Age UK to carry out a review of evidence on digital exclusion of older adults. Their review identified factors in order of their influence on whether a person over 55 used the Internet as age, income, household composition, self-perceived health status, sex, mobility, Asian ethnicity, and memory or self-rated ability to concentrate. Dutton, Helsper, and Gerber's (2009) retired participants chose lack of interest as the most frequent reason they did not use the Internet, followed by not knowing how to use the Internet, not having a

computer, not having time, and then financial cost. Chang et al. (2015) found the greatest barriers to Internet use were lack of knowledge, not having access, mistrust, and cost.

Taken together, these sources and those described in the previous sections suggest that motivation and circumstances are likely to vary between individuals in relation to digital skills. Such variation suggests a need to examine individual factors in a holistic way, taking into account a range of influences that might impact a person with aphasia's Internet skills and use. A useful means to holistically examine such a complex interaction of factors is to use the framework provided by the World Health Organisation, the International Classification of Disability, Functioning and Health (ICF) (World Health Organisation, 2002). The following section introduces the framework and discusses how it might be applied to Internet use with aphasia.

1.3 Identifying Barriers and Enablers to Inclusion for Aphasia: The ICF Framework

The literature discussed in section 1.2 above highlighted that people with aphasia may be vulnerable to digital exclusion, not only because of their aphasia but also other concomitant factors. Digital literacy and Internet use will vary considerably among people with aphasia, just as they do in the wider population. This implies differing needs within the population of people with aphasia. There are likely to be people with aphasia who have never engaged with the Internet, just as there will be people with aphasia who use the Internet, but for whom aphasia has impaired this aspect of their interaction with the world. The International Classification of Disability and Functioning (ICF) (World Health Organization, 2002) (see Figure 1-1) provides a structured means of viewing the impact of health conditions on everyday functioning while taking into account the influence of a person's environment and factors personal to them. Thus, the framework can assist with building a holistic profile to investigate how and why people with aphasia might experience difficulties using the Internet. The ICF is made up of four different components: Body Functions and Structures, Activity and Participation, and Personal and Environmental factors. Each of the ICF components, how they relate to each other,

and how they can be applied to Internet use with aphasia are discussed in sections 1.3.1 to 1.3.4 below.

1.3.1 Body Functions and Structures

Body Functions and Structures are defined as *physiological functions of body systems and anatomical parts of the body such as organs, limbs and their components*².

Impairments can result from damage to these structures (World Health Organization, 2002, p. 10). Aphasia is an impairment of brain functioning which results in difficulties with language and communication.

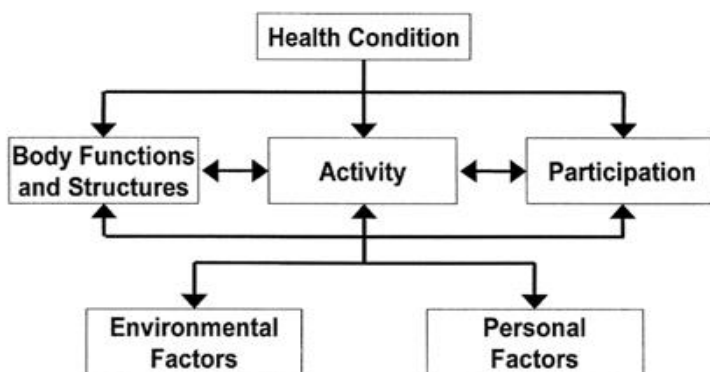


Figure 1-1: Framework for the International Classification of Disability, Functioning, and Health²

It often co-occurs with other forms of neurological impairment, such as hemiplegia, fatigue, visual field deficits, altered mood, impaired memory, or other deficits of cognition. Thus, the Body Functions and Structures component allows for a focus on how such impairments manifest themselves for an individual. It is then possible to

² Reproduced with permission from the World Health Organisation

consider how impairments could impact the ability to access computer equipment, or to access or create online content. Some of the possible difficulties related to aphasia were discussed in section 1.1.

1.3.2 Activity and Participation

Limitations to Activity and Participation are defined within the ICF as '*difficulties in executing activities... problems an individual may experience in involvement with life situations*' (World Health Organization, 2002, p. 10). The Internet is not only a vast source of information; it has evolved to become an interactive tool in everyday use for communication, sharing, and social media. Online communication is changing the way people interact daily. Many activities either have an online equivalent or are exclusively online (e.g., banking, job applications, shopping). The detailed ICF classification system allows researchers to view areas within each component where difficulties might exist (World Health Organization, 2017). Within the Activity and Participation areas of the detailed ICF classification system, many areas can be seen to directly relate to ability to enjoy the benefits of the Internet. Language and other aspect of cognition, among other skills, underpin all of these areas. Examples include learning and applying knowledge (e.g., online courses/education), general tasks and demands (e.g., paying bills, registering to vote), communication (social media connections with friends, contact with people with similar interests), domestic life (e.g., shopping, banking), interpersonal interactions and relationships (e.g., email, social media, photo sharing), major life decisions (e.g., making a will, buying a home) and community, social and civic life (e.g., local events, council information, campaigning).

1.3.3 Environmental Factors

Environmental Factors '*make up the physical, social and attitudinal environment in which people live and conduct their lives*' (World Health Organization, 2002, p. 10) This definition can be applied to several different aspects of using the Internet. One example is the accessibility of online environments for aphasia. There are guidelines to support people in producing written information for aphasia (Herbert, Haw, Brown, Gregory, & Brumfitt, 2012). However, research on the influence of pictures to support reading for

aphasia has produced conflicting results (Dietz et al., 2014; Wilson & Read, 2016). Even if a strong evidence base for the accessibility of written material existed, findings would not apply to online content which is ever changing, multi-media, and interactive, as many websites are today. Modification to online environments for aphasia was considered by Elman (2001), who suggested that disability advocates might have a poor awareness of aphasia, and that, when issues around policies or content guidelines were in discussion, aphasia was unlikely to have been considered. Several examples can now be found online where organisations have attempted to make online written content accessible for people with aphasia (Aphasia Alliance, 2017; North East Trust for Aphasia, 2017; Speakeasy. Supporting Communication, 2017; The Tavistock Trust for Aphasia, n.d.). Elman (2001) acknowledged that independent use may not be feasible for everyone, but proposed creative thinking around supported access might be the way forward for some individuals, using trained communicators to facilitate tandem viewing of information.

The need for help with using the Internet is not only the case for people with aphasia, as many healthy older adults require help with going online (see section 1.2.1). This aspect of the environment of people with aphasia is a highly important one. Friends and family are most likely to be providing help to use computers but may themselves have varying levels of motivation and skills or conflicting demands on their time. In addition, resources such as 'how to' guides, computer courses, or drop-in sessions could be inaccessible for people with aphasia (Egan, Worrall, & Oxenham, 2004). Staff or volunteers operating computer support sessions may not have skills in communicating with people with impaired language. While SLTs have knowledge about language impairment and its impact on participation, they may experience barriers or exhibit varying levels of confidence when providing assistance with technology. The experience of SLTs in this area is not described in the literature. In an unpublished study, Johnson, Morris, and Menger (2014) asked SLTs to identify barriers to using technology with their clients. The most cited barriers were suitability to use technologies, cost of equipment and software, availability of equipment loans and software trials, and awareness of what might benefit their clients. Other professionals are also likely to contribute in this area, for example, Occupational Therapists regarding environmental modifications to facilitate Internet use,

Physiotherapists to advise on seating and positioning, and Rehabilitation Engineers to assess and advise on access to equipment for people with physical disabilities.

1.3.4 Personal Factors

Personal factors are defined as '*gender, age, coping styles, social background, education, profession, past and current experience, overall behaviour pattern, character and other factors that influence how disability is experienced by the individual*' (World Health Organization, 2002, p. 10). We can extrapolate from the literature discussed in section 1.2, that motivation, skills, and barriers to Internet use vary greatly amongst individuals. Differences in Personal Factors may relate to any of the demographic factors discussed. Gender, for example, remains an area of concern in relation to digital exclusion of older women (Office for National Statistics, 2016). Differences in Personal Factors are also relevant for the aphasia population and for those in their environment providing a caring or therapeutic role. Any mismatch between the person with aphasia and those offering assistance could lead to differing views and opinions on what is most important in terms of support and/or rehabilitation. This could have consequences for the nature of support provided.

1.4 Literature Review: Aphasia and Technology

The literature on factors related to digital exclusion and the insight gained via the ICF framework confirms that digital exclusion of people with aphasia is potentially a complex problem. For many people with aphasia, there are likely to be several factors influencing their ability to successfully use the Internet and other areas of technology. Given this complexity, it was important to conduct a literature review with the following aims:

- 1) To identify literature relating aphasia and technology, thus enabling a broad overview of the foci of previous research in this area.
- 2) To critically review studies related to any changes in patterns of Internet use following aphasia.

- 3) To critically review studies on interventions to support people with aphasia with aspects of Internet use.

To address the first of these aims and identify the literature relevant to aphasia and technology, initial searches were carried out using PsychINFO and Linguistics and Language Behaviour Abstracts (LLBA) databases by entering the terms (aphasia or dysphasia) and (computers or technology) or (internet or human computer interaction) into search fields. Initial searches were from January 1990 until June 2015 (later updated). In addition, the terms “aphasia,” “aphasic,” “dysphasia,” “language impairment,” and “speech and language therapy” were entered into the Association for Computing Machinery Digital Library which yielded further results from the field of computing science. These searches were carried out as part of the author’s original published literature review (Menger et al., 2016), which was updated from 2015 onwards via relevant journal and google scholar alerts, and via conference attendance. Therefore, several key or recent papers which did not appear in original search results were also included in this updated review.

Search results were reviewed firstly by title and then by title and abstract. In relation to the first of the above aims, literature broadly related to aphasia and technology could be categorised into the following themes from title and abstract information: computerised therapy, design of technology for aphasia, use of specialist software with aphasia, mobile technologies, and accessibility of text. This literature provided valuable insight into use of technology with aphasia, e.g. difficulties with access, design considerations, experiences of SLTs and end users, and identification of barriers and enablers to technology use. Each theme is summarised in section 1.4 below. Given the amount and diversity of the literature found, this section is not exhaustive and does not systematically review the quality of the work within each area. Rather, it discusses key themes emerging from the literature and uses examples to illustrate specific points. In relation to the second and third aims of the literature review, literature was also identified that was more directly related to either patterns of Internet use with aphasia or to interventions to support people with aphasia with computers and the Internet. These papers are critically reviewed in greater depth in sections 1.4.2 and 1.4.3 below.

1.4.1 Overview of previous research

Computer therapy for aphasia

In the 70s and 80s, the application of computers for speech and language therapy (SLT) began to slowly emerge in the literature (e.g., Colby, 1973; Holland, 1970). In relation to aphasia, computers began to be used for the facilitation of specific therapy activities, such as phonemic cueing (Bruce & Howard, 1987) and confrontation naming (Katz, Wertz, Davidoff, Shubitowski, & West Devitt, 1989). Later in the 1980s came the first use of computers as aids to augment communication for people with aphasia (Steele, Weinrich, Wertz, Kleczewska, & Carlson, 1989) and the first comparisons between computer aided vs. face to face therapy provision (Loverso, Prescott, Selinger, & Riley, 1989). These early studies paved the way for innovative SLT practice using technology over the next three decades. Therapy delivered via computer is sometimes investigated as a means to increase efficiency of service delivery, as an alternative to face to face treatment, and as a way to allow clients to work in their own homes at their own pace and at a time convenient to them (Palmer et al., 2012, 2015). Although the evidence base in this area is growing, a recent systematic review found only seven studies to include in the review and was unable to conduct a meta-analysis due to heterogeneity of study designs (Zheng, Lynch, & Taylor, 2016). Zheng et al. concluded that computer-based SLT may be as effective as that delivered by a clinician, but that their findings should be viewed as preliminary due to lack of high-quality evidence.

For people with aphasia to benefit from computer therapy, they also need to be able to access the necessary hardware and software. One consideration is the ability to control a computer, e.g., to select items on a screen. Crerar, Ellis, and Dean (1996) did not find direct access to be problematic. These authors observed their participants' ability to use a mouse prior to commencing computerised treatment and found nearly all participants could access therapy software in this way. More recently, Palmer et al. (2012) conducted a pilot randomised control trial (RCT) on computer therapy versus usual care for people with post-stroke aphasia. They provided participants who had upper limb impairments or difficulties using a mouse with a trackball or a touchscreen alternative and they were able to use these alternatives to make selections during exercises. When

working with people with acquired apraxia of speech and aphasia, Varley et al. (2016) aimed to minimise any external distractions by making their therapy application the only software participants could access on a loaned laptop. These types of adjustment illustrate how tailored environments can be created for people with aphasia, modifying provision of computerised therapy to best fit each person. These studies did not systematically evaluate the effectiveness of any alternative means of access for their participants but also did not report any specific difficulties.

Mortley, Wade, Davies, and Enderby (2003) used a simple user interface for aphasia therapy software and investigated the feasibility of remote monitoring of the therapy. Participants could use the therapy software independently but several difficulties emerged during the multi-step process of transferring results from the participants' computer to the therapist's. Such obstacles would now be much easier to overcome due to the widespread use of cloud computing, where data can be simultaneously available for many users at the same time. In addition, the development of web-based applications removes the need for installation of specific software. Such advances in technology have potentially eliminated several of the barriers experienced by Mortley et al. and their participants.

There are also examples of innovative design and development of technologies as an adjunct to traditional SLT. For example, the use of digital pens to create interactive paper materials or photographs (Piper, Weibel, & Hollan, 2011, 2014), delivery of gesture therapy using sensors to read participant gestures (Marshall et al., 2013), and the development of a virtual gaming environment to practise communication skills (Galliers et al., 2012; Galliers & Wilson, 2013) or to carry out interventions in virtual reality (Marshall et al., 2016). Such innovations demonstrate thinking beyond the more traditional means of 'screen plus keyboard and mouse' access, opening up possibilities for ways to engage with computers and the Internet that are potentially less intimidating, more accessible, intuitive and motivating.

The attitudes of those who support people with aphasia with computers for therapy is also relevant when considering acceptance and adoption of technologies. Wade, Mortley, and Enderby (2003) reported that partners could influence access to therapy in

a positive way through intuitive knowledge of the needs of the person with aphasia. However, demands on and/or preferences of the partner should also be considered; one partner in Wade et al.'s (2003) study found providing support with therapy very taxing. Similar experiences were reported by volunteer trainers in Egan et al.'s study on computer training (2004); one volunteer reported feeling frustrated with the slow progress of their partnered person with aphasia. Palmer, Enderby, and Paterson (2013) also described how some carers preferred not to provide help with computer therapy, and were happier with an external volunteer working with the person with aphasia. This may relate to burden of care and external influences on carers' time, or perhaps to their confidence and skills for using technology.

Alternative and augmentative communication (AAC)

The development of technology for aphasia can also be seen in the production of high-tech AAC devices. This domain demonstrates collaborative design efforts between SLTs, computing scientists and, in some cases, end users. Examining factors related to success or failure of AAC use has great relevance to adoption or use of other types of technology. Van de Sandt-Koenderman (2004) reviewed literature on high-tech communication aids and found that limited evidence existed on the effectiveness of high-tech AAC for aphasia. She argued that there is a moral obligation for clinicians to conduct further research in this area and to embrace technologies that might be of benefit. In a review of the literature on AAC for aphasia, Jacobs, Drew, Ogletree and Pierce (2004) found that most studies did not show evidence of generalisation of AAC use outside of clinical settings. Jacobs et al. suggested success may be due to several factors and there may also be failure to support people with aphasia to use high-tech devices in more natural environments. Moffatt, Pourshahid, and Baecker (2017) conducted a web-based survey of clinicians to investigate their views on which people with aphasia were the most successful adopters of high-tech AAC. The most cited characteristics were motivation, having supportive and technologically able carers, being young and tech savvy (*sic*) and having relatively intact auditory comprehension skills.

Thus, implementing AAC technologies for aphasia is highly complex. Concluding their review, Jacobs et al. recommended that language, motor, and cognitive deficits should

be considered alongside factors such as readiness for intervention and means of introduction. Jacobs et al. also discuss the environment of people with aphasia, advising that different environments and levels of familiarity with technology introduce different challenges. The complexity of this area of technology use for aphasia has strong similarities to literature discussed in section 1.2 on factors influencing more general computer and Internet use.

Multi-disciplinary collaborations and user involvement are common in the field of AAC. For example, early work by Waller, Dennis, Brodie, and Cairns (1998) on developing 'TalksBac', an AAC system for aphasia, involved an SLT and participants with aphasia in its development and evaluation. Davies, Marcella, McGrenere, and Purves (2004) used ethnography to inform the design of a communication aid. They reported that ethnography, although time intensive and demanding for participants, informed production of the AAC device. Boyd-Graber et al. (2006) utilised SLTs as proxies in the design process. These authors described how they progressed from early paper prototypes to a working AAC device for trial with people with aphasia. Description of the process of design is invaluable in demonstrating how developments can be made through collaborations with those who know and understand aphasia. This is also seen in studies involving people with aphasia and their partners at various stages of design and redesign (e.g., Galliers et al., 2012; Koppenol, Al Mahmud, & Martens, 2010; Al Mahmud, Gerits, & Martens, 2010) or people with aphasia and SLTs (Messamer, Ramsberger, & Atkins, 2016).

Recent developments have produced increasingly bespoke and user-sensitive AAC for aphasia, for example, the use of portable cameras to capture life experiences and share stories (Al Mahmud et al., 2010), the combination of low-tech with high-tech communication support (Al Mahmud, Dijkhuis, Blummel, & Elberse, 2012) or by GPS technology to provide context-aware support and access to vocabulary (Demmans Epp, Djordjevic, Wu, Moffatt, & Baecker, 2012; Kane, Linam-Church, Althoff, & McCall, 2012). Collaborative multidisciplinary work with a focus on aphasia and technologies was carried out by the Aphasia Project (McGrenere et al., 2003). This research group discussed the challenges of designing technology to suit the intended end users and

stressed the importance of having people on a design team who can communicate with a population with impaired language. Work from the Aphasia Project produced several innovative technology designs, including a sound and image enhanced daily planner (Moffatt, McGrenere, Purves, & Klawe, 2004), a visual recipe book (Tee et al., 2005) and 'Photo Talk', a digital image communication application (Allen, McGrenere, & Purves, 2008). Wilson et al. (2015) reported on how they consulted with people with aphasia on the design of two technological projects (GeST and EVA Park). They used techniques such as visual representations to facilitate discussions (e.g., screen grabs and photos of equipment), physical demonstrations, and high fidelity prototypes to reduce the levels of abstraction needed to understand information and to facilitate communication of ideas from people with aphasia.

Projects involving end users in the design process demonstrate how those with the greatest insight into living with aphasia, people with aphasia themselves, can be supported to evaluate new technologies. There is much to learn from such projects regarding facilitation of Internet use. Collaboration between end users, those who support them, and experts in human computer interaction reveal how it is possible to use innovation, creativity, and intelligent design to identify solutions to difficulties.

Software to support literacy skills

People with aphasia are a relatively small and heterogeneous population (Engelter et al., 2006; Wade, Hewer, & David, 1986). For this reason, it seems appropriate to utilise widely available tools where possible. Software designed for larger populations runs less risk of dating quickly and is widely available. Voice recognition software is an example of technology designed for other types of disability being investigated as a possible tool for people with aphasia. Wade, Petheram, and Cain (2001) conducted a study to determine whether the software of that time could understand aphasic speech. Initial results from six participants showed the software had poor levels of acceptability for understanding single words. Nevertheless, the authors made recommendations for how specific training and support might improve the accuracy of speech recognition for people with aphasia and therefore its usefulness. Speech recognition technology has since evolved and has been evaluated in single case studies as an aid to writing, with positive results

for individuals related to functional writing and social participation (Bruce, Edmundson, & Coleman, 2003; Cauté & Woolf, 2016; Estes & Bloom, 2011). Such studies are useful in describing the nature of interventions using speech recognition and its potential uses for those whose spoken output is better than their ability to write or type. However, there is still limited guidance on more detailed aspects of candidacy, for example, regarding the usefulness of speech recognition technology for people with varying severities of aphasia, or with additional physical or cognitive deficits.

Another form of technology designed to assist writing is that of word prediction. Armstrong and MacDonald (2000) reported on the case of a young client with mild aphasia who experienced long-term benefits of using word prediction software for his functional writing. However, the authors provided very little detail on the nature of the intervention with their client other than that he received 12 sessions of training in using the programme. Therefore, it is difficult to determine what may have effected change in this case. Behrns, Hartelius, and Wengelin (2009) investigated the use of computerised writing support for aphasia and used word prediction software with two of their participants. They collected data using keystroke logging and carried out training in using the software, which was delivered in both individual and group sessions. Behrns et al. provide detailed description of their participants' experience of using the software, for example, when they needed prompting and how they behaved when attempting to self-correct errors. They found mixed results as to the benefits of word prediction. For example, one participant was slower when using the software but more efficient when it came to editing his own text. Neither participant improved their spelling and lengths of texts varied considerably between measures. Behrns et al. acknowledged that it was not possible to determine the role of the software in any improvements in written language, as their participants also took part in repeated writing practise. Thiel, Sage and Conroy (2016) conducted a case series study to investigate the use of predictive writing software (Co-Writer) in an intervention with eight participants with aphasia. Their findings showed the technology had benefits for some participants. They found within group differences; for example, those with additional cognitive deficits beyond language impairment had a need for adjustments to reduce the demands of using the software. These findings are in line with literature described in section 1.2.2 on the relationship

between cognitive difficulties and Internet skills. They confirm that individuals with aphasia plus additional cognitive deficits may find it more difficult to learn how to use new technologies. The above studies point to some benefits of word prediction for aphasia but as yet there is insufficient evidence to make any definitive claims on its use to improve writing ability.

Text to Speech reading support, originally used in developments for the visually impaired (Edwards, 1989), may also be used to help people with acquired dyslexia who benefit from hearing the written word being read aloud. As with voice recognition software, the evidence for use in aphasia is based on single case studies (Dietz et al., 2014; Harvey, Hux, & Snell, 2013). Results show some positive benefits, but there is a lack of rigorous evidence available. There remains a need for further research to establish whether computer-generated speech can aid people with aphasia to understand written information and, if so, whether it can be effectively used as a functional strategy for everyday reading.

Dietz, Ball, and Griffiths (2011) published an overview of technologies used to assist people with aphasia with literacy skills. They concluded further guidance is needed to strengthen the evidence base for interventions to support traditional types of reading and to provide guidance for web accessibility for aphasia. Therefore, research into software to assist aspects of literacy on computers is limited. The sophistication of voice recognition software, word prediction, and text to speech continues to evolve. These features are now standard on most computers, tablets and smartphones, so as tools which are relatively affordable and easy to access, they warrant further investigation in aphasia rehabilitation.

Accessibility of text

Reading skills are needed to understand website menu items, information content, picture and video captions, and user-generated text (e.g., Twitter or message boards). Impaired reading can, therefore, negatively impact Internet use. When considering the differences between reading on paper and on screen, it is important to recognise that the two media are not directly equivalent. On-screen reading is slower than paper based

reading (Noyes & Garland, 2008). However, technology allows us greater flexibility for adaptations to screen based text. Research on the reading abilities of people with aphasia may need adaptation to be relevant to research related to reading online content. Ghidella, Murray, Smart, McKenna, and Worrall (2005) examined the accessibility of websites with content related to aphasia. They investigated the views of both SLTs and people with aphasia by asking them to rate websites on their perceptions of quality and accessibility. SLTs and people with aphasia disagreed on which they felt was the most accessible site, with the site favoured by people with aphasia felt to be inappropriate for aphasia by many of the SLTs. These findings illustrate the importance of consulting and including people with aphasia in the design of websites aimed for them and recognising that they may have a different perspective on what is and is not accessible. Kerr, Hilari, and Litosseliti (2010) examined what type of information people with aphasia wanted on websites about aphasia, and how that information should be structured. Their method for investigating how best to organise information involved asking people with aphasia to sort cards containing written and pictorial representations of website content. Participants could place different types of information under group headings or create more headings if needed. Kerr et al.'s study is a good example of a way of including people with aphasia in the web design process. However, the study was relatively limited in that it focused only on content directly relevant to living with aphasia. Although such information is important, people living with aphasia are likely to be interested in accessing information across many other areas of the Internet (Devlin & Unthank, 2006).

Telerehabilitation

Recent years have also seen an increase in the use of telerehabilitation, allowing therapy to be carried out by people with aphasia in their own homes while being remotely monitored by clinicians. Evaluation of telerehabilitation for aphasia is emerging (Fridler et al., 2012; Georgeadis, Brennan, Barker, & Baron, 2004; Hall, Boisvert, & Steele, 2013; Hill, Theodoros, Russell, Ward, & Wootton, 2009; Woolf et al., 2016). Telerehabilitation is often viewed as a means to increase intensity, and to enable access to speech and language therapy for those in more remote communities. Innovative uses

of technologies for remote delivery of therapy are also emerging, e.g., the use of virtual therapists (Cherney et al., 2007) or delivery of interventions within a virtual world (Marshall et al., 2016). Such new means of service delivery may change the way SLTs practise by embedding digital technologies into delivery of interventions. Embracing technologies and the Internet to deliver rehabilitation is innovative, and an exciting time for the SLT profession. However, it is important to ensure that digital inequalities or difficulties accessing technology do not prevent equality of access to services. There is currently a paucity in the telerehabilitation literature of such considerations.

Mobile technologies

In recent years, technology has become increasingly mobile. Smartphone or tablet ownership is reported to be two thirds of the UK population (Ofcom, 2015). Despite the prevalence of mobile technologies as part of everyday life, their accessibility for people with aphasia is largely unexplored. Potential barriers and facilitators to mobile phone use for people with aphasia were investigated by Greig, Harper, Hirst, Howe, and Davidson (2008). However, the design and capabilities of phones and tablet computers have since changed considerably. Such changes could bring different barriers and facilitators to their use for people with aphasia. The use of mobile devices for aphasia therapy via therapy apps has grown in prominence in recent years and the influx of new resources is difficult to continually evaluate and appraise (Brandenburg, Worrall, Rodriguez, & Copland, 2013). Several guidelines and descriptive accounts of therapy-related applications for mobile technologies are available (e.g., Brandenburg, Worrall, Copland, Power, & Rodriguez, 2015; Holland, Weinberg, & Dittelman, 2012; Hoover & Carney, 2014; Kurland, 2014; Ramsberger & Messamer, 2014; Szabo & Dittelman, 2014). However, the surge in apps for aphasia has not been met with the same level of critical evaluation and research evidence as conventional face-to-face therapy studies, computerised therapy, or the field of AAC. As well as ensuring there is evidence behind the content of mobile based therapy applications, any evaluation should seek the views of both SLTs and people with aphasia to ensure they are accessible across aphasia severities. As with telerehabilitation, there should also be steps to ensure that the most vulnerable individuals, particularly those with very severe aphasia, are not prevented

from taking part in research or accessing services. Mobile technologies have a role in everyday participation as well as in rehabilitation, and this aspect of their use also needs to be addressed.

Participatory design

There is a small body of literature describing how researchers have taken a participatory design approach to aspects of Internet use by people with aphasia. One tailored design for aphasia was seen in the development of AphasiaWeb, an accessible social media tool (Buhr, Hoepner, Miller, & Johnson, 2016). This study also used a participatory approach to identify design features such as means of data input and type of content. Participants in a two-month trial of the software were able to use the accessible platform to share pictures and messages with other people with aphasia, and could comment and engage in discussions on the posts of others. Such a short trial does not demonstrate whether use of the network was maintained. In addition, the authors acknowledged that some participants with aphasia wanted to engage with more mainstream social media platforms such as Facebook and Twitter. However, they suggested that an accessible social media environment might be an appropriate and beneficial tool for sharing experiences of living with aphasia.

With such tailored software such as the examples above, there is also always the concern that operating systems will change and no longer support some aspects of the application (Jaeger, 2012). Specific software for aphasia, if provided for use outside of research, would need to be maintained and updated as technology evolves.

1.4.2 Internet use following stroke or aphasia

Previous studies investigating computer and Internet use amongst people with aphasia have provided insight into aspects such as the popularity of various activities, dependence on support, and types of devices and software used. In a conference report, Elman and Larsen (2010) described how they examined computer ownership and Internet use amongst people with aphasia attending a support centre in the USA. They conducted a face-to-face questionnaire and found that although Internet activities had decreased post-stroke for people with aphasia, this was not due to lack of interest.

They recommended that bespoke training programmes should be available to prevent exclusion of people with aphasia from use of computers and the Internet. Elman and Larsen's study is now several years old. Given the phenomenal expansion and developments in digital technology in recent years, it may no longer be as relevant to current types of Internet use. Finch and Hill (2014) published the results of a postal questionnaire on computer and Internet use by people with aphasia, predominantly in the context of using computer programmes for rehabilitation of speech and language skills. Their questionnaire was adapted to provide assistance for people with reading difficulties and participants could be aided to complete the questionnaire by a family member or friend. The study provided useful insight regarding what people with aphasia thought about computers as part of their daily lives and their rehabilitation. Most of the respondents did use computers (84%) but also reported they would require assistance with setting up a computer and with using relevant therapy software (see section 1.2.4 on access to support). Use of computers was common for a variety of tasks pre-aphasia, with work and emailing being the most popular activities. With aphasia, computer use for a variety of daily activities became less frequent and patterns of use changed, with more of a focus on therapy and entertainment purposes. The use of proxy respondents should raise concern about validity of responses (Cruice, Worrall, Hickson, & Murison, 2005; De Jong-Hagelstein et al., 2012). It is also important to consider the possibility that a postal questionnaire unintentionally excluded individuals without access to a friend or family member who were unable to complete a questionnaire on their own.

Gustavsson, Ytterberg, Tham, Nabsen Marwaa, and Guidetti (2016) conducted focus groups on ICT use with Swedish and Danish people who were between 6-12 months post-stroke. The majority indicated at least slight difficulties with communication; however, the specific nature of their communication difficulties was unclear. Participants had all been ICT users before their stroke and reported positive feelings about the use of ICT in their daily lives, viewing them as tools to increase independence and to feel safe and connected to others. They reported using ICT to engage with everyday life for entertainment and leisure, and to manage everyday activities such as shopping and banking. Participants also reported stroke related barriers, describing difficulties with fine motor skills, memory, perception, and speech. They discussed strategies they had used

to overcome these difficulties; for example, by adjusting settings or using larger screens on tablet devices. These strategies were generated alone or with help from friends. Participants reported feeling they had a need for further support as they felt insecure and lacking in knowledge. This study provided useful insight into ICT use post-stroke. However, there was lack of clarity regarding how specific post-stroke impairments affected the participants and no clear distinction between the ICT use of those with and without impaired language.

To summarise, the above studies provide only partial insight into the experience of using the Internet with aphasia, as they focus on a limited range of activities and fail to establish the impact of aphasia in the context of other potentially pre-existing risk factors for digital exclusion (see section 1.2 above). The studies do demonstrate that people with aphasia continue to use computers, both within therapy and for everyday social participation. However, they do not capture detail on how the Internet is used or whether support is needed. They also do not reflect Internet use with aphasia in the context of the phenomenal expansion and developments in digital technology, mobile devices, and social media in recent years (Dutton & Blank, 2011; Dutton et al., 2013; Office for National Statistics, 2017a). To address, this gap in the literature, the first aim of this thesis was to investigate the barriers and enablers experienced by people with aphasia in relation to using the Internet. Research questions related to this aim were as follows:

- *How do people with aphasia use the Internet?*
- *What types of difficulties with Internet use can be attributed to aphasia?*
- *What other factors might contribute to ability to use the Internet with aphasia?*

The first stage of this thesis begins to address these questions. A supported questionnaire was used to investigate Internet use amongst a sample of people with aphasia in comparison to a matched group without aphasia. Comparison of these two groups enabled the role of aphasia in relation to Internet use to be illuminated against a background of other contributory factors such as age and acquired disability.

1.4.3 Intervention Studies

The second most relevant area of research identified by the literature review was that evaluating Internet-related interventions for people with aphasia. The criteria adopted for selecting these studies were those where authors had developed and tested an intervention with the aim of improving Internet use or skills for people with aphasia. Of most interest were papers not related to the use of the Internet for rehabilitation, but to everyday communication and interaction carried out online. Only four published examples of this type of work were identified. An additional study was considered which had been presented as a poster at an international aphasia conference. Each of the studies are listed in Table 1-1.

Authors	Year	Title	Summary
Egan, J., Worrall, L., & Oxenham, D	2004	<i>Accessible Internet training package helps people with aphasia cross the digital divide</i>	The evaluation of an accessible Internet training package for groups of people with aphasia.
Al Mahmud, A., & Martens, J.-B.	2015	<i>Iterative Design and Field Trial of an Aphasia-Friendly Email Tool</i>	A section of this paper describes training people with aphasia to use an aphasia-friendly email tool.
Aujla, S., Lancashire, T., & Cruice, M.	2016	<i>Accessing the Internet: An adapted beginner's computer training course for people with aphasia [poster].</i>	This poster presentation described SPLIT – Speech and Language Therapy and Information Technology, an adapted beginner's computer training course for people with aphasia.
Caute, A., & Woolf, C	2016	<i>Using voice recognition software to improve communicative writing and social participation in an individual with severe acquired dysgraphia: An experimental single-case therapy study.</i>	The study describes a single-case intervention which used voice recognition software to improve communicative email writing.
Kelly, H., Kennedy, F.,	2016	<i>Narrowing the "digital divide"—facilitating access to</i>	The evaluation of an accessible Internet training

Authors	Year	Title	Summary
Britton, H., McGuire, G., & Law, J.		<i>computer technology to enhance the lives of those with aphasia: A feasibility study.</i>	package for groups of people with aphasia. Content was adapted to the needs of individuals in the group.

Table 1-1: Intervention studies on Internet use with aphasia

To review the quality of the interventions described in these studies, each was critically reviewed using the TIDiER (Template for Intervention Description and Replication) checklist (Hoffmann et al., 2014) as a guide to how well the interventions are described and whether they could be replicated.

Three of the five studies developed and evaluated training programmes aimed at teaching computer and Internet skills to people with aphasia. These were based on the premise that individuals with aphasia may need training to enable them to access the Internet because training currently available to the general population may be inaccessible for them. Egan, Worrall and Oxenham (2004) were the first to explore this area. They created a self-directed training manual which they developed in conjunction with people with aphasia, and delivered the package in a group setting using volunteer tutors to facilitate access to aphasia-friendly written instructions, and to encourage learning at an individualised pace. Materials used in the intervention are not described in any detail in the paper, nor are examples available as an appendix. Frequency and length of sessions are not specified although each one was designed to last one to one and a half hours. Each person had a minimum of six lessons but individual variation is not reported, nor is any record of hours participants spent on practice in their own time. Adherence to the manualised materials by volunteer tutors is unknown. The authors report that a post-intervention questionnaire revealed that over half of the participants felt they could use the training materials independently. The remainder required varying levels of assistance. This showed that accessible training materials alone were not sufficient to support some people with aphasia to use computers. Although not all their participants were successful in achieving independent use, Egan et al. explained that this did not necessarily equate to a measure of success, as some who required help from the volunteers also reported they were happy with a supported experience. This

insight highlights a need to define what constitutes a successful experience of using the Internet, as this may not necessarily mean fully independent digital skills. Egan et al.'s study provided important insight into the needs of people with aphasia who wish to learn to use computers. However, as it is now nearly 14 years old, the manualised materials would very likely be out of date. Rapid increases in the number of people using the Internet will now mean that groups of people with aphasia with no previous Internet experience are rarer than over a decade ago. In addition, the study failed to illuminate the factors that might influence whether a person needed more or less support from the programme, e.g. the experience of the volunteer tutor, severity of aphasia, non-verbal cognitive impairment, the ability to practice at home, support from others at home, previous experience with computers or other technology. The study also did not take into account individual goals or preferences of the participants, despite qualitative data from the interviews demonstrating that people had an interest in specific areas of Internet use. Kelly, Kennedy, Britton, McGuire and Law (2016) provided a more bespoke package of Internet training for people with aphasia, also delivered within a group setting. This more recent study involved people with diverse pre-stroke experience with computers in a group intervention and expanded on Egan et al.'s (2004) study. The course materials were based on the work of Egan et al. along with computer training materials available for the wider public. The structure of this intervention is well described and differed from Egan et al.'s study in that one to one support was provided by student SLTs and participants were given the opportunity to indicate topics they wished to learn. Each person was also assessed to determine any specific needs for language support, which was then offered by their SLT student supporter. Intervention was offered at two different levels of intensity with all participants invited to a shared refresher session. Outcomes were positive, and the authors were able to facilitate interactive and social use of the Internet, demonstrating the potential to increase engagement and improve quality of life. Participants in their study provided feedback within small focus groups. All participants agreed on the benefits of a one-to-one or one-to-two support when accessing the training. This study reinforces Egan et al.'s finding that individualised support is beneficial to people with aphasia when learning computer skills. However, as with the 2004 study, it does not describe individual interventions in a

way that could be replicated by other clinicians, nor does it explain how interventions for each individual within the group were chosen based on their individual profile and needs. The final study to examine group interventions on computer and Internet skills was the conference poster report of an ongoing project at City University, London. Aujla, Lancashire, and Cruice (2016) report on a study that carried out introductory computer training sessions for people with aphasia. Their initial evaluations had some positive results for improving participants' frequency of technology use. Analysis of Aujla et al.'s group feedback sessions revealed participants felt they benefited from access to course leaders with a knowledge of aphasia and appreciated the availability of accessible materials. This work has yet to be published, therefore it cannot yet be ascertained how well any published report might comply to TIDieR guidelines for reporting interventions. As with the two above papers, the study also suggests that there are benefits of group training sessions and of individual support and encouragement within these group settings. However, there are several restrictions of such a model of service provision. The ability to attend such sessions may be restricted to those able to travel to the venue. People with physical or financial restrictions may not be able to attend. There are also challenges of measuring and sustaining change with this type of intervention, and of creating personalised interventions for individuals with a range of skills (Kelly et al., 2016). The differing needs of individuals (see section 1.2) are likely to be difficult to manage within a group intervention, even with individualised support. As more people are exposed to the Internet and communication technologies, goals are likely to be more related to rehabilitation of existing Internet skills or to communication technology to support or supplement verbal interactions. The latter was the case in Al Mahmud and Martens (2010) study, in which an application built via participatory design was subjected to a field test by a small number of people with aphasia. Al Mahmud et al. developed an accessible email interface for aphasia, which contained a mini-dictionary tool to assist with word finding. They evaluated the usefulness of the tool for people with aphasia by measuring message length and time taken to produce an email, and by collecting data on how often participants used the mini-dictionary. They found that vocabulary support from the mini-dictionary was beneficial and that this could help people to compose messages. The intervention described in this paper had the aim of

introducing people with aphasia to the adapted email software and demonstrating how it could be used. All Instruction was carried out by computer scientists following advice from SLTs and there is a lack of detail on how this took place. There is also no description of whether settings or training materials were adapted for individual needs. Therefore, it is difficult to ascertain whether the results of the study in favour of the 'Amail' software could be replicated with a different group of people with aphasia, or whether more individualised support might have been beneficial. Feedback obtained from the study participants did identify several areas to improve the design, in particular the use of text-to-speech to read aloud emails and the need for a step-by-step guide to using the tool. However, the complexity of language used to obtain feedback in this study should raise concerns about whether some people with aphasia were able to give reliable feedback on their experiences. Detailed qualitative observations of the software being used in comparison with participants' linguistic and other cognitive skills may have provided more accurate representation of its usefulness for different presentations of aphasia and detail at the level of individual case studies would have been beneficial. Only one single-case was found, that of Caute and Woolf's (2016) case study on a man with aphasia and dysgraphia who was supported to use voice recognition software (VRS) to improve his emailing skills. The intervention is described in some detail in this paper, and the decision to use VRS with this client is justified from assessment results and related to his individual goals for therapy. The study also considers the wider benefits for the person with aphasia in the intervention, demonstrated via an increase in measures of social participation. There appeared to be long-term gains for this man as a result of this individualised approach.

The above review provides a strong argument that although existing research in this area is timely and innovative towards supporting people with aphasia to use the Internet, there are considerable gaps in knowledge. The studies reviewed above provide evidence that people with aphasia can benefit from support to access computers and Internet technologies but the main weaknesses of these intervention studies are a failure to adequately describe interventions, a need to address individual presentations of aphasia, to take into account different goals and previous levels of experience, and to recognise that interventions to support Internet use may be much influenced by factors

external to aphasia. The consequences of failing to support people with aphasia with Internet skills could exacerbate inequalities of access to several essential areas of participation in daily life. Elman (2001) discussed how difficulties with using the Internet could increase isolation and disadvantage for the aphasia population. More recently, Van de Sandt-Koenderman (2011) echoed these concerns, reflecting that the use of technology in aphasia rehabilitation has neglected the area of web accessibility. Van de Sandt-Koenderman called for further research in this area to enable online means of social participation and interaction. The review of literature also demonstrates that previous research on Internet use with aphasia remains sparse in comparison with research on other aspects of technology. Greater understanding is needed on how to prevent exclusion of people with aphasia from participation in the benefits of the Internet. Moreover, there is also a need to broaden the evidence-base of SLT interventions in digital domains of communication. Viewing Internet use by people within aphasia through the ICF framework demonstrates that success is reliant not only on ability to use language to participate and interact, but also on a wide range of other factors from across ICF components. Understanding the potential barriers and enablers linked to each component would allow for a holistic view of the factors involved. This would help identify areas of need for individuals and for the wider aphasia population. Such insight is important, because in the same way that SLTs may address a person's goal to read paper versions of a newspaper or novel, goals may now be related to reading online versions of newspapers or novels on e-readers. Such changes in everyday living have broadened the scope of clinical practice. As well as attending support groups, people with aphasia may now wish to access support with living with a long-term condition from online forums or groups. As an alternative to using the traditional telephone, they may want to engage with video calling services such as Skype or FaceTime because of the multi-modal interaction such technologies afford. By viewing the Internet as a potentially excluding environment, it is possible to see barriers for people with aphasia not solely related to making devices work and navigating their content, but to a range of other factors.

Therefore, the second part of this research aimed to address these issues by taking a case-based approach to exploring assessments, interventions, and outcome measures

for individuals with aphasia who have goals related to Internet use. It asks the following research questions:

- *How can people with aphasia's difficulties with Internet use be approached in assessment and intervention?*
- *How can effectiveness of interventions for people with aphasia be measured?*

Four single-case experimental design studies were carried out to address the above research questions. The case studies were guided by the ICF framework and also enabled further investigation of the barriers and enablers to Internet use for individuals with aphasia. Each one explored interventions to support aspects of Internet use for a person with aphasia by employing a structured experimental design around assessment, decision making, intervention, and outcome measurement.

1.5 Thesis Structure

The aims and research questions emerging from the above literature review are addressed within this thesis in two main stages. Chapters two and three present the method and results of the initial stage, a questionnaire study examining the Internet use of skills of people with aphasia in comparison with peers without aphasia. The thesis then moves on to the second stage of this research and Chapter four presents the methods used across four single-case intervention studies with people with aphasia who had goals related to Internet use. Chapters five to eight each present a single case study. Finally, chapter nine brings together findings from the two stages discussed above by returning to the research questions outlined in this introduction. It discusses how this thesis addressed the current gaps in knowledge and considers the results of both stages of the study in relation to recommendations for research and clinical practice

Chapter 2. Internet Use with Aphasia: Stage One Methods

2.1 Introduction

The literature review in Chapter one revealed there is little published material on how aphasia contributes to difficulties using technologies and the Internet. A small amount of literature was available on Internet and technology use by people with aphasia (Elman & Larsen, 2010; Finch & Hill, 2014) and following stroke (Gustavsson et al., 2016). These studies showed that people with and without aphasia post-stroke continue to use computers, both for therapeutic purposes and for everyday social participation. Although they provided insights into how people with aphasia or post-stroke engage with computers and the Internet, they did not clearly identify the impact of aphasia on Internet use. Literature from outside the domain of aphasia research provided insight into how barriers to Internet use are multi-factorial (e.g., Helsper & Reisdorf, 2016). Thus, the role of aphasia should be considered alongside a range of other possible factors. Chapter one also discussed research findings that demonstrate there is a spectrum of Internet use ranging from those who embrace all aspects to those who are sceptical and hesitant users (Dutton et al., 2013). Therefore, it is important to acknowledge that there is likely to be considerable variation in Internet use amongst people with aphasia both pre- and post-stroke.

This chapter presents the methods used in relation to the first aim of this thesis, to investigate the barriers and enablers experienced by people with aphasia in relation to using the Internet. To meet this aim, the study collected data from two groups of individuals. All participants had experienced the major health event of stroke but one group presented with aphasia, and the others did not. Studying these two groups enabled data to be collected in response to the three research questions related to the above aim. The questions were:

- *How do people with aphasia use the Internet?*
- *What types of difficulties with Internet use can be attributed to aphasia?*

- *What other factors might contribute to ability to use the Internet with aphasia?*

The key difference between the groups meant that aphasia could be considered an independent variable alongside other variables shared across the two groups, for example, age and level of education. As stroke is more prevalent in older adults (Bhatnagar, Scarborough, Smeeton, & Allender, 2010), the sample was likely to be older than one chosen from a wider population. An older sample increased the likelihood that some participants would have age-related difficulties with Internet use (Chang et al., 2015; Dickinson, Eisma, & Gregor, 2011). All members of the sample had also experienced a stroke and with it the possibility of long-term disability with potential impact on their daily lives.

2.2 Methods

The protocol for this initial stage of the research is available in Appendix A. The study obtained a favourable opinion via National Research Ethics Service Proportionate Review on 25 July 2013 by the South East Scotland Research Ethics Committee (No.1). The initial aim of the study was to recruit two groups of participants: 20 people with aphasia following stroke and 20 people who had had a stroke with no resulting aphasia. Adult individuals with aphasia were recruited via local speech and language therapists working in rehabilitation teams in the local region. Stroke participants (with no aphasia) were recruited by Stroke Research Nurses at review clinic appointments. In addition, local support groups for people with aphasia within the North East Region were approached to establish whether members would be interested in taking part in the research project.

The inclusion criteria were: Adults (over 18 with no upper age limit) with a diagnosis of aphasia resulting from single symptomatic stroke; people with a diagnosis of single stroke; at least six months post-onset of aphasia/stroke; medically stable; willing to participate and complete a questionnaire; able to consent to the study; absence of psychiatric conditions; absence of any other neurological condition; normal (or corrected) hearing and vision. Participants were excluded if any one of the inclusion criteria were not met.

Information sheets informing recruiters and potential participants about the research and consent forms for each group of participants are provided in Appendix B. One leaflet provided introductory information for recruiters, one provided information for support groups, two provided more detailed study information for individual participants with aphasia (one with more written information for people with aphasia with better reading abilities and one for more severe participants), and a final leaflet was provided for people without aphasia. All information passed ethical review and documents and consent forms for people with aphasia were designed using established principles on accessible written information (Herbert et al., 2012; Rose, Worrall, Hickson, & Hoffmann, 2011). To facilitate recruitment of as diverse a sample as possible, the information leaflets emphasised that the study was interested in all people post-stroke, regardless of whether they were familiar with or used the Internet. This was to encourage people with a range of experiences of the Internet to take part.

2.2.1 Data collection

To generate data, all participants were seen in person (one-to-one session) and were asked a range of questions about their Internet and technology use. Each question was presented to be as easy to understand as possible, also informed by research and guidelines on written materials for aphasia (Herbert et al., 2012; Pearl, 2014; Rose et al., 2011). Consequently, materials comprised written versions of the questions with key words highlighted and simple pictures illustrating each question. They were each read aloud by the researcher and repeated or explained further as needed. Possible responses were provided in pictorial and written form, and the researcher again read each one aloud. This was to ensure that verbal responses were not necessary to provide a response. When questions required either a yes/no answer or response on a Likert scale, participants were given clear visual representations of choices. To ensure questions asked of participants were the same, these resources were presented to all participants regardless of whether they had aphasia or not. If relatives or friends were present they were asked not to contribute.

The questionnaire content was informed by detailed OXIS surveys of the UK population (Dutton & Blank, 2011; Dutton et al., 2013, 2009), thereby investigating areas relevant to

current Internet use. Questions were selected to cover a broad range of Internet and technology use. To prevent irrelevant questioning, all participants were initially asked whether they used the Internet. There were then two versions of the questionnaire with each containing a set of core questions. For those who said they were Internet users, Questionnaire A had additional questions on types of use. Those who said they did not use the Internet were given questionnaire B. There were additional questions on whether they had used the Internet in the past and if they wanted to use it in the future. The study design allowed for comparisons between people with and without aphasia, and (for core questions) between those who defined themselves as Internet users and non-users. Each aspect of Internet and everyday technology use covered by the questionnaire is discussed below, with motivation for and explanation of the questions. Core questions presented to all participants are discussed first, followed by those directed at Internet users or non-users. Each area is labelled with an alphanumeric code to match the corresponding sections of the questionnaires, which are provided in Appendix C.

Use of everyday technologies (all participants)^{A5/B2}

To determine how people with aphasia were using technologies in comparison with their non-aphasic peers, pictures of a range of common entertainment, computing, and other digital technologies were presented to all participants. Each person was asked first whether they owned and then whether they used the item.

The Internet for communication (all participants)^{A13-14/B9-10}

Communication is the single most common use of the Internet (Dutton et al., 2009), offering a number of ways to interact with others both socially and professionally. As aphasia is a communication disability, it is of great importance to explore the impact of aphasia on online interactions as well as those carried out face-to-face. All participants were asked about their means of communication with others to allow comparison between online and more traditional means (e.g., use of email and social networking compared with writing or visiting). Participants were also asked to indicate how

frequently they had any contact with others on a five-point visual scale from less than monthly to several times a day.

Barriers to acquiring or improving Internet skills (all participants)^{A4/B3}

Participants had already stated whether they used the Internet. Therefore, this question on barriers to acquiring or improving skills was worded slightly differently for Internet users and non-users. Users were asked about barriers to improving existing skills while non-users were asked about why they did not use the Internet or why they had ceased using the Internet. The choice of possible responses was the same for all participants. Options were informed by the OXIS surveys (Dutton & Blank, 2011; Dutton et al., 2009). The choices 'aphasia' and 'stroke' were added as these were responses potentially appropriate to these participants.

Supported use (all participants)^{A12/B4-5}

Previous research suggests that many older adults are heavily supported with their Internet use; Dutton et al. (2013) reported that 25% of the UK retired sample questioned stated they had access to a proxy who used the Internet on their behalf. Full independence may not always be an ultimate or realistic goal for people with aphasia and many may be satisfied with achieving success while supported by others (Parr, 1992). Although participants were asked whether they used the Internet or not, it was appropriate to assume that there may not be such a clear distinction between 'users' and 'non-users'. Proxy use was investigated by asking those who said they were Internet users whether anyone helped them with each of their Internet activities. Those who said they were non-users were asked if anyone helped them to do things on the Internet. They were given a choice of possible supporters and asked to select the types of activities they were helped with.

Sources of information (all participants)^{A7-10/B6-8}

Access to information is a priority area of need post-stroke (McKevitt et al., 2011). The Internet is a valuable resource for meeting information needs on not just health but a myriad of other areas. Those who are not able to tap into the benefits of such a wealth

of information are more likely to experience disadvantage (Helsper, 2008). To investigate how participants were accessing information, three initial questions were chosen to tap into two differing aspects of information need. The first two questions focused on health and on information directly related to stroke and aphasia. The second question explored a non-health-related topic where information may be needed, that of going on a trip or a holiday. Participants were asked to select their first choice for seeking information on their health, their stroke/aphasia, or going on a trip or holiday and were given a choice of possible responses. To obtain a broader picture of the type of information searched for, participants were then asked a set of eight questions on whether they ever looked for online information on a range of areas. These questions required only a *yes* or *no* response.

Location and means of Internet access (Internet users only)^{A1-2}

To determine the location of any Internet use and types of devices used to go online, all Internet users were asked where they used the Internet and their means of access. This was to determine whether any of the sample could be described as 'next generation users' (Dutton & Blank, 2011), people who use the Internet in a variety of places and on a range of different devices.

Internet skills and activities (Internet users only)^{A3, A11}

Participants rated their own Internet skills, and were asked whether they would like to improve them, providing a measure of levels of satisfaction with their own Internet abilities. They were then asked how often they carried out 20 common Internet activities. Choice of responses ranged from 'never' to 'several times a day'. To establish whether use was independent or supported, participants were also asked whether they had help with the activities, and if so, who provided that help (see section above entitled 'Supported use').

Accessibility Tools (Internet users only)^{A6}

It was also important to establish whether participants were using any tools to assist with their use of computers and the Internet, such as a specialist keyboard or mouse, or

software such as screen readers or speech recognition. Those who said they used the Internet were asked whether they used any adjustments or tools to help, and were provided with a list of possibilities with pictorial representations.

2.2.2 Data Analysis

Responses were viewed first through descriptive statistics on all aspects of the questionnaire. When numbers allowed for meaningful comparisons, further statistical analysis was carried out using pairwise comparisons between people with and without aphasia, and people who said they were Internet users and non-users. Participants with and without aphasia were directly compared in relation whether they defined themselves as Internet users or non-users. Further regression analysis was then carried out to include possible other predictors of Internet use. For the remainder of the questionnaire, all participants were compared by presence or absence of aphasia regarding their use of everyday technologies, the Internet for communication, perceived barriers to acquiring or improving Internet skills, support with using the Internet, and sources of information. Internet users were compared regarding location and means of access, Internet skills and activities, and use of accessibility tools.

Results of the questionnaire study follow in Chapter three. An explanation of the motivation for each question is described alongside the results for that question.

Chapter 3. Internet use with Aphasia: Stage One Results

This chapter presents the results from the survey described in Chapter two, which aimed to investigate the barriers and enablers experienced by people with aphasia in relation to using the Internet. The research acknowledged the known complexities of barriers to Internet use for a population that is predominantly older and may have additional disabilities and compared two groups of people post-stroke with the presence or absence of aphasia as their main distinguishing variable. The two groups both completed a supported questionnaire on their Internet and technology use.

3.1 Participants

Forty-two people who were at least five-months post-stroke were recruited via stroke review clinics, SLTs, and stroke support groups in the North East of England. Participants were recruited in the chronic phase and either lived at home or in residential care. Twenty-five presented with chronic post-stroke aphasia of a range of severities and 17 had had a stroke but did not have aphasia. None had any other neurological or psychological conditions. All were native speakers of English. Severity of aphasia was measured using the scale from the Boston Diagnostic Aphasia Examination (Goodglass, Kaplan, & Barresi, 1983), based on examiner observations during interaction with each participant. Demographic information is shown in Table 3-1. Within the group of people with aphasia, there was a range of severities with representation of people with mild to severe difficulties. Distribution of severity can be seen in Table 3-2. Statistical comparisons (two-tailed) between the two groups did not reveal significant differences in terms of age ($t[40] = -.247, p = .806$), gender ($\chi^2[1] = .494, p = .482$), and levels of education ($\chi^2[2] = .601, p=.741$)³.

³ All chi-squared comparisons in this chapter were two-tailed.

Group	Gender		Age			Education		
	Male	Female	Mean	Min	Max	School	16+	University
With aphasia (n=25)	15	10	68.9	38	90	16	5	4
Without aphasia (n=17)	12	5	69.8	56	82	9	5	3

Table 3-1: Participant demographics

Aphasia severity	Severe	1	2	3	4	5	Mild
Number of participants		9	6	3	4	3	

Table 3-2: Distribution of aphasia severity

3.2 Analysis of questionnaire responses

Participants were divided into sub-groups for further analyses according to the presence or absence of aphasia or whether they said they used the Internet. Numbers of participants in each of these groups is outlined in Table 3-3. Results are presented below related to areas of the questionnaire, with further analysis of potential factors influencing Internet skills and potential predictors of Internet use/non-use.

	Internet users	Internet non-users
With aphasia (n=25)	10	15
Without aphasia (n=17)	12	5
Totals	22	20

Table 3-3: Number of participants in each sub-group

Statistical comparisons were carried out to examine whether the groups were matched according to the three demographic factors (age, gender, and educational level). Results showed no significant differences for each of these factors between Internet users with and without aphasia, Internet non-users with and without aphasia, and participants without aphasia who did and did not use the Internet. Amongst the participants with aphasia, Internet users were similar in age and gender to those who did not use the Internet. Comparison of levels of education between these participants also showed no significant differences. However, Linear by Linear Association output⁴ from SPSS chi-squared comparisons did demonstrate a trend towards lower levels of education for people with aphasia who said they did not use they Internet in comparison with those with aphasia who were Internet users (χ^2 Linear by Linear Association [1] = 4.056, $p = .044$)⁵.

Below, predictors for Internet use/non-use are discussed in relation to regression analysis using the demographic information collected. Analysis of questionnaire responses follows. All participants with and without aphasia were compared regarding use of everyday technologies, the Internet for communication, and perceived barriers to acquiring or improving Internet skills. Internet users with and without aphasia were compared in relation to their online activities, the support they received, the type of information they sought online, their self-perceived skills, and their use of accessibility tools. Non-users with and without aphasia were compared regarding their use of proxies.

3.2.1 Predictors of Internet use

Cross-tabulated comparisons of Internet use/non-use and presence or absence of aphasia suggested that the group with aphasia were significantly less likely to say they used the Internet (χ^2 Likelihood ratio [1] 3.881, $p=.049$). However, as digital exclusion is

⁴ Also known as Mantel-Haenzsel test.

⁵ All chi-squared comparisons in this chapter were two-tailed.

widely felt to be a multi-factorial problem (see section 1.2), it was necessary to consider the possible influence of factors external to aphasia. Thus, a binomial logistic regression analysis sought to explore which other factors might influence Internet use amongst the sample; Specifically, the model sought to determine whether the presence of aphasia had a significant influence on individuals' Internet use in the presence of other potentially influential factors. Self-reported Internet use vs. non-use was the dependent variable. Age, gender, educational level, and presence or absence of aphasia were entered into the model as predictor variables. Each of these independent variables were selected from the dataset as there was evidence in the existing literature on digital exclusion that they influenced Internet use (Dutton et al., 2013; Friemel, 2016; Office for National Statistics, 2016; Van Deursen & Helsper, 2015). Due to the small sample sizes involved, all independent variables were entered into the regression simultaneously. This allowed each independent variable to be considered in terms of its unique contribution to the dependent variable (Tabachnick & Fidell, 2013) The model was statistically significant ($\chi^2 [5] = 13.771, p = .017$). There was 76.2% group classification accuracy. The Nagelkerke R square coefficient of .373 suggested that this model explained only 37% of the variance in the data. In terms of individual variables that made significant contributions to the model, age was a significant variable regarding whether a person used the Internet or not with older participants less likely to say they were Internet users ($p = .044$) and presence of aphasia approached significance ($p = .051$). Educational level was considered within the regression by comparing one of three levels against the other two. None were significant predictors for Internet use ($p = .204$). Further output from the regression analysis can be seen in Appendix D.

3.2.2 Use of everyday technologies (all participants)

Table 3-4 illustrates the findings comparing technology use between people with and without aphasia. Figures are also given in percentages to enable comparisons between the people with and without aphasia. Both groups used very similar types of technology, with a preference for older style devices like digital televisions or cameras over smartphones and tablets.

Type of technology	With aphasia		Without aphasia	
	n (25)	%	n (17)	%
Digital TV	24	96	15	88
Basic mobile	11	44	12	71
Laptop	10	40	9	53
Digital camera*	7	28	11	65
Smartphone	6	24	7	41
Tablet	6	24	8	47
Other tech	4	16	5	29
E-reader*	3	12	8	47
Games console	2	8	3	18
MP3 player	2	8	2	12
Webcam	2	8	4	24

Table 3-4: Comparison of use of technologies by people with and without aphasia *p = <.05

Between-group comparisons were carried out using Fisher's exact tests across all types of technologies apart from when fewer than ten people in total used the technology (webcam, games console, and mp3 player). The majority of the comparisons demonstrated no significant differences between the technology use of people with and without aphasia. There were two exceptions. People with aphasia had significantly less use of e-readers (Fisher's exact, p = .029) and digital cameras (Fisher's exact, p = .029).

3.2.3 The Internet for communication (all participants)

Regarding the use of the Internet for communication, there were significant differences between the people with and without aphasia regarding the use of email ($\chi^2 [1] = 3.990$, p = .047) and text messaging ($\chi^2 [1] = 6.959$, p = .010). People with aphasia were using these methods significantly less than those without aphasia. Table 3-5 presents these comparisons. There were no significant differences in other forms of communication

between the two groups. An independent samples Mann Whitney U test demonstrated that people with aphasia reported significantly less contact with others than those without aphasia ($p = .022$). There was no significant difference in amount of reported contact with others between Internet users and non-users ($p = .865$).

How do you communicate with others?	With aphasia		Without aphasia	
	n (25)	%	n (17)	%
Phone	20	80	16	94
Visiting	19	76	9	53
Writing/sending cards	9	36	10	59
Email*	7	28	10	59
Text messaging*	6	25	11	65
Social Networks	4	16	6	35
Video calling	4	16	4	24
Other	1	4	4	24

Table 3-5: Comparison of means of communication with others. * $p = <.05$

3.2.4 Barriers to acquiring or improving Internet skills (all participants)

Participants were asked either whether they wanted to improve existing Internet skills or, if they did not use the Internet, what prevented them from acquiring skills. Most of the 22 participants who used the Internet said they wanted to improve. They then selected factors which they felt prevented them from doing so. Four participants did not answer this question because they did not feel their existing skills needed improvement ($n=3$), or they chose not to respond ($n=1$). Responses from Internet users are presented in Figure 3-1 to illustrate the most commonly perceived barriers to improving existing Internet skills. Figure 3-2 illustrates the responses from the 22 participants who said they did not use the Internet. Of these, nine people with aphasia and one person without aphasia said they had used the Internet in the past; therefore, the figure represents barriers both to acquiring or re-engaging with Internet skills. The largest barrier for the group as a

whole was lack of confidence, and this was the second largest barrier for people with aphasia, with aphasia the largest. Health and physical problems also featured as a barrier, but not for the majority of participants in either group. There was a small number of other reasons for non-use chosen by members of both groups. For both figures below, the barriers are presented with the most frequently occurring at the top of the graph.

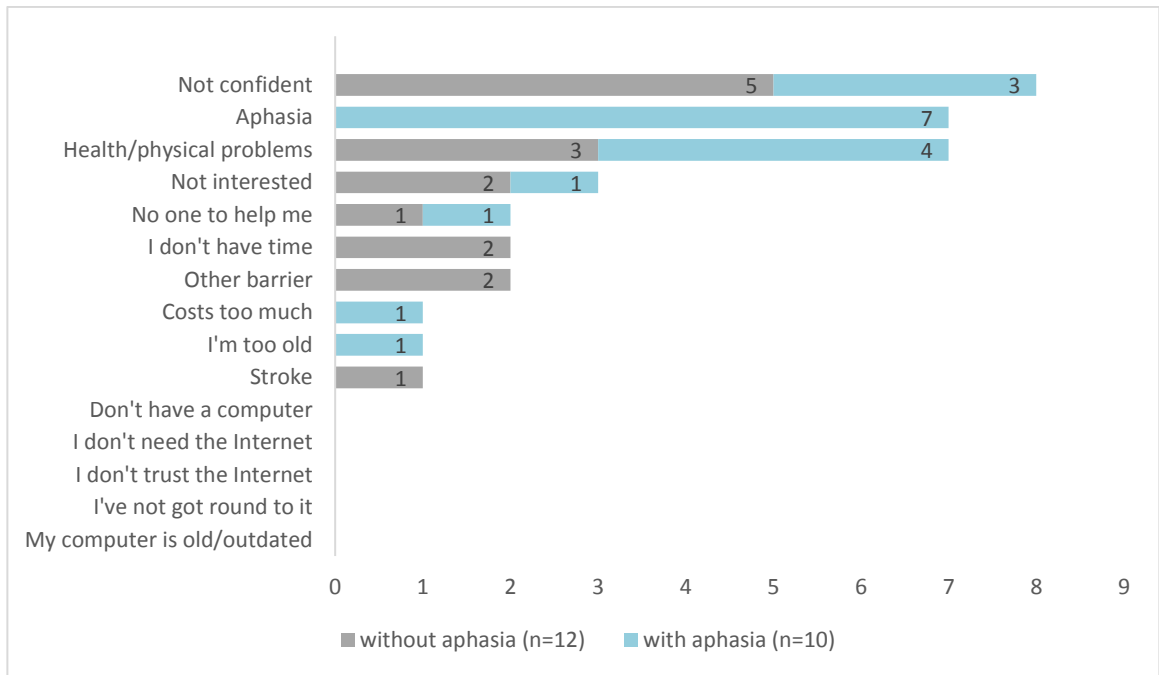


Figure 3-1: Barriers to improving Internet skills (Internet users)

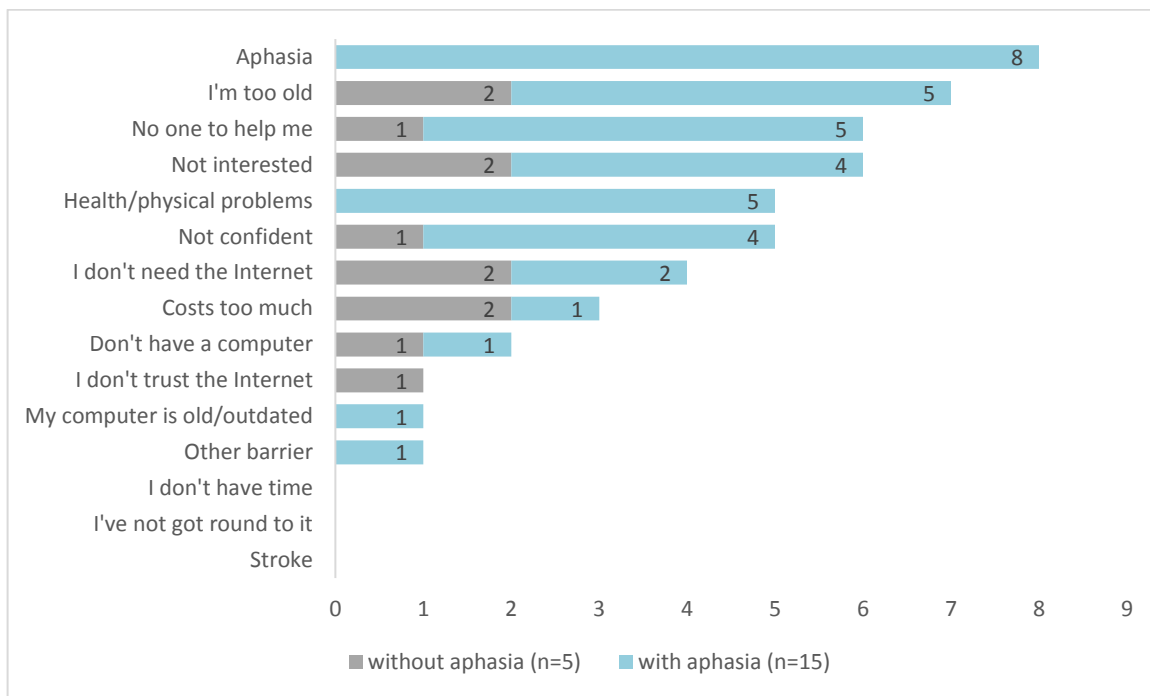


Figure 3-2: Barriers to acquiring or re-engaging with Internet skills (non-users)

The mean number of reasons cited was calculated to ascertain whether people with aphasia perceived more barriers than those without aphasia and whether those already engaged with the Internet perceived fewer barriers to improving skills than those not engaged. The mean number of barriers chosen by people with aphasia was higher than the mean number of barriers chosen by people without aphasia (2.2 vs 1.6); however, this difference was not statistically significant ($t[40] = 1.74, p = .089$).

There was a significant difference between the mean number of barriers chosen by those who said they were Internet users (1.5) and those who said they were not (2.5) ($t[40] = -2.1, p = .006$). Sixty-three percent of participants with aphasia ($n=15$) said their aphasia was a barrier to improving or acquiring skills. The mean age of those who felt age was a barrier was 78, while the mean age of those who did not was 68. This represented a significant difference ($t[35] = 2.912, p = .015$). An independent samples Mann Whitney U test showed those who said aphasia was a barrier were significantly more impaired on the Boston scale than those who did not select aphasia as a barrier ($p = .003$).

Only one participant identified ‘stroke’ as a discrete barrier, a person without aphasia who used the Internet but perceived their stroke as a factor influencing ability to improve skills.

3.2.5 Sources of information (all participants)

There was a preference in both groups for asking others as a first source of information rather than using the Internet or the phone. No participants reported looking for information in books. Therefore, this category is omitted from the results on preferred sources of information. These are presented in Table 3-6. No response is denoted as NR. The one person who did not respond for the health category did so because they had worked in a health profession and felt they already had adequate information. Those who did not respond for the travel/holiday question reported their health no longer allowed them to go on holiday. For both groups, the Internet was used more as a source of information for travel/holidays than for health.

	Health				Travel/Holidays			
	Internet	Phone	Ask	NR	Internet	Phone	Ask	NR
Aphasia (n=25)	3	4	18	0	6	1	13	5
No aphasia (n=17)	5	0	11	1	8	0	8	1

Table 3-6: First source for information on health and travel/holidays.

3.2.6 Location and means of Internet access (Internet users)

There were 22 Internet users in total, 52% of the entire group. This comprised ten people with aphasia and 12 without aphasia. As the numbers here were not sufficient for pairwise comparisons, only descriptive statistics are presented within this section. Table 3-7 shows the responses from participants who reported they used the Internet. All those without aphasia and all but one of the participants with aphasia had the Internet at home. There was a small amount of use in other locations, the greatest being in the home of family members or friends. Three people with aphasia reported going online at

a library and two at an aphasia support group. The 'other' response for two individuals in each group represented mobile Internet use.

Location	With aphasia		Without aphasia	
	n (10)	%	n (12)	%
Home	9	90	12	100
Home of family or friend	4	40	5	42
Library	3	30	0	0
Support group	2	20	0	0
Work	2	20	1	8
Internet café	2	20	1	8
Other	2	20	2	17

Table 3-7: Comparison of locations of Internet use

Table 3-8 shows the type of devices used to access the Internet. The most common device used across the two groups was a desktop computer, followed by laptops, mobile phones, and tablet devices. Many participants used more than one device to go online. There were no significant differences between the people with and without aphasia in terms of the types of devices used.

Internet device	With aphasia		Without aphasia	
	n (10)	%	(n=12)	%
desktop computer	7	70	6	50
mobile	7	70	4	33
laptop	7	70	9	75
tablet	6	60	7	58
e-reader	2	20	2	17
other	2	20	1	8

Table 3-8: Comparison of devices used to access the Internet

3.2.7 Types of information (Internet users)

A further question on sources of information asked whether Internet users had ever sought information on eight possible areas. News and travel were the most commonly sought types of information, followed by local events, health, sports, funnies, jobs, and volunteering. Responses to this question are illustrated in Table 3-9. There were no significant differences between the two groups.

Internet device	With aphasia		Without aphasia	
	n (10)	%	(n=12)	%
News	8	80	7	58
Travel	6	60	9	75
Local events	7	70	7	58
Health	7	70	6	50
Sports	5	50	7	58
Funnies	4	40	3	25
Jobs	1	10	3	25
Volunteering	2	20	1	8

Table 3-9: Comparison of information seeking online

3.2.8 Types of online activities (Internet users)

Types of activities carried out by Internet users were ranked according to mean frequency of use. The most popular activities for people with aphasia were (in order of preference): watching TV/films, sending emails, comparing products/prices, buying something online, and Facebook. Most popular for people without aphasia were: sending emails, playing games, Facebook, watching TV/films, and comparing products/prices. Least popular activities for people with aphasia were: discussion groups/forums, religious websites, Twitter, betting or gambling, and blogging. For people without aphasia the least popular activities were: information on the government, betting or gambling, Twitter, discussion groups/forums, and blogging. Comparing the two lists of

20 activities between people with and without aphasia using Spearman's rank correlation ordered by mean popularity indicated a very strong similarity of types of Internet use ($\rho_s [18] = .835, p = .0001$).

3.2.9 Support with online activities (Internet users)

Many activities were carried out independently; however, participants in both groups also reported needing some form of help. Figure 3-3 illustrates the breakdown of independent and supported Internet use by people with and without aphasia for activities where at least one or all participants reported requiring support. People with and without aphasia reported both being independent and receiving support across a range of activities.

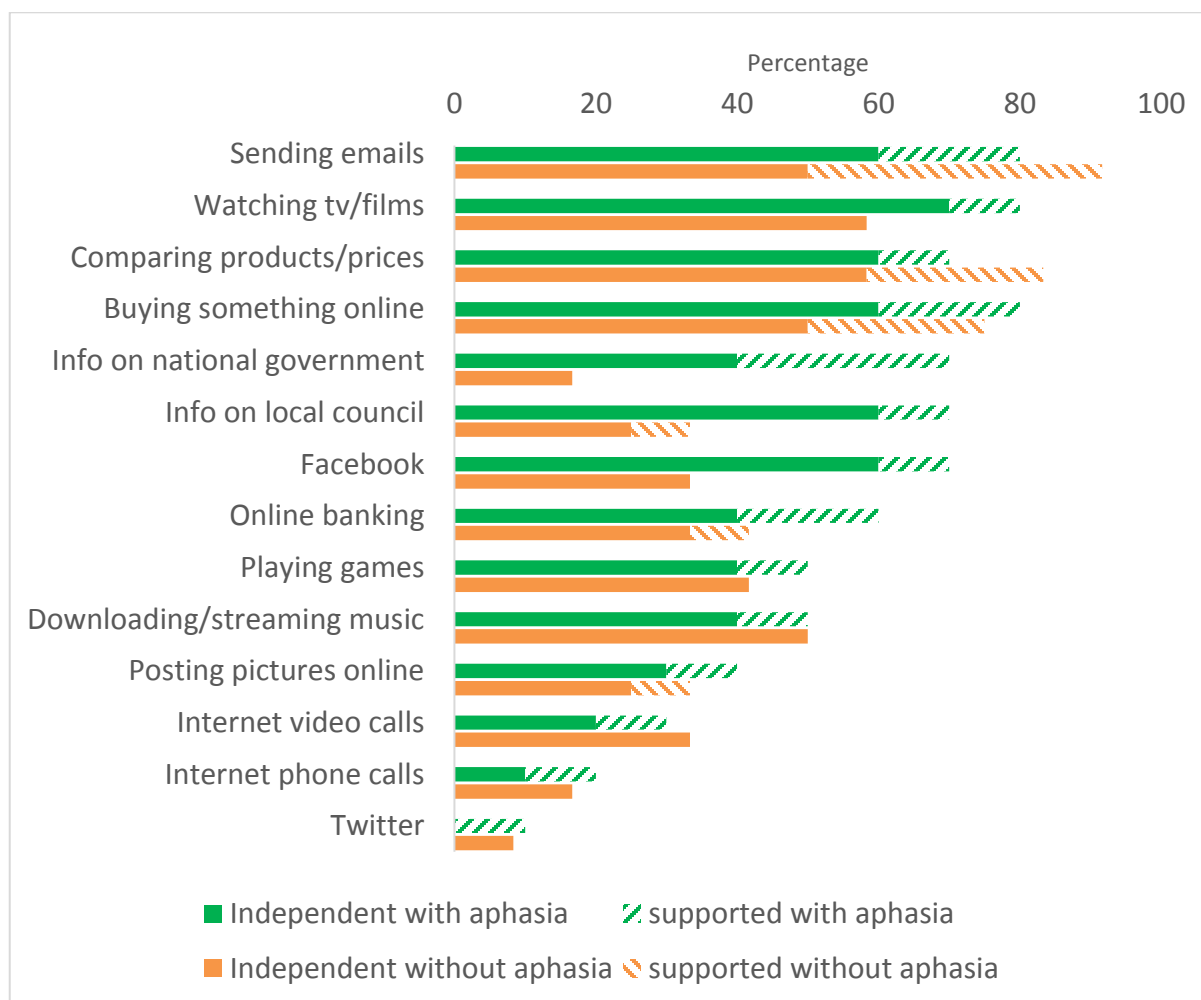


Figure 3-3: Comparison of independent and supported Internet use

3.2.10 Internet skills (*Internet users*)

Mean self-rating of Internet skills for all Internet users broken down by group are presented in Table 3-10. For people with and without aphasia, self-rating of Internet skills was very similar. The mean rating for those with less education was notably lower than those with university level education, suggesting people educated to a higher level were more positive about their own Internet skills.

For the whole sample, a Spearman's analysis of age in relation to self-rating of Internet skills showed no significant correlation ($\rho_s [22] = -.294, p = .185$). Thus, there was no difference in self-rated skills related to presence or absence of aphasia, or to the age of participants. However, there were differences seen in relation to educational levels with a positive correlation between educational level and self-rating of Internet skills (χ^2 Fisher's exact = 15.813, $p = .011$).

	All (n=22)		with aphasia (n=10)		without aphasia (n=12)	
	Mean	SD	Mean	SD	Mean	SD
School education	2.90	0.74	3.00	0	2.83	0.98
16+ education	2.50	1.38	2.33	0.58	2.67	2.08
University education	4.08	0.92	4.00	1.00	4.17	1.04
All	3.11	1.13	3.10	0.88	3.13	1.35

Table 3-10: Mean self-rating of Internet skills by sub-group

3.2.11 Accessibility tools (*Internet users only*)

Four Internet users with aphasia and three Internet users without aphasia reported using adaptations or strategies to access computers. For the people with aphasia this consisted of two using touchscreens, and one accessing communication aid software which integrated with email on a tablet device. A fourth participant had learned how to adapt settings to avoid two-handed use of 'ctrl-alt-delete' function on their keyboard. The three participants without aphasia who reported using adaptations or accessibility tools were using word prediction to speed up typing, a stylus to compensate for sensory

problems in hands, and adjustment of brightness settings to compensate for post-stroke visual sensitivity.

3.2.12 Proxy use (*Internet non-users only*)

Twenty people said they did not use the Internet (15 with aphasia and five without). All were asked whether someone helped with the Internet on their behalf or shared online content with them in some form. One participant's responses to this question were excluded because the researcher was unable to elicit a reliable response. Seven out of 14 people with aphasia (50%) and four out of five without aphasia (80%) said that someone did help them with the Internet or carried out activities on their behalf.

3.3 Discussion

This stage of the research aimed to address the first aim of the thesis, and the research questions revisited in section 2.1. The initial research question was how people with aphasia use the Internet. The results presented above provided a wealth of information in response to this question, and are discussed below.

3.3.1 *Internet use with aphasia*

Comparisons between the people with and without aphasia demonstrated highly similar types and amount of Internet use. However, key differences were seen in the way the Internet was used for communication purposes. The differences in use of email and text messaging as means of everyday communication are most likely related to difficulties with understanding, reading, speaking, or writing. The majority of the people with aphasia reported visiting others or using the phone over online means of communication. This finding is in contrast with research that warns of social isolation of people with aphasia (Northcott et al., 2016) and could be interpreted as a lack of need to use online communication in favour of more traditional forms of interaction. However, there was a significant difference in the amount of contact people with aphasia had with others in comparison with their non-aphasic peers. Such isolation could be related to fewer means available to arrange social interactions. Therefore, the differences in use of email and text messaging can be seen as a possible example of social exclusion of

people with aphasia (Hilari & Northcott, 2016), with exclusion now present in digital environments.

Use of technology was also similar in the two groups, with only two exceptions: e-readers and digital cameras. The differences in use of e-readers are most likely related to acquired difficulties with reading. However, e-readers offer features that could increase access to books for people with aphasia (Caute et al., 2016). Use of digital cameras may be difficult if a person has limited use of one hand or limb, and aphasia is associated with more severe stroke-related disability such as hemiplegia (Bhatnagar et al., 2010; Pedersen et al., 1995). A motor difficulty of this sort may also be relevant to other types of technologies which can require two hands to operate, for example, opening and closing a laptop.

Comparison with studies on Internet use amongst older adults suggests the findings were in line with those investigating a wider older population. For example, this study found that amongst the entire sample, email was the most popular and blogging the least popular activity. Dutton et al.'s UK-based studies, and Chang et al.'s California-based research all reported similar findings (Chang et al., 2015; Dutton & Blank, 2011; Dutton et al., 2013). These three studies all found email was the most popular Internet activity for retired healthy adults, and blogging and maintaining a website amongst the least popular.

In Dutton et al.'s (2013) survey, the percentage of older adults rating their Internet skills at four or five ("good" or "excellent") on a similar scale was 49%. In comparison, only 8% of the aphasia group in this study felt they had this level of skill, and 24% of the without aphasia group. This finding that both groups in the current study rated their skills substantially lower than the UK older population may be suggestive of the influence of their general disability, poor health, or related to their location in the North-East of England, an area with high levels of digital exclusion (Blank et al., 2017). The finding that non-users with aphasia had lower levels of education than Internet users highlights that there may be a subgroup within the aphasia population with greater vulnerability. Those with lower educational levels may have more barriers to overcome towards

obtaining Internet skills or receiving support, barriers that may be exacerbated by the sudden onset of disability.

A small number of participants in the study reported the use of accessibility support tools. The numbers here were too small to infer any differences between people with and without aphasia. There are several options which could aid people who have had strokes not selected from the choices presented or mentioned by either group of our participants; for example, adapted keyboards for people with limited use of one limb, adjustment of text size, speech to text conversion, voice recognition, or specialist technology for reading difficulties (Leff, Ong, Brown, Plant, & Husain, 2012). There are recent studies describing these types of adaptations and adjustments with aphasia (Al Mahmud et al., 2014, 2012; Al Mahmud & Martens, 2013; Caute & Woolf, 2016). However, there is limited evidence regarding their usefulness or guidance on selecting the best fit for individual needs. The lack of awareness of both groups of accessibility tools may be because people are finding more informal solutions (Gustavsson et al., 2016). However, people may not be aware of options available to them.

3.3.2 The contribution of aphasia and other factors

Two research questions related to the aims of this stage of the research. They asked what kind of difficulties with Internet use could be attributed to aphasia, and what other factors might contribute. The results indicated that barriers to Internet use for most people with aphasia appeared to stem not only from their aphasia but from a combination of factors. Although aphasia may have a considerable influence, other influences are likely to contribute. This makes people with aphasia a complex population with whom to achieve digital inclusion. Motivation and circumstances vary amongst older adults and researchers have suggested that it is inadvisable to consider older adults as a homogenous population (Van Deursen & Helsper, 2015). This study confirms the heterogeneity of the post-stroke population regarding Internet use and skills.

Most Internet users from both groups felt they would like to improve their skills. This may also be true of the general population, who are likely to have acquired their skills from a variety of sources. Limitations may be due to being self-taught or to the pace of change

of hardware, software, and online environments. The analysis showed that age had a greater influence than aphasia on whether someone used the Internet after a stroke. However, the regression model explained only 37% of the variability. This suggested that other factors, beyond those considered, were likely to contribute to Internet use/non-use. The finding that aphasia is likely to be one of several contributory factors raises the need to identify ways to support people with Internet use which consider factors external to their aphasia. Discussion of these factors is revisited in Chapter nine. The findings from this initial part of the study provide a strong argument for a need to consider each person with aphasia individually, recognising the variety of factors that might influence that person's Internet use and skills both pre- and post stroke. Such an approach is important for rehabilitation in order to ensure a holistic profile to guide appropriate interventions (Simmons-Mackie et al., 2017). The following chapters take an individualised approach, exploring four single cases of people with aphasia who had rehabilitation goals around Internet use. The findings from this initial stage of the research influenced the design of the case by providing considerable insight into possible barriers and enablers to Internet use along with a need to explore possible wider influences for each individual. Detailed information for the methods for the case studies are presented in Chapter four, including information on how this stage of the research influenced their design.

Chapter 4. Case Study Methods (Stage Two)

4.1 Introduction

The literature review in Chapter one highlighted the relative paucity of evidence on interventions to support Internet use for people with aphasia (section 1.4.3). This demonstrates that previous literature has predominantly evaluated group interventions to introduce and improve Internet skills (Egan et al., 2004; Kelly et al., 2016) with only one single-case study offering an approach centred around a person with aphasia (Caute & Woolf, 2016). Further, the review highlighted a need to view Internet use with aphasia from a wider perspective, taking into account a myriad of individual factors that might influence an individual's Internet use and skills. However, there is currently very little information to guide assessment, design of interventions, or outcome measurement when working to support individuals with aphasia with their Internet use. Findings from the first stage of this research (presented in Chapter three) revealed that although some people with aphasia were independent Internet users, the majority reported their aphasia was a barrier to acquiring or improving Internet skills. This chapter, and the single-case studies that follow relate to those individuals for whom aphasia has *impaired* their existing Internet skills in some way. These chapters will address the second gap in current knowledge identified in Chapter one as they aim to explore assessments, interventions, and outcome measures for individuals with aphasia who have goals related to Internet use. Research questions related to this aim are:

- *How can difficulties with Internet use experienced by people with aphasia be approached with regard to assessment and the design of interventions?*
- *How can effectiveness of interventions for individuals be measured?*

This chapter describes the methods employed across single case studies carried out in the second stage of this research. The associated protocol is available in Appendix E. This stage of the research obtained a favourable ethical opinion on 25 February 2015 via the National Research Ethics Service Committee – Newcastle and North Tyneside 2. Information leaflets about the study can be seen in Appendix G. The

case studies were conducted with individuals with aphasia who had used the Internet prior to their stroke and who had Internet-related goals. They adopted broadly the same approach to assessment, interventions, and outcome measurement. The cases were exploratory and based around novel methods. They were not intended to provide any definitive evidence for or against interventions to support Internet use for the aphasia population. The purpose was, rather, to explore and illustrate the complexities of carrying out interventions in this area and to highlight findings that may be worthy of further research. Below, there follows a detailed description of methods common across the cases. Chapters five to eight each present one case study. Any aspect of method unique to a case is in the relevant chapter.

4.2 Participants

Inclusion criteria for individuals to participate in the study were: adults (over 18 with no upper age limit) with a diagnosis of aphasia made by an SLT resulting from single symptomatic stroke; at least six months post-onset of aphasia/stroke; medically stable; user of the Internet prior to stroke; identified rehabilitation goals around Internet skills; willing to participate in the study; willing to withdraw from NHS SLT for the duration of the study; able to give informed consent; absence of psychiatric conditions; absence of any other acquired or developmental neurological condition; normal (or corrected) hearing and vision; English as a dominant language.

Participants were excluded if any one of these criteria were not met. Consent forms for people with aphasia and for interview participants can be seen in Appendix G.

The initial aim for recruitment (as per the protocol available in Appendix E) was to work with nine participants representing a spread of ages and aphasia severities and to also consent their associated carers and SLTs. Six potential participants were referred from SLT caseloads in the North-East of England. All six met the inclusion criteria. One elected not to take part following an initial information visit. One person consented to the study and completed the initial assessments but decided not to proceed to intervention as they wished to return to SLT treatment with a broader focus. This meant that the study involved only four participants with aphasia, fewer than originally anticipated.

Participants are described using the pseudonyms Bill, Nancy, Rose, and Oliver. A summary of relevant demographic information and aphasia severity rated on the Boston scale as in stage one (Goodglass et al., 1983) is provided in Table 4-1. All had retired prior to their stroke. The person’s SLT and a close friend or family member who provided support to the person were also asked to consider taking part in the study and in all cases agreed. SLTs and supporters were included on the basis that they knew the participant with aphasia well and had provided some assistance with Internet use following their stroke.

	Bill	Nancy	Rose	Oliver
Age	74	67	73	78
Previous occupation	Academic (Scientist)	Factory worker	Primary teacher	Engineer
Type of stroke	Left basal ganglia infarct	Left parietal infarct	Left middle cerebral artery infarct	Left total anterior circulation infarct
Aphasia severity (Boston scale)	1	1	3	5 ⁶
Time post-onset (months)	24	27	24	6
Handedness	R	R	L	R
Years of education	>16	<12	>16	>16

Table 4-1: Biographical information of case study participants

Each participant took part in a process of assessment, goal-setting, decision-making, and intervention described below in sections 4.3 to 4.6. All SLT and supporter participants were also interviewed as part of this process.

4.3 Assessment

⁶ See Chapter eight, where Oliver’s aphasia will be discussed.

The aim of the assessment process was to obtain a detailed profile of current Internet skills and use, and to determine barriers and enablers influencing the person's ability to participate in Internet based activities. The methods used across case studies were designed using the ICF framework as a guide (see section 1.3). Data was collected in relation to each component of the framework. Kagan et al. (2008) discuss how interventions targeted at one component within the ICF have the potential to influence other components. This type of outcome needs to be considered in the assessment process. For example, the ability to write emails may impact the number of interactions with others, and could also affect quality of life measures. During the process of assessment, qualitative and quantitative methods were used as part of an approach where measures could be best suited to their purpose (Greene, Caracelli, & Graham, 1989). The data collection measures used around each component of the ICF are described below and are summarised in Figure 4-1. All assessments and interviews were carried out by the author.

4.3.1 *Body Functions and Structure*

Information about degree and type of physical impairment was gained from eliciting background history information from the participant and their supporter or the SLT. Assessment of language was carried out using subtests from the Comprehensive Aphasia Test (CAT) (Swinburn, Porter, & Howard, 2004). The following subtests were chosen to provide a comprehensive overview of language abilities without excessive burden of assessment: semantic memory, comprehension of spoken words and sentences, comprehension of written words and sentences, naming objects, spoken picture description, reading (words, complex words, and non-words), and writing. When further information was needed for diagnostic purposes, additional measures from other aphasia assessments were selected. These are discussed in relation to the relevant participant.

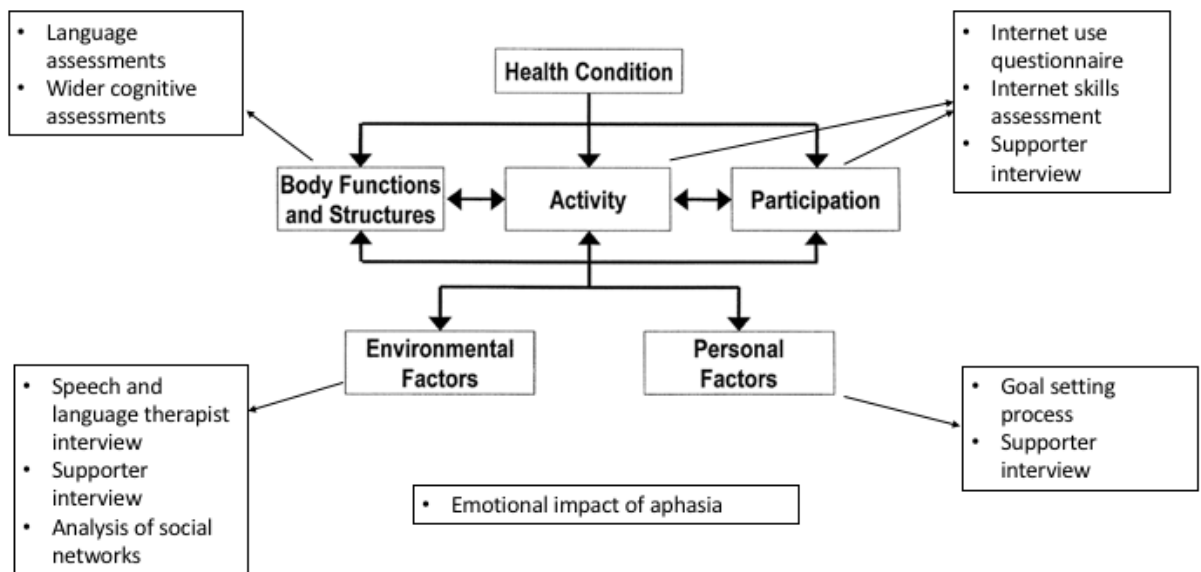


Figure 4-1: Data collection guided by the ICF Framework

Wider cognitive abilities were assessed using formal tests in order to determine any impairment of visual perception, attention, memory, and executive functioning. The symbol cancellation subtest of the Cognitive Linguistic Quick Test (CLQT) (Helm-Estabrooks, 2001) was used to assess perceptual visual disturbances. The Mazes subtest of CLQT was also used to assess visual-spatial skills and provide additional information on planning, self-monitoring, working memory skills and executive functioning. The Wechsler auditory and visual memory span subtests (Wechsler, 1987) were used as a standardised measure of short-term memory skills (verbal, non-verbal respectively). The Modified Wisconsin Card Sorting Test (M-WCST) (Schretlen, 2010) was used to provide a standardised measure of executive functioning. The number of categories correct section of the M-WCST has previously been shown to have strong ecological validity when administered post-stroke (Chiu, Wu, Hung, & Tseng, 2017). In addition, the executive functioning composite score was used as an overall measure of executive functioning, which also provided a percentile score.

4.3.2 Activity and Participation

The impact of stroke and aphasia on Internet-related Activity and Participation was investigated using two methods: an assessment of Internet skills, and an accessible questionnaire about Internet use.

Assessment of Internet skills

Data on participants' Internet skills was collected via an assessment based closely on methods used by Van Deursen and Van Dijk (2010) who proposed definitions of Internet skills to allow for nuanced understanding of the complexities of Internet based tasks. They divided Internet skills into four categories (operational, formal, information, and strategic) and asked randomly selected participants from the Dutch population to carry out a series of increasingly complex Internet tasks. For the present research, Van Deursen and Van Dijk's method was simplified and modified for use with people with aphasia. Prior to data collection with the participants described in Chapters five to eight, a pilot version was tested with a member of the Newcastle aphasia research user group (ARUG) (Newcastle University, 2017) and a volunteer participant without aphasia. Their performance on the assessment and their feedback during pilot trials informed the final design.

Description of Operational, Formal, Information, and Strategic skills based on those of Van Deursen and Van Dijk (2010, pp. 898–890) are provided in Table 4-2. Definitions of each category allow for distinctions between the different types of skills required to successfully use the Internet. A further category of linguistic skills (not featured in Van Deursen and Van Dijk's definitions) was added as linguistic skills are necessary for most Internet activity and are likely to be affected by aphasia.

The assessment was carried out in participants' homes on their preferred devices. It involved asking them to work through a series of Internet-based tasks. To assess each of the skill types, four tasks were designed and presented in a presumed hierarchical order of difficulty (easy to more challenging). As most aspects of Internet use are highly complex, it was not possible to design tasks to assess each type of skill in isolation. Therefore, elements within each task were pre-coded according to

the skills required. This pre-coding involved a level of assumption around likely routes individuals could take to achieve each task, e.g., the need to use a search engine, to enter information on times or dates, to scroll down a page. Participants were not penalised for taking a different route than the one expected (e.g., going directly to an appropriate website rather than using a search engine first). The tasks were designed to be of broad relevance to everyday Internet activities; the type of online tasks which require no specific knowledge but that participants may want to carry out. Instructions were designed to be accessible to someone with aphasia i.e., they used simple written language alongside relevant pictorial information, repetition of instructions, and task separation.

Type of Skill	Examples
Operational (O) <i>basic skills in information technology</i>	Opening websites by entering the URL Navigating forwards and backwards Opening various common file formats (e.g., PDF) Operating Internet-based search engines
Formal (F) <i>Navigation and orientation around the Internet</i>	Using hyperlinks (e.g., menu links, textual links, image links) Maintaining a sense of location while navigating on the Internet
Information (I) <i>Actions taken to fulfil information needs online</i>	Choosing a website or a search system to seek information Defining search options of queries Selecting information and evaluating information sources
Strategic (S) <i>Relates to the use of the Internet towards reaching particular goals which benefit the user</i>	Developing an orientation towards a particular goal Taking the right action to reach this goal Making the right decision to reach this goal
Linguistic (Lr) (Lw) <i>Relates to language processing skills required for digital literacy</i>	Understanding written information on websites (Lr) Entering information using keyboard or other text entry system (Lw)

Table 4-2: Types of Internet skill and examples (based on Van Deursen and Van Dijk, 2010)

A head mounted video camera recorded the computer screen and followed participants' head movements as they looked at the screen and keyboard. The assessment comprised four tasks: 1) switching on a device and logging on, 2) finding out information on weather for a particular date and location, 3) obtaining contact information and a newsletter from a charity website, and 4) finding the cheapest train tickets to arrive somewhere at a particular time. For each task, if the participant asked for or appeared to need assistance, verbal or written prompts were given to direct them towards their goal. If this was unsuccessful, direct prompting alongside verbal/written prompts or specific support with language was provided (e.g., initial letter or verbal cueing). Finally, if needed, further assistance was given (e.g., hand over hand guidance, or repeated cueing). If participants were unable to complete any element of the task independently, the researcher would sensitively offer to carry it out on their behalf and move on to the next step. For scoring, there was a breakdown of the likely steps required to complete the task. Each of these steps were pre-coded per the types of skills required. Performance on each task could then be scored according to completion of each step, and according to the amount of assistance needed. The assessment was scored within the session, then scoring was reviewed later using the video recording obtained from the head mounted camera. To obtain a measure of satisfaction with their performance, participants were also asked to rate how they felt about their performance on each task on a pictorial five-point scale. The scale can be viewed alongside the assessment in Appendix G. Timings were obtained from the video from when the assessor presented the instructions for each task to when the task was completed or abandoned. These were then added together for the total time needed to complete the assessment. To obtain qualitative data on response to the tasks, detailed notes were made on participants' performance. This took the form of a description of the behaviours of both the researcher and the participant during the assessment. Observations included the individual steps taken by each participant in approaching a task, the types of difficulties they encountered, the solutions they found, when assistance was requested or when cues were given by the assessor, and when assistance was beneficial. Appendix G contains a description of all tasks in the assessment, pre-coding of each element of the tasks, and examples of the instructions.

Accessible questionnaire about Internet use

The second means of collecting information for the Activity and Participation component was an accessible questionnaire on Internet use. The questionnaire was a reduced and revised version of the one described in Chapter two. Changes involved the removal of collection of demographic information, any questions directed at non-users of the Internet, and questions either less relevant for this stage of the research or which had not provided useful information in the initial stages. Aspects retained were on where Internet use took place, type of devices used, whether participants used any form of accessibility support, means and frequency of contact with others, how often participants carried out a range of online activities, and whether they were supported to do so.

There were also some additions to the original questionnaire. Questions on the frequency of specific types of Internet use included the addition of a 'before stroke' and 'now' component. Comparison of these two ratings afforded insight into whether previous Internet activities had decreased or increased following stroke. This was administered using visual prompts depicting the period before the stroke and the current time. All participants in this stage of the research were known to have difficulty using the Internet related to their stroke and aphasia, as this was one of the referral criteria. To identify the areas of difficulty which might arise because of stroke-related impairments, the revised questionnaire asked: 'How has your stroke affected your ability to use the Internet?'. The choices were pictorially represented with accompanying text and were based on possible challenges resulting from motor, visual, or cognitive stroke-related impairment. To investigate possible difficulties external to stroke, additional options were added based on areas of difficulty vulnerable groups may experience with Internet use (Communications Consumer Panel, 2010). Any responses irrelevant to the modified questions, or which were not selected by any participants in the initial stage of the research, were removed. A summary of the revised version of the questionnaire is available in Appendix H.

During the questionnaire, participants sometimes conveyed (or attempted to convey) further information to qualify their choices. A total communication approach was used

to facilitate communication during any times when the message was not initially clear. For example, use of pen and paper, gesture, drawing, or circumlocution. Such additional information was noted on the questionnaire form and considered as part of a holistic profile of the participant.

4.3.3 Personal Factors

Information related to personal factors was elicited through a goal-setting process with each person with aphasia, and via interview data from their SLT and their supporter. Principles of collaborative goal-setting with people with aphasia were used (Hersh, Worrall, Howe, Sherratt, & Davidson, 2012) and each person was asked to focus on which aspects of Internet use were most important to them. Different types of Internet use were presented for discussion using a visual method of sorting activities by order of personal priority. This method has been used successfully with people with aphasia as an aid to conversation and to setting appropriate goals (Bornman & Murphy, 2006; Hux, Buechter, Wallace, & Weissling, 2010). Pictures representing aspects of Internet use alongside the corresponding word or phrase were presented one at a time, and participants were asked to rank and place them on a visual scale according to their relative importance. This allowed for a focused discussion on aspects given the highest priority. Participants whose assessment had indicated no difficulties with reading or non-linguistic aspects of cognitive processing were not given pictures but were asked to prioritise goals using a written list of possible types of Internet use to target. They were then asked sort them into a table representing most to least important priority. A list of all the types of Internet activities discussed in goal setting is provided in Appendix I. Examples of the pictorial resources can be seen in the case study chapters five to eight.

4.3.4 Environmental Factors

The Environmental Factors component was split into two main areas: the digital/online environment and the environmental support received from others. The impact of the digital/online environment was investigated using the Internet skills assessment described above. It was anticipated that some aspects of performance could be related to hardware design, or to the accessibility of web pages/online

environments. Type of equipment being used was noted as part of the initial assessment process and detailed observation notes provided information on the impact of digital/online environments. Environmental support from others was investigated using interviews with supporters and SLTs and via Antonucci's (1986) Social Network Analysis. Each is discussed in more detail below.

Interviews

Interviews provided detailed data on the experiences of those supporting people with aphasia to use the Internet. Ritchie, Lewis, McNaughton Nichols, and Ormston (2003) justified the use of qualitative methods for health research, writing:

Although quantitative research will be able to identify the barriers at a global level - that is, awareness, access, cost, convenience, applicability and so on, it will be less able to explain the origin of these barriers and how they deter people from service use. (Ritchie et al., 2003, p. 41).

Four supporters and five SLTs were interviewed. One participant (Chapter five) was working with two SLTs, so both were interviewed together. The interview data collected was primarily used to provide insight into the contribution of Environmental Factors impacting Internet use for each participant. However, It was anticipated that interview data might also be relevant to other ICF components and could provide additional information in relation to identifying barriers and enablers to Internet use. The interviews took a positivist approach, assuming that supporters and SLTs were able to present a factual account of their experiences. It was necessary to design interview schedules which elicited truthful and detailed responses and which built standardised 'checks and remedies' into the design (Silverman, 2006, p. 120). The interviews were semi-structured and the same format was followed with each participant.

The extent to which researchers can anticipate topics to be covered in an interview depends on previous literature on the subject, and on whether unanticipated themes may emerge (Arthur & Nazroo, 2003). The schedules designed for supporter and

SLT interviews were based on themes emerging from the literature review (Chapter one) and findings from the first stage of the research (Chapter three). They followed guidelines on designing topic guides for qualitative interviews from Arthur and Nazroo (2003). A pilot version of the interview schedule was trialled with the spouse of a member of the Newcastle Aphasia Research User Group (ARUG) (Newcastle University, 2017) who provided feedback and informed the design of the final version. The questioning structure ordered topics in a manner to ease participants into the discussion. Interviewees were asked to discuss computers and the Internet in relation to the person with aphasia they supported, then to discuss their experiences of providing support. They were then asked to consider what had influenced their ability to help the individual concerned. If initial questions did not elicit sufficient information, the interview schedule contained a range of open-ended sub-questions to focus on information within that area. At the end of the interview, participants were given an opportunity to add anything they felt had not been covered. The opportunity to comment without question at the end of the interview allowed them to raise any issues they felt were important, but that had not been captured. The interview schedules are provided in Appendix J.

According to the principles of phenomenological analysis, statements, sentences, or quotes that provided an understanding of how interviewees viewed a person with aphasia's difficulties or their experiences of providing support were highlighted in summary transcriptions of participants' responses. Key themes were then identified which could be used to illuminate issues of relevance to each component of the ICF, or to validate data collected via other means.

Social Network Analysis

To provide insight into the number of people available to provide support and their relationship to the person with aphasia, Antonucci's (1986) method of investigating social networks around an individual was used. Each participant was asked to complete a diagram containing three concentric circles by putting the names of those closest to them in the innermost circle, then people who were less close but still important in the middle and outer circles, relative to their degree of closeness. They

were also asked to indicate the nature of their relationship with each person (e.g., were they a friend, neighbour, family?). Some participants requested more time to complete this task either alone or with their identified supporter. Those providing help were instructed that it should be completed regarding the person with aphasia and should reflect the social network of that individual. If the person wished to complete the diagram within an assessment session and required assistance, the researcher worked with them to complete the diagram using supported conversation techniques.

4.3.5 Emotional wellbeing

To obtain a measure of the impact of aphasia on emotional wellbeing, rather than as a factor influencing the disability itself, all participants completed the emotional scale of the Communication Disability Profile (CDP) (Swinburn & Byng, 2006).

4.4 Decision-making on Interventions

Simmons Mackie et al. (2017) present the results of a worldwide consensus project on best practice guidelines for aphasia. Regarding interventions, consensus was reached that *“people with aphasia should be offered intensive and individualised aphasia therapy designed to have a meaningful impact on communication and life”* (p9). Simmons-Mackie et al. go on to recommend that interventions may take a variety of approaches, including impairment oriented, compensatory training, functional/participation oriented therapy, and environmental intervention. This holistic process is well established within speech and language therapy but has not yet been applied to management of everyday communication and interactions carried out online. Internet-based communication can be considered as a different domain to ‘in-person’ interactions and one which involves different considerations around decision-making. Due to the limitations of previous research in this area, there was inadequate guidance or useful evidence to aid decision-making around possible approaches. Therefore, before designing interventions for the case study participants in this research, it was necessary to systematically consider possible approaches to intervention with a specific focus on rehabilitation of Internet skills. Through the assessment and information gathering process, a profile of language and related impairments was obtained to determine the impact of stroke and aphasia on previous

Internet use, and obtain a picture of the person's online environment and the level of support available to the individual. This information was essential to the initial goal setting process where the SLT and the person with aphasia worked together to establish the aspects of Internet use that were most important to them. After these priorities were established, the researcher considered the demands of chosen activities in relation to the predominant skills required. For example, using email requires intact reading, writing, and non-verbal skills. The researcher could then consider these activities in relation to the person's profile. The researcher then made reference to a detailed decision-making framework which was produced for the purposes of the case study interventions. The aim of the framework was to systematically consider different types of possible intervention in relation to task demands of prioritised activities and individual impairment. Such structured consideration of different approaches to intervention meant that it was possible to draw on a range of possible means to meet participant goals. Three broad categories of intervention were considered within the decision-making framework, broadly influenced by Simmons-Mackie and Kagan's work (2007) on the application of the ICF in aphasia but with a focus on Internet use. These were: impairment-based interventions, strategies to support participation, and environmental interventions. Environmental interventions were further broken down into three sub-categories: compensatory technologies, changes to the online environment, and support from others. Each possible category of intervention was considered in relation to the predominant area of impairment for the participant concerned and the physical, cognitive, and linguistic demands of the chosen activity. There was an expectation in using the framework that more than one approach might be appropriate for each participant and that a combination of approaches might be needed. Each category of intervention within the framework is discussed below with the relevant section provided in Tables 4.3 to 4.7.

4.4.1 *Impairment based interventions*

Impairment based interventions aligned with the ICF component of Body Functions and Structures and focused on the rehabilitation of impaired linguistic or non-verbal Internet skills. Table 4-4 shows how these types of interventions relate to impaired

skills or task demands highlighted as part of an individual’s profile of Internet use and skills. The focus of this type of intervention would be around the remediation of impaired cognitive function. Language skills required for Internet use are auditory comprehension (e.g., needed for understanding audio and video content), written comprehension (e.g., required for reading webpages), verbal expression (e.g., for making video calls), written expression (e.g., for writing emails). Non-linguistic Internet skills involve skills necessary to operate aspects of the Internet successfully, e.g., clicking links and remaining oriented online (see section 4.3.2 under ‘Assessment of Internet skills’). Interventions were guided by well-designed studies on language-based therapies for aphasia. Where possible, interventions aimed to replicate published studies (e.g., Whitworth, Leitão, et al., 2015, Chapter seven).

Type of Intervention	Impaired skills/task demands				Non-linguistic Skills
	Auditory Comprehension	Written Comprehension	Verbal Expression	Written Expression	
Impairment-based interventions focus on the rehabilitation of impaired language or non-verbal skills	<p>Guided by best available evidence from aphasia research.</p> <p><i>Consider for individuals with clear language-based goals. Appropriate for: those motivated and functioning at a linguistic level within reach of goal. Able to attend to therapy sessions and tolerate level of intensity required.</i></p> <p><i>Consider any outcome of previous impairment-based interventions (plus level of intensity tried), extent of non-verbal cognitive deficit (e.g. memory/attention), extent of any additional deficits, e.g. verbal or limb dyspraxia.</i></p> <p><i>Impairment- based interventions are likely to be carried out in conjunction with one or more of the other approaches.</i></p>				<p>Intensive repetitive drilling of specific tasks. E.g. finding web pages, or goals around a task where steps remain the same each time.</p> <p><i>Consider if goals very specific and if participant demonstrates ability to learn new behaviours through demonstration/practice.</i></p>

Table 4-3: Decision-making framework: Impairment based interventions

4.4.2 Strategies to support participation

Strategies to support participation aligned with the ICF component of Activity and Participation and provided means to modify how participants compensated for their difficulties with using the Internet. Possible strategies in relation to impaired skills or task demands are provided in Table 4-4. They were designed to introduce participants to strategies or train them in techniques to facilitate everyday Internet use. Such interventions were considered collaboratively with participants for whom

focused strategies might assist with the difficulties they experienced with Internet use and who were willing to trial a strategic approach.

Type of Intervention	Impaired skills/task demands				
	Auditory Comprehension	Written Comprehension	Verbal Expression	Written Expression	Non-linguistic Skills
<p>Strategies to support participation</p> <p>put behavioural changes in place to support participants with specific difficulties with using the Internet.</p> <p><i>Consider the impact of non-verbal cognitive skills on ability to problem solve and use strategies and ability to self-initiate. This type of intervention may be carried out in tandem with other approaches</i></p>	<p>e.g. asking others to repeat, reducing background noise, rewind and repeat on audio/video.</p> <p><i>Consider for all participants wishing to understand verbal information online and who have identifiable comprehension problems.</i></p>	<p>e.g. chunking information, reading aloud, reading key details.</p> <p><i>Consider for all participants reading at sentence level or beyond who report difficulties with reading and retaining information.</i></p> <p><i>If reading is at single word or short phrase level another type of intervention may be more appropriate.</i></p>	<p>e.g., self-cueing, circumlocution, total communication approach.</p> <p><i>Consider for participants with functional output which could be improved by above strategies in the context of Internet audio/video communication.</i></p> <p><i>Unlikely to be of benefit for participants with limb dyspraxia who are unable to draw/gesture/write.</i></p>	<p>e.g. use of key words to convey core meaning, picture sharing rather than written communication.</p> <p><i>Consider for all participants who report difficulties constructing written information. If written language is not intelligible or at single word/short phrase level, Impairment-based, or environmental interventions may be more appropriate.</i></p>	<p>e.g. prompt sheets to support memory of steps towards a task.</p> <p><i>Consider for participants who struggle with initiation and planning but who can cope with simple text/pictorial instructions and benefit from these as memory aid. Individuals who effectively refer to instruction sheet for Internet tasks may be good candidates.</i></p>

Table 4-4: Decision-making framework: Strategies to support participation

4.4.3 Environmental Interventions

Interventions involving environmental modifications were grouped into three different types: use of compensatory technologies, changes to the online environment, and involvement of others in providing support. Some adaptations to the environment also involved a degree of behavioural change. This was to enable participants to adapt to changes and learn new skills.

Compensatory technologies

Possible interventions in the category of compensatory technologies are provided in Table 4-5 in relation to each possible area of impairment or task demand.

Interventions using compensatory technologies focus on the use of specialist software to support literacy. Studies reporting their use with people with aphasia were described in section 1.4.1). Such approaches were considered when particular software might be beneficial to an individual in reaching their goal.

Type of Intervention	Impaired skills/task demands				
	Auditory Comprehension	Written Comprehension	Verbal Expression	Written Expression	Non-linguistic Skills
Compensatory technologies use specialist software to compensate for particular difficulties.	N/A	<p>E.g., text to speech software, inbuilt dictionaries, text simplification.</p> <p><i>Consider text-to-speech for participants whose auditory comprehension is better than their reading or for whom having text read to them improves comprehension. May also be used to support decoding of single words, e.g. if reading irregular words is problematic.</i></p> <p><i>Consider use of plug-in or browser dictionary to support participants with difficulties with semantic access to written words. Can be used in conjunction with text to speech.</i></p> <p><i>Consider text simplification for participant's who struggle with</i></p>	<p>E.g., web based software, e.g. Tapgram</p> <p>Use of existing text to speech settings to supplement verbal expression.</p> <p><i>Consider AAC type software for individuals with limited to no verbal output but good executive functioning skills²</i></p> <p><i>AAC approach unlikely to be of benefit if SLT approach has previously attempted work on AAC type skills (high or low-tech) without success. Unless low levels of intensity in previous therapy or other possible explanations for failure of AAC approach.</i></p>	<p>E.g., speech to text</p> <p>Word/grammar prediction</p> <p>Symbol based communication³</p> <p><i>Consider word/grammar prediction for those with higher level cognitive skills (visual memory, attention and task switching)⁴</i></p> <p><i>For those with lower level cognitive and writing skills consider use of word⁴</i></p> <p><i>Consider AAC type software with symbol support for individuals with limited to no written output but good executive functioning skills²</i></p>	N/A

Type of Intervention	Impaired skills/task demands				
	Auditory Comprehension	Written Comprehension	Verbal Expression	Written Expression	Non-linguistic Skills
		<i>overload of information on webpages and may benefit from removal of pictures/links etc.</i>	<i>May be used in conjunction with Environmental (tech) or other approaches.</i>		
			<i>Individuals with poorer executive functioning skills may benefit from this approach in conjunction with Environmental (people) approach.</i>		
<ol style="list-style-type: none"> 1. Guidance available from (Dietz et al., 2011; Moss, Hilari, Marshall, & Woolf, 2014) 2. Nicholas, Sinotte, & Helm-Estabrooks, 2005 3. Guidance available from Albright & Purves, 2008; Bruce, Edmundson, & Coleman, 2003; Dietz et al., 2012; Estes & Bloom, 2011; Thiel, Sage, & Conroy, 2015 4. Thiel (personal communication, 25 June, 2015) 					

Table 4-5: Decision-making framework: Environmental interventions/compensatory technologies

Changes to the online environment

Simple modifications to participant’s hardware were considered either where motoric difficulties were demonstrated to impact on direct access to technologies or where a different means of access to the device or to device content might be easier with adaptations (Hanson & Richards, 2013), e.g., use of a stylus to access a touchscreen or a tablet computer as a main device rather than a laptop or desktop. Table 4-6 describes possible options for intervention within this category in relation to impaired skills or the task demands of Internet activities.

Type of Intervention	Impaired skills/task demands				
	Auditory Comprehension	Written Comprehension	Verbal Expression	Written Expression	Non-linguistic Skills
Changes to the online environment	E.g., subtitling on online video	E.g., use of more accessible device to support	E.g., use of more accessible	E.g., use of more accessible	Simplification of technology environment

Impaired skills/task demands					
Type of Intervention	Auditory Comprehension	Written Comprehension	Verbal Expression	Written Expression	Non-linguistic Skills
consist of interventions to simplify or personalise areas of the Internet accessed by the person with aphasia.	<i>Consider for those who can use written information to supplement impaired comprehension. Use of the such a strategy may be dependent on environmental support from carer.</i>	<i>reading, such as a tablet instead of a pc Consider for participants who struggle with task demands of using laptops/desktops e.g. use of mouse, navigating cursor, switching between windows. Apps may be simpler to access than entering data in web pages.</i>	<i>hardware to support verbal communication Consider for participants who struggle with task demands of using laptops/desktops e.g. use of mouse, navigating cursor, switching between windows. May be used with text to speech above to support communication</i>	<i>device to support writing Consider for participants who struggle with task demands of using laptops/desktops e.g. use of mouse, navigating cursor, switching between windows.</i>	<i>may reduce cognitive load. E.g., removal of clutter on desktop, hiding all unused apps, placing all participant's apps/browsers in one area. Consider for participants who display distraction/difficulty focusing on Internet and other tasks, and for those whose Internet skills prior to stroke are described as limited to specific activities.</i>

Table 4-6: Decision-making framework: Environmental interventions/changes to the online environment

No additional expensive hardware was purchased and all avenues were explored to make best use of existing equipment. The aim was for interventions to be relevant to the individual, clinically relevant, and not dependent on any specific or new technology. Modifications of online settings and environments on existing hardware were used with the aim of influencing ability to access information.

Support from others

Environmental interventions related to support from others were considered in consultation with participants and their supporters when a possible intervention could be aimed at adapting the behaviours of others in the person's environment. Table 4-7 gives examples of how this category of intervention would relate to impaired skills or task demands of specific activities. Such an environmental approach would not target the person with aphasia, rather the behaviour and skills of those around them. Turner and Whitworth (2006) discussed the challenges of selecting partners for conversation

training interventions. Although a different area of intervention, issues of candidacy are also likely to apply when considering whether to involve supporters in interventions around Internet use.

Impaired skills/task demands					
Type of Intervention	Auditory Comprehension	Written Comprehension	Verbal Expression	Written Expression	Non-linguistic Skills
<p>Support from others involves interventions to train or advise friends or carers on how to facilitate use of the Internet with a person with aphasia</p> <p><i>Others involved in this category of intervention should be willing to engage in training to support the person with aphasia.</i></p>	<p>E.g., training of carer to reduce any background noise when participant listening to online content or to discuss summaries/transcript of content prior to or after listening.</p> <p><i>Consider for participants with impaired auditory comprehension who benefit from key words and pictorial cues.</i></p>	<p>Training of carer to support with environmental changes OR</p> <p>Paired reading OR</p> <p>Carer reads and discusses written materials using supported communication</p> <p><i>Consider for participants unable to use any strategies independently but who benefit from prompting and support.</i></p>	<p>Training of video/audio chat conversation partners in supported conversation techniques.</p> <p><i>Consider for participants unable to use any strategies independently but who benefit from prompting and support.</i></p> <p><i>May also combine with strategies to support participation if participant has sufficient executive functioning skills to use rating scales/gesture/drawing to support own communication.</i></p>	<p>Training of carer to support participant with writing. May include:</p> <p>Guidance in choosing from word lists/copying</p> <p>OR</p> <p>support with use of strategies OR</p> <p>Support with aspects of AAC</p> <p>OR</p> <p>Paired writing</p> <p><i>Consider for participants unable to use any strategies independently but who benefit from prompting and support.</i></p>	<p>Training of carer to provide prompts/reminders of steps towards a task. E.g. paired browsing with carer compensating for impaired skills and participant carrying out what he/she can independently.</p> <p><i>Consider for participants who have some skills towards a task or who can use compensatory technologies but who struggle to initiate or to complete a number of steps towards a task.</i></p>

Table 4-7: Decision-making framework: Environmental interventions/support from others

Some pairings might be more suitable for this type of intervention than others. Factors to consider might be, for example, the person’s skills as a supportive communicator, their other commitments, and their digital skills. Environmental interventions involving the supporter of the person with aphasia were chosen when the person with aphasia was unable to use strategies independently or was already frequently facilitated with communication by the other person. The supporter would

also need to be willing to engage in training related to helping the person with aphasia to use the Internet.

4.5 Review and agreement of goals

Use of the decision-making framework allowed the researcher to consider the demands of each participant's prioritised Internet activities in relation to the person's performance/profile and determine possible interventions. The researcher and participant (plus carer if appropriate) were then able to negotiate goals in terms of what may be realistic and achievable for the participant, but always maintaining a focus on aspects of Internet use that were important and valuable to them. This process involved discussing possible and recommended interventions, any necessary revision of goals, and agreement on the duration and intensity of therapy.

4.6 Format of Interventions

Each case study took the form of a single case pre-test/post-test control design (Lum, 2002). Participants took part in an initial assessment period of two to three weeks. There was then a period of one to two weeks when possible interventions were considered and discussed with the participant and their supporter. Detailed information on the nature of interventions chosen for each participant is provided in Chapters five to eight.

Due to the heterogeneity of the participants and differences in interventions, additional assessment was needed for each of the participants. This data was collected following consideration of possible interventions and before the nature of interventions was determined. Examples included: a participant held diary of Internet activities (Chapter five), Internet skills assessments with a focus on narrower aspects of Internet use (Chapters five and six), and additional language assessments or sampling (Chapters seven and eight).

Duration of therapy lasted up to eight weeks and intensity was decided with consideration for participants' personal preferences. The interventions were carried out using participant's own devices using changes to settings where necessary.

There was minimal need for any additional equipment or software. Whenever possible, software was used that was available on the participant's existing operating system. Any trials of software required as part of an intervention were either provided on loan from University stores or obtained as a free trial. Participants were then free to purchase software themselves should they wish to continue using it following the research.

4.7 Effectiveness

The terms 'efficacy' and 'effectiveness' may be given different definitions within the speech and language therapy literature (Lum, 2002). In this study, the term 'effectiveness' is used to refer to what Lum defines as '*patient specific efficacy*' (p156). Thus, an effective intervention with the case study participants would be one where the participant improved in the area of Internet use targeted. In addition, there would be evidence to support that the intervention was responsible for that change.

All participants were reassessed in the week following intervention using the repeated measures described in section 4.8. It was anticipated that interventions based on one or more component of the ICF might lead to change in outcome measures based around other components and, therefore, cross component assessment was again needed. Control measures differed for each participant depending on the nature of intervention and the level of severity of the person with aphasia. Individual control measures were chosen from initial assessment measures where change was not anticipated (Pring, 2005). Additional assessments carried out prior to the intervention were repeated if they could be used as an outcome measure or to provide control data. Assessments of non-verbal cognition and some language assessments were omitted at reassessment as these were used for diagnostic purposes rather than as outcome measures.

The Internet skills assessment was repeated using the same equipment as in the initial assessment. Any treatment-related adapted software installed onto participants' devices was available for their use. It was left up to the individual whether they made use of any adaptations during the reassessment.

Interviews with supporters were repeated if the intervention had actively involved the supporter or aimed to change their behaviours in providing help with Internet use. This was only the case for one participant (Chapter five). In this case, qualitative data from the repeated interview was analysed in the same way as described in section 4.3.4, under 'Interviews'.

4.8 Data Analyses

The collection of pre- and post-intervention measures for each participant allowed for investigation of possible change both within and across ICF components. Type of data collected post-intervention and means of analysis are discussed below.

4.8.1 Language assessments

The CAT (Swinburn et al., 2004) provides T-scores across all subtests and guidance on the amount of change needed in a subtest to be statistically significant (Howard, Swinburn, & Porter, 2010). This enabled comparison of pre- and post-intervention scores. Additional language assessments, as relevant, were analysed depending on the nature of the data generated. Detailed description of the methods of analyses will be discussed in the relevant participant chapters.

4.8.2 Internet skills assessment

Scores for each element of the Internet skills assessment tasks reduced from four to zero depending on the amount of assistance needed from the assessor. Therefore, an increased score for a task would reflect reduced need for assistance. Any changes to speed of performance were reflected in the time taken to complete the assessment (measured in minutes and seconds from the video recording of the assessment). A marked reduction in time to complete tasks could be interpreted as an improvement in efficiency of Internet skills. Qualitative observations generated from the video recordings could also be compared to identify any changes in self-initiated behaviours, response to cues or assistance, or routes towards completion of a task.

Environmental influences from the design of equipment and from websites were identified from qualitative observations on the video recording of the Internet assessment. Comparison of qualitative descriptions of performance on each task allowed for differences to be identified pre- and post-intervention. For example, the route taken towards a goal, the impact of website design, or the amount of assistance required.

4.8.3 Internet questionnaire

A repeat of the Internet questionnaire was predominantly designed to identify any notable changes in the frequency of Internet activities. The questionnaire would also identify whether participants reported that any accessibility tools were now used post-intervention. Some participants might also contribute additional qualitative data during the questionnaire process (see section 4.3.2).

4.8.4 Social Network Analysis

Antonucci's (1986) Social Network Analysis was repeated to investigate whether any improvement in access to online means of communication had changed the amount of social contact they had with others. Numbers of contacts and frequency of interactions were recorded and compared descriptively, pre- and post-intervention.

This chapter described the methods used across four single-subject design exploratory case studies, which follow in Chapters five to eight. Methods specific to individual cases are described within the relevant chapter.

Chapter 5. Bill's Case: Access to Online News and Sports.

This chapter describes assessment and intervention with Bill, a 74-year-old man with severe aphasia. One of Bill's goals for Internet use was access to online news on current affairs and sports. Section 5.1 presents results from assessment and information gathering structured around the ICF framework. Section 5.2 describes the intervention designed to support Bill. Section 5.3 discusses the measures of effectiveness used for the intervention and section 5.4 presents the results and evaluates the effectiveness of the intervention.

5.1 Bill's Profile

Prior to a left basal ganglia infarct (two years before this research), Bill had retired but continued to maintain a role in his academic field. He lived with his wife Violet who was also retired. Bill had two adult children; one lived elsewhere in the UK and the other lived abroad. Other members of his family and many of his friends also lived abroad. Bill had worked with two SLTs; SLT1 had initially worked with Bill when he was an inpatient in a stroke ward. She had continued her involvement when he left hospital under the care of a stroke discharge team. SLT2 became involved when Bill was transferred from stroke rehabilitation services to more general SLT community rehabilitation. As SLT1 also worked within the community team, they shared his care. Bill and his wife had also recently attended a conversation partner training group run by other SLTs.

A detailed description of all assessments and interview data follows in sections 5.1.1 to 5.1.6.⁷

⁷ Assessment information for all participants is also collated in Appendices L (core assessments) and N (additional diagnostic assessments).

5.1.1 Body Structures and Functions

Bill had a right-sided hemiparesis affecting his hand, arm, and leg. He was independently mobile with a walking stick for short distances. In the initial months post-stroke, he had suffered several episodes of sudden loss of vision but had experienced no recurrence of this at the time of the study. He was previously right-handed but now had no functional use of this hand. He wore glasses for reading. No difficulties with hearing were reported or observed.

Language assessments

Bill was heavily dependent on others to support his conversation. He demonstrated ability to understand simple language, but there were frequent breakdowns in communication if there was a change of topic or he was presented with information out of context. His expressive language consisted mostly of 'yes' and 'no', and some single word responses. He also often produced echolalic repetitions of others. Bill used facial expressions to good effect and often communicated his feelings in that way. His wife Violet reported during initial meetings that his language abilities fluctuated. For example, on some occasions she noticed he could produce words and short phrases easily but on others he appeared to struggle much more. Language assessments indicated Bill had good auditory and written comprehension at single word level but some difficulties understanding spoken and written sentences. Attempts at naming and reading aloud predominantly contained phonemic paraphasias, for example, vest -> /bɛst/, cigarette -> /ɛgələt/, telephone -> /fɛləfon/. There were also occasional jargon or mixed semantic and phonemic errors. His attempt to describe the picture from the CAT was largely unintelligible and contained only a few appropriate words interspersed with jargon. Bill could copy written words well and accurately write the names of some shorter nouns. However, written picture description was similar to spoken output and contained unintelligible content alongside isolated single words. Violet also reported during assessment sessions that Bill was susceptible to fatigue and this negatively impacted his language. Detailed results from Bill's CAT language assessments can be seen in Table 5-1.

CAT Subtest	N	Raw Score	T-Score
Semantic memory	10	10	60
Comprehension of spoken words	15	15	60
Comprehension of written words	15	15	65
Comprehension of spoken sentences	16	15	52
Comprehension of written sentences	16	12	46
Spoken picture description	--	0	--
Naming objects	24	11	49
Reading words	24	12	50
Reading complex words	3	2	51
Reading function words	3	0	35
Reading non-words	5	0	40
Writing: copying	27	27	61
Writing: picture names	5	4	55
Writing to dictation	5	2	50
Written picture description	--	1	--

Table 5-1: Language assessment results: Bill

Assessment of cognition beyond linguistic profiling

Bill's visual perception skills were not impaired (Symbol Cancellation, Mazes). He also demonstrated skills of sustained attention, planning, and mental flexibility (Mazes). However, auditory and visual memory (Wechsler) were impaired apart from a relatively high score for the backwards visual memory task. This relative strength was not in keeping with impaired performance for other aspects of the assessment. Performance on the M-WCST was impaired for number of categories correct and the executive functioning score was within the M-WCST definition of 'low average range'. Given Bill's occupation and high levels of education, these scores were evidence of

impairment of executive functioning. Detailed results from all the above measures can be seen in Table 5-2.

Cognitive test/subtest	N	Raw	Percentile
Wechsler digits forward	12	4	6
Wechsler digits backward	12	1	<2
Wechsler visual memory forward	12	3	<4
Wechsler visual memory backward	12	6	62
CLQT mazes	8	7	--
CLQT symbol cancellation	12	11	--
M-WCST categories correct	6	3	4
M-WCST executive function composite	--	--	12

Table 5-2: Assessment of cognition beyond linguistic processing: Bill⁸

5.1.2 Activity and Participation

Internet use: Bill's perspective

The questionnaire data on type and amount of Internet use was disregarded as Bill's yes/no responses were inconsistent, he often appeared uncertain, and showed poor understanding of the concepts of 'before stroke' and 'now'. Therefore, a simplified version was used that only required Bill to indicate frequency of carrying out a range of online activities. A numerical scale was used instead of the wording describing levels of frequency of use. Bill's responses were more certain and consistent for this simplified version. He conveyed that his most frequent activities were looking at news

⁸ Highlighted scores on this and other tables reporting cognition scores represent a score greater than one and a half standard deviations from the mean of standardised non-clinical samples (Wechsler and CLQT) or impaired performance as defined by the M-WCST manual. The CLQT does not provide standardised data.

and sports, followed by e-mailing. Other activities were looking for information on local events, general browsing, looking for information on health, jokes/funny content, and online discussions. However, due to the need for simplification, it was unclear whether he was referring to his current Internet use or his use prior to his stroke.

Internet skills

Bill carried out the Internet skills assessment using his Asus laptop running Windows 7. He reported this was their main computer and Violet confirmed their laptop was the device they used the most. A recently acquired iPad was predominantly used for speech and language therapy apps. He could carry out some individual elements of the assessment, although he needed multiple prompts throughout. Prompts involved repeated reminders of the task and suggestions regarding what to do next. Pointing was also needed to direct him to specific areas of the screen. Operational skills (the presumed simplest level in the hierarchy) were the most preserved. Bill could switch on his computer, and he could click on links and copy a URL into the correct location. He had more difficulty with fo

ormal skills. With orientation around webpages he could not find his way back to where he had been before without assistance, and needed prompts to switch between tasks. He was distracted by other aspects of a website (e.g., by reading aloud all menu items on the BBC home page), and needed frequent reminders to refocus his attention to the task. Informational skills also needed considerable support and were influenced by his impaired language; typing accurate search terms, and interpreting search results were both difficult. He made errors in typing and struggled to scan and select appropriate results from an Internet search. Strategic skills were poor; Bill needed step by step direction to complete the final task (booking train tickets at a specific date and time). Finally, he also displayed problems with manual-motor coordination. He struggled to efficiently use a mouse with his non-dominant hand to navigate a screen pointer and to click on hyperlinks. However, with a great deal of assistance from the researcher he could carry out some aspects of all the tasks and complete the assessment. His scores and times taken for each task on the Internet assessment can be seen in Table 5-3.

	Task	N	Score	Time taken
	Switch on/operational	8	8	01:49
	Weather/operational	20	14	09:27
	NETA/formal	28	22	06:07
	Train information/formal/strategic	36	14	13:09
	TOTAL	92	58	30:32

Table 5-3: Internet assessment scores: Bill

Supporter perspective

Bill's wife Violet stated in her interview that before his stroke Bill used the Internet regularly. She reported that he used computers for writing reports and was often on the Internet to search for information for his work. He also used e-mail to regularly correspond with friends and colleagues. Bill's computer and Internet skills were self-taught, and if he did not know how to do something he would be able to work it out by looking up the information. Violet reported she felt these abilities changed a great deal following Bill's stroke, as he was now unable to carry out any of his previous Internet activities independently. She said that trying to communicate the simplest of ideas frustrated Bill, and this was a contrast to his previously articulate self. She described her husband prior to his stroke as, '*a whizz, ... he would get up in the mornings and put the computer on... and check the emails that sort of thing*'.

SLT perspective

The SLTs discussed in their joint interview how goals related to Internet use were briefly considered, but were not their primary focus as Bill at the time indicated his wish was to improve his speech and language skills. They were aware that Bill had a laptop he used for therapy software and an iPad that had been purchased by his sons to help with his rehabilitation. SLTs involved before them (while Bill was still an inpatient in hospital) had suggested suitable apps for installation on the iPad. To their knowledge, he had used his laptop very regularly before his stroke but did not have a

great deal of experience with iPads. SLT1 confirmed that Bill had mentioned writing emails but that he did not identify it as something he needed to improve on. Goals were focused on more basic aspects of written language such as single word writing. During their period of involvement, they had recommended speech and language therapy software both on his iPad (Tactus Therapy, n.d.) and his desktop computer (Bungalow Software, 2017). Bill and his wife had reported being able to operate the therapy software independently. Therefore, the SLTs had not prioritised any work on computer or iPad skills.

5.1.3 Environmental Factors

Bill completed the Social Network Analysis with the researcher and Violet, referring to a personal communication book containing pictures of his friends and family. The completed diagram contained three names in the inner circle, those of his wife and his two adult children. The middle and outer circles contained nine names each (a mixture of other family members and friends). There was one colleague in the outer circle. Bill reported that he saw his wife every day. He saw five of the individuals fortnightly, eight monthly, and the remainder rarely. A summary of his responses can be seen in Table 5-4. This information highlighted that Bill's social support came predominantly from his wife; he had little access to any other regular contact with friends or family. In a conversation noted by the researcher in field notes, Violet responded to a suggestion that video calling might be more accessible to Bill than email. She reflected that most of their friends and family were not as Internet literate as Bill was previously and would not be able to set up or take part in a video call. This was another potential environmental factor; Bill had limited access to others who possessed the skills to be flexible around means of communication.

The Internet assessment provided some useful information on environmental factors. Bill only had use of his unaffected arm and hand and struggled to open the screen of his laptop. He had frequent problems discriminating between left and right click buttons on an external computer mouse.

Section of diagram	No. of people
Inner circle	3
Middle circle	9
Outer circle	9
TOTAL	21

Category	No. of people
Spouse	1
Family	12
Friend	5
Colleague	1
Other	2
TOTAL	21

Table 5-4: Social Network Analysis: Bill

Bill was facilitated by the physical presence of a keyboard in that he could match letters when copying the text of a URL. However, he became easily distracted by reading aloud aspects of web content that were not necessary to achieve his goal. He clicked on links in error, and became disoriented and unable to return to his starting point. The need to scroll to an area of a website not in view on his screen created difficulties, as did identifying text and icons leading him towards his goal. Aspects of design such as tabs for each day of the week on the BBC weather website did not prompt him to click for further information, and he needed verbal prompting to do so. Some simple web design features were helpful to Bill, for example, a menu bar at the top of the screen helped him to navigate around web pages. When searching for contact information for a person, a picture and hyperlinked text containing an email address helped him to locate the desired information.

Violet conveyed during her interview that she recognized that Bill was no longer able to read and write independently. She reported that she provided help by sitting with him to read and reply to e-mails from friends and by encouraging him to read e-mails himself. They would sit together to read a message, then write out a reply longhand for Bill to type. Violet stated she was willing to put Bill's rehabilitation first over other activities, as she felt his needs were more important than general chores. Her interview also revealed that she felt she and Bill had benefited from attending a conversation partner training group (see section 5.1). Violet reported this experience had been very helpful to them, teaching them new ways to communicate with each other and reducing their frustrations.

Although Violet indicated during her interview that time was not a problem, she also remarked several times during visits that she was busy looking after Bill as well as carrying out all other household tasks. She reported that due to being so busy, she had to be reminded by family and friends to check for e-mails. She reported many aspects of computer use were bewildering to her. She said she struggled to use Bill's laptop, feeling much of it was unfamiliar and that she lacked the necessary skills. She found it hard to concentrate for any length of time on computers. If she encountered problems, she would try for a short time to solve them but then switch off and try again later. She reported feeling overwhelmed by some aspects of technology, saying they were unfamiliar territory and that she would find herself unable to explain problems to Bill or to rectify them.

Violet was asked during her interview to talk about any help Bill had received from health professionals with using the Internet. She reported that there had been no support of this kind. Despite their geographical distance, Violet reported that their children had provided some help with technology. They had recently bought and set up an iPad for Bill as an alternative to his laptop. Although the skills of their children were highly valued, and their help appreciated, Violet indicated that she and Bill found it difficult to understand what was being done on their behalf. She commented that when the children were helping with Bill's computer or the iPad, they carried out tasks too quickly for her to learn. She also indicated that she was reluctant to ask them to slow down, for fear of causing offence.

Violet's interview also revealed that before retirement the couple had access to technical expertise from their employers. This was no longer available and Bill's work related e-mail account was about to close. Lack of access to technical expertise became apparent soon after his stroke, when Bill's laptop had a hard disc failure. He was alone when it happened and when Violet returned from a brief trip he was distressed, and unable to explain what happened. Bill and Violet sought help from the department store where they initially purchased the laptop. Violet reported finding the service there very helpful and accessible. She stated, '*on two occasions I remember their staff sat with us for about half an hour... and spoke through things and installed the Internet and all sorts of things, they were really fantastic*'.

The interview with Violet identified several barriers and facilitators to Bill's Internet use that were related to the support he received from others. Facilitators could be seen in Violet's previous engagement with supported conversation training and her willingness to prioritise Bill's rehabilitation. She was already facilitating his access to email and had identified a place to seek help with computer issues. He had access to modern equipment (his iPad and laptop) and both his wife and children were willing to provide technical assistance when able. Barriers could be seen in Violet's lack of confidence in her Internet skills, demands on her time, and the couples' support from their children being at a level they struggled to process.

5.1.4 Personal Factors

Educated to doctoral level and having worked previously as an academic, the benefits provided by the Internet were important to Bill. His wife had reported he used e-mail to stay in touch with people around the world. Additional conversation with Bill and Violet revealed he was a high achiever, motivated in his career, and although officially retired, he had continued to work and hold a role with his university up until his stroke. Violet confirmed his ongoing drive and motivation to improve, recalling in her interview that Bill recently returned from a stroke support group meeting and, despite a long and tiring day he still wanted to do his speech exercises. Bill was clearly motivated for rehabilitation.

Goal setting

In the goal-setting discussion, Bill indicated his most important priorities for Internet use were using e-mail, entering passwords, instant messaging, reading the screen, news and sports, writing on the screen, understanding written instructions, asking for help, understanding speech or audio, and general browsing. He placed more emphasis by repeated pointing on news and sports and on e-mailing. Violet confirmed that using e-mail would be an important goal to help Bill stay in touch with important people in his life, including close friends who lived abroad. Figure 5-1 illustrates the organisation of pictures at the end of Bill's Internet goal setting session.

As Bill placed increased emphasis on e-mail, news, and sports, these three aspects of Internet use were agreed as his main priorities. An informal observation of Bill's ability to use email was conducted during one of the assessment sessions. Bill was asked to show the researcher how he used his email. He was unable to locate his email provider on his laptop. He attempted to type '*email*' into the URL bar but could not progress further from this point.

Bill's severely impaired expressive language precluded compensatory technology options such as voice recognition or word prediction. However, an environmental intervention involving paired reading and responding to emails could have been an appropriate choice for enabling access, albeit heavily supported. However, Violet had described how they already had a system for reading and replying to emails together.



Figure 5-1: Bill's priorities from the goal setting session

As support with emailing was already in place, the researcher suggested prioritising an intervention to enable independent access to news and sports, Bill's other prioritised goal. Bill and Violet reported they still wanted to consider more independent use of email as a future goal but were happy to focus on his other

priority during the study. They agreed to an intervention with a focus on allowing Bill to independently access his preferred news and sports information. They decided with the researcher that a measure of success would be if Bill were able to independently access news and sport information several times each week.

5.1.5 Further data collection

Ability to access news and sports / iPad skills

Despite clearly indicating goals around accessing news and sports, Bill's actual ability in that area was unknown. It was also not clear whether he had skills for using his iPad. Documented observations during initial sessions showed that Bill was keen to use the iPad and could switch it on (with a little difficulty due to one handed operation). He could also remember and enter his pin code and locate the BBC news app. However, he was unable to navigate within the app and reported he did not use it. A tailored assessment was therefore designed to assess Bill's ability to use his iPad and to find sports-related news. He was asked to look for the score for a recent high profile rugby match (task one) then to locate fixture information for a football team's upcoming match (task two). The tailored assessment can be viewed in Appendix L.

Bill's iPad was used for this baseline measure, as it had been chosen as his preferred device to use during the intervention (see section 5.2.1 for justification for this decision). The measure was based on the original Internet assessment and scored in the same way. Scores and time taken to complete each task can be seen in Table 5-5.

As with the standard Internet assessment, Bill needed multiple cues to achieve each task. He struggled to find solutions to achieve the tasks such as locating a search engine or trying another route if his first was not successful. He found it difficult to use tapping gestures to select links on the iPad, and was distracted by reading large amounts of information on a screen (e.g., multiple sports stories). He became disoriented after selecting incorrect links or due to errors in the use of iPad gesture controls (e.g., by using multiple taps on the screen). He was unable to initiate words

for searches but copied search terms letter-by-letter from paper-based task instructions. He could locate the desired information if it was present at the top of a page and he could use sweeping gestures to move between pages.

Task	Score	Time taken (mins:secs)
Task 1 (rugby scores)	20/28	06:34
Task 2 (football fixtures)	14/24	08:25
TOTAL	34/52	14:59

Table 5-5: Scores and timings for tailored Internet assessment

Diary of Internet activities

The Internet questionnaire had generated inconsistent information on frequency of Bill's Internet use therefore did not provide adequate information on how often he was using the Internet, or when he and his wife carried out activities together. To obtain this information, Violet was asked to keep a simple diary of Bill's Internet and computer use for one week without changing their current behaviour. This was collected a week later and Violet was asked to clarify any aspects that were not clear. She reported that the diary represented a typical week of computer use since Bill had returned home from hospital. Violet started the diary on a Thursday. On that day, she had helped Bill to check the news and to work on speech and language therapy apps. The following day he had worked independently on the speech and language therapy apps. During the weekend, Violet noted that Bill was watching a major rugby tournament so did not go online. In the following two days, he had again devoted time to the speech and language therapy apps (with Violet's help). There was no independent use of his laptop or the iPad to find news and sports information. Violet also completed the diary following the intervention.

5.1.6 Emotional wellbeing

Bill's responses on the emotional scale of the CDP allowed consideration of some of his feelings related to his aphasia. He reported no anger or loneliness (rated zero)

and mild feelings of unhappiness, worry, lack of confidence, and embarrassment (rated one). He rated his contentment, ability, and feelings of being valued at the second most positive end of the scale (scored one to represent low impact of disability). Feelings of determination, frustration, and lack of control were all at the middle point (rated two). His strongest negative ratings were how he was feeling at the point of the assessment and about the future (rated three). The scores for this assessment can be seen in Table 5-6.

Emotions	Score ⁹
Total score (/56)	15
Angry	0
Frustration	2
Determined	2
Unhappy	1
Worried	1
Content	1
Under confident	1
Lack of control	2
Able	1
Lonely	0
Embarrassed	1
Valued	1
Feelings about the future	1
Feelings about today	1

Table 5-6: CDP Emotional Scale: Bill

5.2 Intervention

⁹ For all emotional scales ratings were 0 – 4. A score of 4 represented the most negative emotion

Possible interventions were considered using the decision-making framework outlined in Chapter four. Recommendations for discussion were presented to Bill and Violet using supportive conversation techniques to ensure Bill understood the proposed intervention. Both were keen to proceed and a timeline was agreed. Bill's intervention would target his ability to access news and sports information by working on a range of strategies and making adaptations to his online environment. Bill would be encouraged to use his iPad as a more accessible device than his PC. He would learn basic iPad skills and how to use subject specific apps to access written, pictorial, and video information. Simplification of access to this information on his iPad would reduce choice and amount of distracting content. Apps would be personalised to allow prioritised access to his preferred information. Finally, Bill's wife would receive advice on improving her Internet skills to allow her to support him with greater confidence in future. The justification for each of these aspects to the intervention is discussed below, with reference to Bill's profile and relevant literature.

5.2.1 Justification

Accessing news and sports online requires the ability to operate an Internet browser or an app and to navigate content using links while remaining oriented. There may also be a need to use search terms and select results if looking for specific information. The use of links and Internet searching are reliant on linguistic skills of reading and writing (for searches). Comprehension of news or sports stories requires reading skills at either phrasal/sentence level (for headlines) or discourse level (for more detailed information). There is also a need to understand numerical information from scores.

Assessments described in section 5.1.1 indicated Bill's reading comprehension was impaired at sentence level. Further information on his ability to retain and process longer pieces of written information would have been helpful, ideally within the context of reading on a screen. However, during the tailored assessment of Internet skills, he demonstrated functional ability to read menu items and identify and understand scores. There was evidence from his previous SLT involvement that he could learn how to use simple software in the form of speech and language therapy

apps. The Internet skills assessments showed although he struggled to use a mouse and some iPad gesture controls, he could click/tap on links and understand simple menu items. The assessments suggested Bill could learn to navigate simple menus related to news and sports content. However, one potential area of difficulty was the likelihood that he would become disoriented online. He therefore needed a more direct and less complex route to his news and sports information and an environment where he was less likely to click a link leading him to an unrelated area.

The use of targeted apps on an iPad instead of searching for information within a browser would allow Bill to access his news and sports information with an environment which contained only relevant information. Such subject specific apps would reduce task complexity and could potentially allow Bill independent access to news and sports information without the need for support (e.g., to enter a URL or find an appropriate website). It would also be possible to reduce the amount of distracting content by cutting down the number of app choices on his iPad and by personalising menu items. Bill could also be introduced to video and pictorial content within applications. This could serve as an alternative to written information and introduce variety to his browsing experience.

Accessing a laptop required ability to open and close the screen and the use of a mouse to select and open different applications. In contrast, an iPad requires only one button to turn the device on and off from standby and one tap to open apps. iPad apps can be organised in themed groups within the home screen, so all those related to news and sports could appear together. A simple iPad stand and stylus pen could assist Bill by keeping the device upright on a table in front of him and allow him to access the screen more accurately.

One aim of the intervention was to increase Bill's independence for accessing news and sports information. However, it was anticipated he might still need a degree of assistance. Violet was willing to help her husband in any way she could and Bill was happy to receive her support. They reported they worked together well and enjoyed spending the time together. However, Violet had expressed anxiety around using technology, and poor confidence in her computing skills. The iPad was new to them

both and they were using it in quite a limited manner (predominantly for SLT apps). Enabling Violet to identify solutions to some of her difficulties with computer use might equip her with greater confidence to assist her husband with technology.

5.2.2 Intervention design

An outline of the intervention was produced in advance to ensure all aspects were covered. This amounted to ten sessions in total, each lasting 40 minutes to one hour, dictated by Bill’s level of fatigue. Nine of the sessions consisted of one-to-one intervention with Bill while Violet was not present. Following each session, Violet was provided with a summary of what Bill had been working on, shown any handout material, and given a written reminder of any homework. Violet also took part in one hour-long session without Bill present with a focus on her Internet and computing skills. Each of Bill’s sessions were accompanied by a handout which provided an outline of each aspect of the sessions and contained simple text with highlighted key words alongside supporting images. Individual components of the intervention are described below, with a summary provided in Table 5-7.

Prior to commencing interventions, simple modifications were carried out to facilitate access to the iPad. On the researcher’s suggestion, Violet purchased an iPad stand for Bill to help him work at the device from his favoured spot sitting at a table. A stylus pen was provided by the researcher.

	Weeks	1→	2→	3→	4→	5→	
Time A	Sessions	1-2	3-4	5-6	7-8	9-10	Time B
Assessment	Basic iPad skills	iPad practise App selection/personalisation	iPad practise Training sessions	iPad practise sessions	iPad practise Training sessions	iPad practise Problem-solving session with Violet	Reassessment
	iPad practise	Training sessions Resources for Violet				Information on ongoing support	

Table 5-7: Timeline for Bill’s intervention

Learning basic iPad skills

Bill had previously used his iPad very little. He demonstrated poor knowledge of some aspects of its operation during the tailored assessment. Therefore, a first step was to ensure he was familiar with and could use basic iPad techniques. Introduction to these techniques involved use of free apps to enable Bill to practise skills such as tapping/selecting, pinching/zooming, and dragging. A simple colouring app involved Bill tapping on a colour to select it then tapping on an area of a line drawing to colour that section of the picture. Bill used his fingers and the stylus pen interchangeably for this task. The researcher demonstrated selection of colours and application to each picture. Bill was encouraged to copy colour selection and application and to colour one of the pictures. Once he had mastered this skill, he was then shown how to use pinching gestures to zoom in on smaller areas of the picture. Figure 5-2 shows Bill using the colouring app. He was also shown how to zoom in on areas of the screen using the Google Earth app and encouraged to practise this skill. Bill could copy and use all gestures effectively. He reported that he enjoyed the colouring experience, and 'visiting' many places on Google Earth he had been to in person or where his friends and family lived.

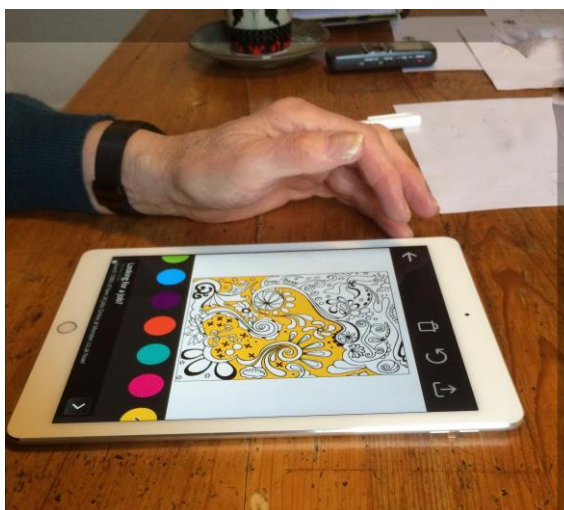


Figure 5-2: Bill using a colouring app on iPad

Bill was then taught sweeping gestures to move an item from one location on an iPad screen to another. This was again achieved via the demonstration and copying

technique using an app to play the card game Solitaire. However, Bill was unfamiliar with Solitaire and found it very difficult to understand the rules of play. As a result, tapping, zooming, and selecting skills were prioritised via the colouring and Google Earth apps. Bill was given online colouring to complete and a list of places to find on Google Earth for homework. He was asked to practise using the apps in his own time and Violet agreed that she would provide encouragement and support.

App selection and personalisation

Bill was provided with a list of six possible popular apps from the Apple Store for accessing news or sports information (chosen from the store list of most popular free apps). Each was downloaded to Bill's iPad and the researcher and Bill looked at the content together. Bill then rated each experience using a visual Likert scale based on how much he liked the app and would want to use it. On this basis, he selected four apps as his favourites. These were BBC News, BBC Sports, the Guardian, and BT Sports. The rejected apps were deleted from his iPad and his chosen ones were placed alongside colouring and Google Earth on a devoted section of the iPad home screen referred to as 'Bill's page'.

Bill was aided to register for usernames and passwords where these were required. He then worked with the researcher to select his preferred news and sports topics from within each app and to select these within the personalisation options as his preferred content. This meant that items of interest to him would appear with high priority, reducing the number of choices necessary. Bill's main interests were rugby, football, and world news. He also wanted to see the 'most popular' items. Pictorial and video content was prioritised where possible, as were options for news in 'in brief' containing shorter news stories (to reduce the need for reading large amounts of information). Where possible, settings within apps were adjusted to minimise the amount of content per page (e.g., by turning off the compact layout setting on BBC news).

Training Sessions and iPad practise

The initial step to introduce Bill to using news and sports apps was to ensure he could select an appropriate app for the information he required. His selected apps contained similar content, therefore it was likely that more than one app would provide information on information such as sporting scores. However, it was important to ascertain that he could take initial steps towards seeking a piece of information. He was asked to start at the home screen then to select which app he would choose for different purposes. For example, to look at news videos, to read rugby news, or to find out about formula one scores. Practise using each of the chosen apps followed. There was a focus on one app at a time and Bill was given a handout to guide him through basic features. Certain icons were consistent across applications. For example, the three parallel horizontal lines commonly found to represent top level menus are known as the 'hamburger icon' (Antonio, 2014). The researcher repeatedly reminded Bill to 'look for the hamburger', pointing out the visual similarity to a burger bun and reinforcing that this icon would always take Bill back to a menu list if he became disoriented. Play, pause, rewind, and stop buttons were also consistent across applications and influenced by symbols found on traditional video equipment. Orientation to each app consisted of demonstration and practise finding different areas of interest within the app, followed by repeated practise finding items from a list. Appendix N gives examples of handouts for some of these training sessions.

Bill was encouraged to look at sections within apps with high pictorial and/or video content (e.g., The Guardian and BBC 'in pictures' and 'video' sections). This was to demonstrate how he could find news information from a range of different sources. He was shown how to swipe between each picture from a set. Taking time to look at each picture was encouraged, as was discussion of the content via supported conversation. The aim here was for Bill to adapt to finding information from different media sources. He and his wife might then use these sources as a prompt for conversation. Bill was shown how to stop, pause, rewind, and play videos he found within the apps and encouraged to practise rewinding and replaying something he

had not understood or wanted to watch again. Figure 5-3 shows Bill using the stylus pen to pause and rewind video content from the BBC news app.

Initial sessions required a great deal of prompting to direct Bill towards the area of apps he had been asked to locate. Through repeated practise, the amount of assistance and prompting was gradually reduced until Bill could locate a range of different menu items independently in all his chosen apps. Strategies were also needed to support Bill's ability to read and understand written content. During the Internet assessment, he had been observed to spontaneously attempt to read written information aloud. However, this led to paraphasias and unintelligible output and did not help him complete tasks.

During intervention, there was a repeated focus on headlines, pictures, and initial paragraphs of news stories, which also aimed to discourage reading aloud. Appendix N contains an example of a handout providing visual reinforcement of this element of the intervention.

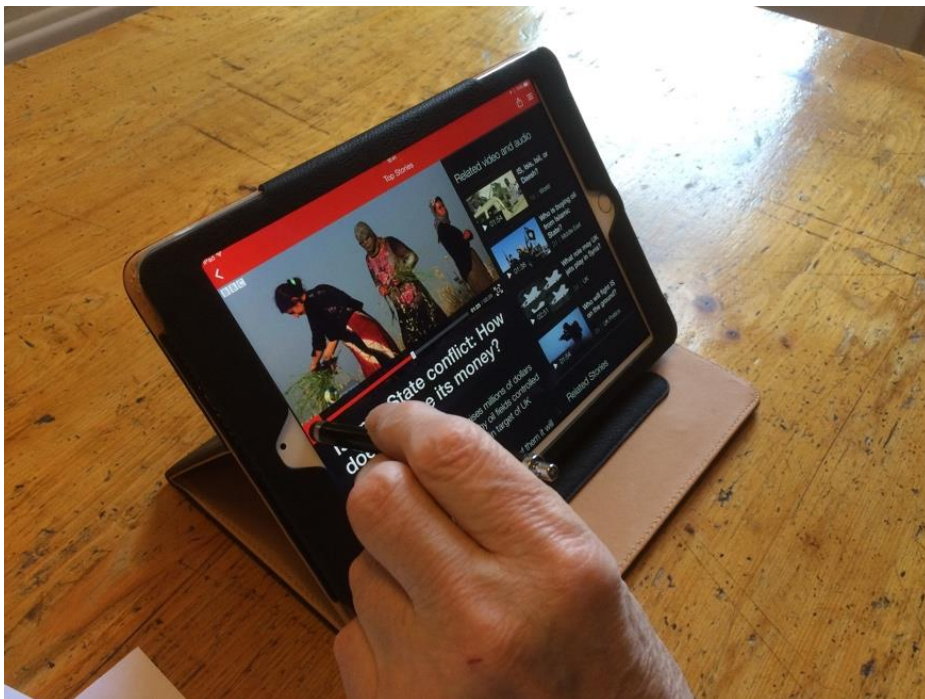


Figure 5-3: Bill learning to pause and rewind video content

Violet: provision of resources and problem solving

This part of the intervention involved Violet as Bill's main source of support. During the second week, a page for Violet was created on a separate home screen on the iPad. This was a space to collate useful information and included a link to a YouTube video providing basic instruction on all the features of the iPad (Cox, 2014). She was also provided with a direct link to the online iPad user guide (Apple Inc., 2014). Violet was encouraged to watch the video and explore the information in her own time, and to write down any questions she had. At the end of each session with Bill, Violet was also given the opportunity to ask any other questions regarding technology. She was informed that this need not be directly related to Bill's work on the iPad. She used this opportunity several times to ask about problems she had encountered since the previous visit or about something she had heard from friends was possible with the iPad. Violet also attended an hour long 'problem solving' session when Bill was not present. Prior to this, she was asked to write down any areas she would like help with, and any questions about iPad or computing use in general. The session involved one-to-one support with reverting to Windows 7 following an unwanted system update on their laptop, deleting apps and setting up email on the iPad, deleting and flagging emails, taking pictures with the iPad, emailing pictures, and using the BBC Radio Player app. All resulting information was written down for Violet, either during the session or in the form of a handout produced for her afterwards.

Ongoing support

At the end of the intervention, Violet was provided with a summary of all the information she had received. This was accompanied by a list of places to find technological support in her local area including one-to-one help from the local library, and online resources. It was also suggested that she consider an iPad basics course at the local Apple Store. For Bill, information was provided on computer drop-in sessions with a local aphasia charity, including an upcoming group for iPad owners.

5.3 Measures of Effectiveness

The measures chosen to determine the effectiveness of the intervention and those selected as controls are outlined in Table 5-8.

Measure	Predicted outcome
Diary of Internet use	Increased time looking at news and sports online Reduced need for support
Interview with Violet	Report of increased independent Internet use Evidence of increased confidence in her own Internet skills
Internet skills assessment (tailored)	More accurate and efficient response to tasks
Internet skills assessment (main)	Possible improvement of wider Internet skills
Language assessments	No change
Social Network Analysis	No change

Table 5-8: Measures of effectiveness for Bill's intervention. Control measures are shaded.

5.4 Results and Discussion

All measures of effectiveness are presented below with comparisons of Bill's performance at times A (pre-intervention) and B (post-intervention)

5.4.1 Internet use

It was predicted that the intervention would be successful in facilitating Bill to use a more accessible means to view his preferred websites. It was anticipated that as a result he would increase the frequency of time spent looking at news and sports online. The simplified version of the Internet questionnaire was repeated to obtain Bill's report on the frequency of his Internet use. However, his responses continued to contain possible confusion and, therefore, they were not included as a possible measure of change.

A repeat of Violet’s diary of Bill’s Internet use showed the amount of time Bill spent on computer activities each day and whether she had provided any assistance. It was anticipated that Bill’s independent use of the iPad would increase, but also that he would carry out more activities with his wife. An increase in shared activities might be due to Violet feeling more confident in her own ability to use technology. The diary showed that prior to the intervention, Bill carried out two different activities on five occasions (looking at the news and speech and language therapy). Violet helped with both activities. Following the intervention, there was a record of seven different activities on fifteen occasions (email, guardian sports, colouring, solitaire, news, google earth, and ‘surfing’). Violet had helped on four occasions with email, solitaire, and colouring. A summary of the diary entries can be seen in Table 5-9. One record in the diary reported the couple had sent an email to the researcher during that week. This had been a photograph of them both taken with the iPad camera and sent via email on the device. They had tried sending a photograph together after Violet had learned that this was possible. Such use of the iPad camera to send photos perhaps paved the way for potential future work towards more independent use of email for Bill. In summary, Violet’s record suggested that Bill’s use of computers post-stroke had evolved from primarily speech and language therapy exercises and shared looking at the news with his wife to more independent use over a broader range of activities.

		Activity (I = independent, S= supported)	
		A	B
1	-	Google Earth x2 (I)	
2	Speech therapy (I)	Google Earth (I), Colouring (S), Solitaire (S), BBC News (I), Sports (S)	
3	-	-	-
4	Speech therapy (I)	News (I), Google Earth (I)	

		Activity (I = independent, S= supported)	
		A	B
5	Checked news (S), Speech therapy (I)		News (I), Surfing web (I), Email (S)
6	Speech therapy (I)		-
7	-		Colouring (I), Google Earth (I), Solitaire (S)
TOTALS	5 (I = 4, S = 1)		15 (I = 10, S = 5)

Table 5-9: Internet use diary at times A and B: Bill

During the intervention sessions, it was possible to observe Bill as he explored using the new apps on his iPad. He would still tap on the ‘wrong’ area of a page or find himself somewhere that differed from instructions for a task. However, it was noted that he often found items of interest to him because of these errors. Such ‘stumbling upon’ behaviour is perhaps the very nature of ‘web surfing’. It did not matter if Bill did not end up where he had intended (or where instructions had dictated) if he found items of interest along the way. The most important requirement of simplification of his online environment was that such wrong turns should not take him far from his intended path. The relatively restricted content of apps meant that it was not possible for him to accidentally stray from an area outside his interest.

Violet’s post-therapy interview was conducted following a short break over the Christmas period and after the completion of all other data collection. Violet spoke about how Bill’s computer and Internet use had changed following the intervention. He had ceased to use his desktop computer and laptop and now only used the iPad. She confirmed that she was still providing support but not for all activities. She helped mostly with email by encouraging Bill to send photos in email messages to their sons. This was something the researcher had demonstrated in response to one of her questions. It had allowed Bill to show his sons how he was, by sending a picture when he had been recently unwell and to update them on his progress by sending another picture when he was feeling better. Violet gave her opinion on the

intervention, saying, *"I think it's fantastic because it supported Bill and myself and it's helped us both to...it's certainly helped me to be a bit more confident in the whole caboodle"*. She reported Bill had enjoyed using the apps to practise basic iPad skills and now used them for pleasure, particularly Google maps. Her brother had moved house and Bill had initiated finding the area he had moved to by typing a search into the Google maps app. He continued to use the colouring app for leisure, and to look regularly at news and sports websites. In addition, they were regularly working together to send emails using the iPad. They were also trying to do sudoku puzzles within another app. Violet reported Bill made mistakes when typing into emails but felt that as long as he was happy and enjoying the experience she would not correct him. Violet said that she and Bill found the iPad *"more convenient and easy"* as he could sit with it anywhere in the house. She felt Bill knew more than she did about the device and that he continued to be motivated to do more with technology. She described that Bill had a routine for his iPad use, working through the apps he had used as part of the intervention, and moving on to more general browsing on news and sports information. Violet reflected, *"everything you've given has been a little bit of a challenge that we've been able to cope with"*. She admitted her confidence was still lacking when things went wrong, but that she had learned through experience what to do when she experienced problems. When trying something new, she reported she and Bill still had to work things out together, but that they did so with good humour and usually solved problems if they took their time. Violet said that she was keen to continue to expand her computer and Internet skills, wishing to become as adept at technology as younger members of the family.

Violet was unfailingly positive about the intervention and its benefits for them both and expressed thanks for Bill's involvement in the research. It is important to consider that both interviews were carried out by the researcher who also carried out the intervention. Violet was aware of Bill's goals for interventions when completing the second diary of his Internet and computer use. It would therefore be unwise to rule out the possibility of a form of acquiescence bias (Podsakoff, MacKenzie, & Podsakoff, 2012) in the data from Violet's interviews and the computer use diary. Violet may have reported positive outcomes to avoid disappointing the researcher.

Therefore, it was important to view Violet’s interview and diary records alongside the tailored assessment of Internet skills to confirm any positive change, thereby using different sources of data to confirm findings (Hammersley, 2008). Whilst further objective measurement such as logging of online activity could have confirmed changes to Bill’s Internet use, information of that nature would have been difficult to obtain without violating privacy.

5.4.2 Internet skills

Bill’s Internet skills were influenced by several factors (see section 5.1). The intervention attempted to improve his ability to access information within a more controlled environment where content had been simplified and personalised. Therefore, it was not anticipated that Bill’s wider Internet skills would improve. It was expected, however, that the Internet skills assessment on news and sports information would show change in that Bill would be able to retrieve information through apps with greater success and efficiency.

The repeated Internet assessment was carried out in a replication of the conditions used at time A, that is, using his laptop computer. The results from this assessment can be seen in Table 5-10

Task	N	Scores		Times	
		A	B	A	B
Switch on/operational	8	8	8	01:49	00:52
Weather/operational	20	14	11	09:27	06:54
NETA/formal	28	22	19	06:07	08:00
Train information/formal/strategic	36	14	22	13:09	08:46
TOTAL	92	58	60	30:32	24:32

Table 5-10: Internet assessment at times A and B: Bill

Notes taken from the video recording of the repeat assessment confirm he continued to need repeated and direct cueing for each aspect of the tasks. Examples included:

frequent reminders of the task, verbal instruction, pointing and verbal direction to focus on specific areas of a web page, reminders to use the return key, finding letters and symbols on a keyboard, assistance to enter the correct search terms and to scroll down a page to find results. For the repeated Internet assessment tailored to assess his ability to access news and sports information (using his iPad), Bill was considerably faster at time B in finding the required information. There were 13 elements in total to the two tasks in the tailored assessment. This breakdown of scores was compared and Bill's performance was significantly better at time B (Wilcoxon, $z(n=13) = -2.26, p = .024$), representing a reduction in his need for prompting and assistance. Comparisons between the timings and the detailed breakdown of scores of the repeated tailored Internet assessment are provided in Table 5-11 and Table 5-12. During the assessment, Bill returned to the menu icon several times when his initial attempts had not produced the results he needed. On some (but not all) occasions he needed prompting to do so. The results demonstrate that Bill's Internet skills improved, but only for the specific area of use covered by the intervention. For Internet tasks not covered during the intervention and when using his laptop, his performance was very similar at times A and B. Without any steps to adapt the way information was presented, Bill was unable to complete the necessary steps to achieve the tasks within the assessment.

	Time taken (mins:secs)	
	A	B
Task 1 (rugby scores)	06:34	02:43
Task 2 (football fixtures)	08:25	01:52
Combined	14:59	04:35

Table 5-11: Timings for Bill's tailored Internet assessment (news and sport)

Task	Element of task	Score	
		A	B
Task 1 (rugby scores)	Switch on device	4	4
	Locate search engine	1	4
	Enter appropriate search term	1	1
	Select appropriate result from search	2	4
	Locate link for results	4	4
	Click on link	4	4
	Locate scores	4	4
Total		20/28	25/28
Task 2 (football fixtures)	Locate search engine	1	4
	Enter appropriate search term	1	4
	Select appropriate result from search	2	4
	Locate link for fixtures	3	3
	Click on link	4	4
	Locate information on next match	4	4
	Total		15/24

Table 5-12: Breakdown of scores for tailored Internet assessment (news and sport)

It is not known whether Bill would have performed better on the Internet assessment had it been conducted using the iPad with access to a search engine or weather app or one specifically for booking train tickets. That is, whether a simplified environment alone would have enabled more efficient and independent responses to some of the tasks in the assessment. Additionally, it is not known whether a similar intervention using tailored content on his laptop would also have been beneficial.

5.4.3 Control measures

The intervention did not target Bill's impaired language. Therefore, all CAT subtests could be used as controls not expected to change. Bill's performance showed no notable changes between times A and B. No change in CAT T-scores was at a significant level as per the CAT manual. Notable but non-significant differences in either direction can be explained by either increased delay in response times (comprehension of written words), reduced delay in response times (comprehension of spoken and written sentences), or the test containing only a small number of items (reading function words). Results from reassessment can be seen in Appendix K.

5.4.4 Social Network Analysis

Bill's goals had not stipulated any wish to contact others via the Internet, and the intervention focused on him and his wife with no external support. Therefore, Bill's social network was not expected to change. For the repeated Social Network Analysis, Violet helped Bill to complete the diagram. At time A they reported 21 people in their network and at time B there were 20 people. The inner circle remained the same consisting of their closest family members. Some names in the middle circle had shifted to the outer circle and a previous colleague was not mentioned at time B. This was as expected, with no evidence for any widening of Bill's social network.

5.5 Summary

This chapter described assessment, intervention, and outcome measurement with Bill, who had goals around using the Internet for information on news and sports. An intervention involving simplification of the online environment, teaching basic iPad skills, practicing use of apps, and developing the skills of Bill's main supporter (his wife) led to increased skills in the area of Internet use of interest to him. Further, the intervention had some unexpected benefits. Activities built into the intervention to teach basic iPad skills had been adopted as leisure pursuits. In addition, Violet had learned to use the iPad for email and this had been adopted as a shared activity. Bill may not have been able to compose written narrative as he did before his stroke, but

he now had potential to progress towards achieving his other goal, that of returning to independent use of email. This could be achieved via the use of sharing of photographs as an alternative to writing, perhaps with some simple written annotation.

Bill's case illustrates how a considered decision making process supported the development of a suitable and effective intervention related to Internet use. Findings from this intervention raise several points for discussion. Aphasia was a major barrier to Bill participating in his previously proficient use of the Internet. However, there was also a considerable impact of motor skills, of other (non-verbal) aspects of cognition and of the environment. Barriers included the equipment Bill used, how information was presented, and the quality of support he received. Findings from this study are of value in considering means to enable people with such severe aphasia to achieve success with the Internet and to empower others to provide effective support. Chapter nine discusses these points further.

Chapter 6. Nancy's Case: Writing for Facebook

This chapter describes an intervention with a focus on the social media platform, Facebook. The person described in this case study, Nancy (a 67-year-old woman with aphasia) expressed goals around writing for Facebook to interact with family and friends. Section 6.1 presents results from assessment and information gathering structured around the ICF framework. Section 6.2 describes the intervention designed for Nancy. Section 6.3 describes measures of effectiveness used for Nancy's case and section 6.4 presents results and evaluates the effectiveness of the intervention.

6.1 Nancy's Profile

Nancy was a retired factory worker who had an ischaemic stroke 27 months prior to her involvement in this research. MRI scanning reports post-stroke revealed damage to the left premotor, inferior frontal and parietal cortices and the white matter surrounding the left putamen. Nancy had 11 years of formal education. She was widowed and lived alone with support from her daughter and her grandchildren. Nancy divided much of her time between a large extended family who lived locally. She was referred into the research by SLT3. At that time, she was on review following several blocks of SLT intervention carried out in her home (with a focus on total communication as well as her speech and writing). Nancy had also attended an intensive period of outpatient individual and group therapy. She was independently mobile within her home and outside and regularly walked short distances to travel on local buses.

Nancy's assessment results are discussed in sections 6.1.1 to 6.1.6.

6.1.1 *Body Structures and Functions*

Nancy was right-handed pre-stroke. She continued to use her right side but reported a mild weakness of both her right arm and leg and some reduced movement in the fingers of her right hand. She reported no difficulties with hearing and wore glasses for watching TV and using her laptop computer. Nancy responded appropriately to questions in conversation, with no indication of comprehension difficulties. Her expressive language was typical of agrammatism with marked difficulties with naming and constructing sentences. Her initiations and responses were predominantly single nouns or short

phrases with considerable use of ‘aye’, ‘uh huh’ and pointing accompanied by the phrase ‘that one’.

Language assessments

Assessment on the CAT indicated that comprehension was intact at single word level for spoken and written words. Her performance on written and spoken sentence comprehension subtests was broadly similar. There was evidence of difficulty understanding embedded sentences and those containing prepositional phrases. The CAT assessment confirmed marked impairment of naming. Successful attempts at spoken naming of pictures were produced without any delay. Unsuccessful attempts led to fillers such as ‘I know it’ or ‘I can’t’. Nancy could be facilitated with naming if given phonemic cues, but not consistently. She was observed to form initial letters on her palm with her finger, but she was unable to use this as a strategy to cue her naming. Her response to the CAT spoken picture description consisted of eight isolated nouns and one verb. Nancy wrote in block capitals and could correctly produce three out of five items on the CAT written naming subtest (*boy*, *eye* and *pear*). She correctly wrote the first or first two letters on two further items (*tank* -> *T* and *giraffe* -> *GI*). Written picture description was similarly impaired to spoken, with only six nouns produced alongside the capital letters ‘L’ and ‘I’ in isolation. All scores for Nancy’s language assessments can be seen in Table 6-1.

CAT Subtest	N	Raw Score	T-Score
Semantic memory	10	10	10
Comprehension of spoken words	15	15	15
Comprehension of written words	15	15	15
Comprehension of spoken sentences	16	13	13
Comprehension of written sentences	16	12	12
Spoken picture description	--	15	14

CAT Subtest	N	Raw Score	T-Score
Naming objects	24	6	21
Reading words	24	12	12
Reading complex words	3	0	0
Reading function words	3	2	2
Reading non-words	5	0	0
Writing: copying	27	27	27
Writing: picture names	5	3	2
Writing to dictation	5	1	1
Written picture description	--	6	7

Table 6-1: Language assessment results: Nancy

Assessment of cognition beyond linguistic profiling

Nancy's Symbol Cancellation score was at ceiling and she made only one error on the Mazes assessment. This indicated no significant difficulties with sustained attention, planning, and mental flexibility. Performance on the Wechsler digit pointing span were in the low percentiles for ability to retain verbal information (3rd and 9th percentiles) but scores for visual memory forwards and backwards pointing span were higher (47th and 21st percentiles). This suggests that Nancy's visual memory was better than her ability to retain verbal information. Nancy commented during testing that she found the test of executive functioning (M-WCST) very difficult. Her percentile ranking scores were representative of what the manual terms 'low average performance' for her age and educational level. Results from all of the measures of non-verbal cognition can be seen in Table 6-2.

Cognitive test/subtest	N	Raw	Percentile
Wechsler digits forward	12	1	3
Wechsler digits backward	12	2	9
Wechsler visual memory forward	14	7	47
Wechsler visual memory backward	12	5	21
CLQT mazes	8	7	--
CLQT symbol cancellation	12	12	--
M-WCST Categories Correct	6	3	10
M-WCST Executive Function Composite	--	--	16

Table 6-2: Assessment of cognition beyond linguistic processing: Nancy

Additional diagnostic assessments

Nancy had been observed to use finger writing when attempting spoken naming tasks. She could also often retrieve the initial letters of words when writing. As the CAT written naming subtest contained only five items, additional assessment was needed to assess her ability to retrieve orthographic information of words. Nancy was reluctant to write by hand and preferred typing so was asked to type the names of 58¹⁰ items of the shortened Nickels naming test (Nickels, n.d.) into the notepad application on her laptop. She named 8/58 items correctly (14%). Of the 50 items she was unable to name, Nancy could retrieve three or more letters in the correct order for 12 items, two letters in the correct order for 17 items, and the correct initial letter for a further 15 items. She was unable to produce any correct initial letters for six items. There was an effect of both frequency and length as seven of the eight correct items were high-frequency words

¹⁰ Two items from the original 60 were omitted in an administration error.

with one or two syllables¹¹. However, Nancy was not always certain whether her attempts were correct and asked for reassurance several times.

6.1.2 Activity and Participation

Internet use: Nancy's perspective

Nancy accessed the Internet using a Sony laptop running Windows Vista (which was at that time an outdated operating system). She had a desktop PC but reported she did not want to use it. She also owned a basic smartphone that her family used to call and text her. She reported that she would sometimes text back one word responses. The Internet questionnaire revealed her most popular Internet activities before stroke had been using Facebook, Facebook messaging, playing games and posting pictures (on Facebook), general browsing, looking at the news, Internet banking, using the local council website, and shopping online. She reported that she continued to use Facebook with the same frequency and still received messages but now rarely played games or posted pictures on the site. Nancy provided some comments that enhanced the data provided by the questionnaire responses. She reported that she liked using Facebook as it was her means of discovering what family and friends were doing. When discussing what was difficult when using the Internet, Nancy selected 'can't see own mistakes', 'can't write', 'difficulty understanding written instructions', 'difficulty understanding spoken instructions', 'speaking to others online via video calls', and 'asking for help'. Nancy also selected the 'other' category and indicated that spelling was particularly difficult for her. When choosing from a list of non-language-related barriers to Internet use, Nancy chose 'lack of confidence', 'no one to help', 'helpers don't have time' (she reported this was only sometimes), and 'can't choose equipment' (she expressed that her daughter would do this for her). Her daughter managed her Internet service provider and Wi-Fi. Nancy

¹¹ The Nickels naming assessment was designed as a test of spoken naming. Although syllable length does not apply to written language, it is included here as an indication of the length of items.

also indicated that despite slight weakness in her right hand she could use both hands to type, although she had problems using her index finger.

Internet skills

Nancy used her Sony laptop running Windows 7 for the Internet assessment. It had an internal trackpad mouse and no external modifications. She did not have a table so she balanced the laptop on the sofa next to her and turned to face it. She reported '*it's old*' and indicated that the mouse/trackpad did not work well. She could switch on the laptop independently without any need to enter a password. Once booted up she wanted to show the researcher her Facebook page. She had many notifications she had not looked at but could scroll through her feed and identify who people were. Her Facebook feed consisted mainly of pictures of friends and family. Some of her Facebook friends had tagged her in pictures so that she could see them. There were also automatic posts from an online game. She reported that these posts were made by her sister using Nancy's account. She showed the researcher how she used Facebook to send short messages. Her messages often used smiley faces and a love heart emoticon. Nancy's Facebook profile was open to the public. This meant it was possible to view her Facebook posts from before her stroke. She had not posted regular status updates, and her profile consisted mostly of automated requests to friends to join her in playing an online game.

On the assessment of Internet skills, Nancy scored 59 out of a possible 92 for all tasks, with the reduction in possible scores due to repeated need for assistance. Qualitative observations indicated that she was uncertain what to do to complete the tasks and was not confident of her responses. Each element of each task required a degree of assistance. This was predominantly at the first level of the hierarchy (verbal prompting). Nancy was given repeated suggestions on her next step, often in response to her asking for help. The second level of assistance was also used frequently by pointing to an area of the screen requiring Nancy's focus, for example, where she should enter text, where she should look for information, or where she needed to click. At the linguistic level,

Nancy demonstrated she could read simple menu information on websites and select the menu item she needed. On all occasions where reading was required, she had received verbal prompts about what to look for or used the instructions sheet to remind her of the task. When she was required to write (e.g., a search term), Nancy used a strategy of copying from the instruction sheet letter by letter. She was unable to generate her own search terms when needed and wrote the letter 't' after being prompted to write 'train times' in a search box. This was sufficient to generate a drop-down list from her Internet history, from which she could select a suitable website. On one occasion, the final level of assistance in the hierarchy was used when Nancy did not respond to any prompts, so an element of a task was completed on her behalf. This was to independently locate a search engine in the third (train times) task. She also experienced difficulties with using the trackpad on her laptop. For example, when attempting to select and delete sections of text with the URL bar. Nancy was using her left (non-dominant unimpaired) hand and reported the trackpad was broken. It was tested by the (right-handed) researcher, who had no difficulties.

Nancy demonstrated a range of functional skills during the assessment. She could copy words from the instruction sheet (e.g., an URL or a place name), select from drop-down lists, click on links, and use an online calendar tool to select a date. She could also look at the train times generated by her search, and work out which one she should catch. Despite these skills, she was either unable to problem solve or lacked confidence to carry out the individual steps needed to complete each task. She needed the support and reassurance of someone else to guide her. Her scores and times taken for each task on the Internet assessment can be seen in Table 6-3.

Nancy's performance on the Internet skills task was considered alongside her and her daughter's report of a limited range of online activities before her stroke. Nancy reported a small number of activities carried out regularly (Facebook and general web browsing). These activities would have required predominantly operational and formal Internet skills. However, her daughter reported she also liked online shopping and looking at

holiday sites. These activities may have required similar strategic skills to those involved in the train tickets and times task (e.g., looking for the cheapest item, matching holiday facilities with the family’s requirements). It is unknown whether Nancy previously carried out her online shopping and holiday searches alone or with support.

Task	N	Score	Time taken
Switch on/operational	8	8	-- ¹²
Weather/operational	20	13	04:18
NETA/formal	28	19	05:57
Train information/formal/strategic	36	19	09:11
TOTAL	92	59	19:26

Table 6-3: Internet assessment scores: Nancy

Nancy displayed a familiarity with Facebook and could navigate the site to view posts and profiles of her Facebook friends. She liked receiving messages and demonstrated how she sometimes replied with a word or by using emoticons and pictures. Nancy accessed Facebook on her laptop using a bookmark saved in her browser (Firefox). During conversation, she reported she had low confidence with computers.

Supporter perspective

Nancy’s daughter Anne (pseudonym) was her main carer. She consented to be interviewed for the study. In her interview, Anne confirmed that her mother liked to use Facebook and that before her stroke she looked at shopping websites for at least an hour every day. She used Facebook to keep in touch with people and to scan old photos and post them on her profile page. Anne reported that Nancy no longer did this. They

¹² -- indicates this part of the assessment was not timed.

had experienced difficulties connecting their scanner to Nancy's laptop, and Nancy now preferred the laptop to her desktop PC. Anne felt that Facebook was very helpful to Nancy as the website allowed her to find out information about people and keep in touch with friends. Since the stroke, it had taken Nancy a while to use her laptop again, and to find something she enjoyed. Previously, she would have searched for information on her hobbies or for things she wanted to buy. This was now difficult for her, as she could not think of search terms to use. Anne had helped by suggesting activities Nancy could do and writing down website addresses for her to copy. She also saved bookmarks within Nancy's browser. Anne felt that Nancy would forget the names of websites but could use bookmarks for reminders and inspiration. When asked what Nancy would like to improve, Anne was unsure. She said that she thought 'knowing what is going on' was the most important thing for her mum. Facebook use was probed a little more, and Anne talked about Nancy's use of Messenger. She reported that Nancy coped with using Facebook to read messages but was unable to write sentences in response. She felt that people who did not know about Nancy's aphasia might think that was strange. However, she said that Nancy did click 'like' and make occasional comments on others' Facebook posts and that this was a change from immediately post-stroke when she would not go on the laptop at all. Anne had supported Nancy by teaching her how to use the laptop as a replacement for her (older) desktop computer. This included how to switch it on and off and help with spelling. She felt that attendance at an intensive outpatient clinic in the months following her stroke and the work using computers there had helped Nancy's confidence.

SLT Perspective

In her interview, SLT3 reported that she felt the stroke and aphasia had impacted hugely on Nancy's socialisation. Her social participation had increased with improved confidence since early post-stroke, but family members had taken over many activities which SLT3 felt Nancy could perhaps do herself if encouraged. She described her perception of Nancy as being previously independent and sociable. SLT3 had

discovered through her meetings with Nancy that she had used Facebook daily to keep in touch with others. SLT3 had discussed Internet use with Nancy who reported that pre-stroke she had not posted a great deal online but interacted a lot with family and liked surfing the Internet, shopping, and looking at holidays. She remembered that when she first mentioned the computer in Nancy's home, Nancy had reported that she was no longer able to use it. However, with time she had observed that Nancy was using Facebook and that she liked the engagement with others. She felt that although Nancy had returned to using Facebook, she would like to be able to do more. However, writing and spelling were a major barrier as Nancy was unable to send messages or search for things online.

6.1.3 Environmental Factors

Nancy's Social Network Analysis was completed with communication support from the researcher. It revealed her social network predominantly consisted of several siblings and their families who all lived in the surrounding area. Nancy placed ten names in her inner circle, nine in the middle circle, and two in the outer circle. Seventeen of these 21 people were family members, three were friends, and one was not specified. On being asked for more information, she reported that she saw her daughter every day and 11 other people at least once per week. She had a routine where she visited family members' houses on set days of the week. Nancy had a small number of friends who she said she saw less frequently. A summary of her responses can be seen in Table 6-4.

Anne stated in her interview that Nancy's family were supportive. However, communication problems caused ongoing frustration between them, particularly between Anne and Nancy. However, Anne reported that she was willing and able to help her mother when needed and time was not an issue. She named family members who were particularly supportive. Anne's aunt (Nancy's sister) was helpful in sending Nancy regular messages on Facebook, and Anne's own daughters were more 'Internet savvy' and would help their grandmother.

Section of diagram	No. of people
Inner circle	10
Middle circle	9
Outer circle	2
TOTAL	21
Category	No. of people
Family	17
Friend	3
Other/not specified	1
TOTAL	21

Table 6-4: Social Network Analysis: Nancy

Anne did not have high confidence in her Internet skills. She had acquired the skills she had through using an iPhone and a tablet and felt that she could only do the basics with a computer. Anne had tried to show her mother an iPad, but Nancy became frustrated and did not understand. She had installed some software (she could not remember the name) which allowed Nancy's laptop to speak text out loud but she was not sure whether her mum liked that. She had also tried but failed to install an aphasia therapy programme.

Anne was asked about where she or her mother would obtain technical support if it were needed. She said she would not know where to get this type of help. If the laptop was broken, she would take it to a computer shop. She acknowledged that Nancy's laptop ran very slowly and likely needed 'a good clean'. Financial barriers were also discussed. Anne felt that it was not a problem for her mother to pay the monthly fee for Wi-Fi at home but the costs of new equipment would be difficult for her to manage.

SLT3 reflected on her early involvement with Nancy during her interview, recalling that in the initial stages of rehabilitation Nancy mainly wanted to work on speech and expressive language. The interventions had focused on verbal expression, but Nancy also practised writing some phrases and names that might be useful to her on Facebook. They had utilised Nancy's mobile phone, producing a set of typed messages

she could copy and send to family. This intervention had been extended when Nancy attended an intensive clinic. The SLTs there had provided her with flashcards containing useful phrases she could copy into her phone. However, Nancy did not report or demonstrate that she used this strategy.

Nancy's laptop was observed to be an old model and to run slowly. She and her daughter had both commented on its poor performance. It was observed that bloatware¹³ and additional toolbars had been installed onto Nancy's browser. This slowed down the performance of her device. The laptop was, however, sufficient for Nancy to access and use Facebook, which was her main priority. It was not possible to determine whether Nancy had adequate virus protection, but several pop-up messages were observed indicating she needed to register her version of windows. The environment in her home for using her laptop was also not ideal, as she balanced her laptop on her knee and the sofa. Nancy's Facebook profile was also open for others to access, suggesting she may have limited knowledge of security and privacy settings.

6.1.4 Personal Factors

In conversation and during assessments, Nancy was keen to make clear that she was 'not stupid'. She sought reassurance that her responses were correct, and clarification as to what was expected during tasks. SLT3 indicated that it had taken a long time for Nancy to regain any level of independence following her stroke and that lack of confidence was an ongoing issue in therapy. SLT3 also reported that Nancy had been highly motivated and compliant with all therapy offered.

Goal setting

During the goal setting discussion, Nancy conveyed very clearly (through her placement of pictures representing aspects of Internet use) that her priorities were around using

¹³ Potentially unwanted and unnecessary software.

Facebook and Facebook Messenger for writing. An image of her priorities is provided in Figure 6-1.



Figure 6-1. Nancy's priorities from the goal setting session.

Her previous activity of online shopping was ranked in the middle of a scale from least to most important. Use of Facebook was placed at the 'most important' end of the scale. Nancy made it clear she was referring to Facebook rather than Twitter (both were in the picture used) by pointing to the Facebook symbol and reading aloud the name. She was asked about her current use of Facebook as her daughter had reported she was already sending some short messages and commented on pictures and status updates. Nancy conveyed that this was the case but that she did not send messages or write on Facebook walls often. She said this was because her spelling was poor and she wanted to be able to write more. It was agreed, therefore, that Nancy's goal was that she would be able to initiate and write short messages on Facebook via Messenger and respond in the same way to pictures and status updates.

6.1.5 Emotional wellbeing

Ratings on the CDP in relation to her aphasia suggested Nancy's predominant emotions were determination, unhappiness, lack of control, loneliness, and embarrassment (all rated four at the most intense point of the scale). She reported moderate feelings of frustration and worry (rated two). She felt very valued by others (rated zero on a reverse scale). Nancy rated her feelings about now and the future at the middle point of the scale (rated two). The scores for this assessment can be seen in Table 6-5.

Emotions	Score
Total score (/56)	30
Angry	0
Frustration	2
Determined	1
Unhappy	4
Worried	2
Content	1
Under confident	0
Lack of control	4
Able	4
Lonely	4
Embarrassed	4
Valued	0
Feelings about the future	2
Feelings about today	2


Table 6-5: CDP Emotional Scale: Nancy

6.1.6 Further data collection: writing for Facebook

Further assessment was designed to establish Nancy's baseline ability to write within Facebook. She had informally demonstrated that she could open Facebook, navigate the site, and click on 'Like' in response to pictures or comments. She had conveyed that she did not currently write status updates, but liked to read those of others. An assessment was designed to determine Nancy's ability to produce simple written Facebook content like that found on her Facebook timeline. Nancy was presented with

six pictorial and/or written stimuli one at a time and asked to comment on each one by typing underneath the picture. The pictures and status updates used in the assessment were like those seen on Nancy's Facebook wall, related to everyday occurrences and news from people's lives. Table 6-6 provides the stimuli and Nancy's responses to each one.

Nancy managed a pragmatically appropriate response for three out of the six stimuli. Although these responses were short, they were spelled correctly. The remaining responses consisted of successfully retrieved initial letters or letters contained within her suspected target. For the entire assessment, she produced six complete words, with one repetition of the word 'nice'.

Instructions	Stimuli	Nancy's response
<p>Your friend has a new grandchild. She posts a picture. Can you comment?</p>		<p>baby boy nice</p>
<p>Your friend has baked a cake. She posts a picture. What do you think? Can you comment?</p>		<p>nice</p>
<p>Someone in the family got married. Here are the bride and groom. Can you comment?</p>		<p>ca (presumed target of 'congratulations')</p>

Instructions	Stimuli	Nancy's response
A friend has been in hospital after an accident . She posts an update from A&E : What do you comment?	<i>Well folks it looks like my leg is badly broken. Surgery needed tonight then need to stay in hospital for a few days 😊.</i>	sorry
A family member posts: Can you advise?	<i>Where is the best place in Newcastle to buy a new sofa?</i>	F (presumed target of name of local department store)
Write a status update about what you did today.		Fac (presumed attempt at 'Facebook')

Table 6-6: Facebook writing assessment with Nancy's responses

6.2 Intervention

Consideration of Nancy's profile and possible options for intervention suggested an appropriate approach would be to train her to use word prediction software to improve her writing. This recommendation was discussed with Nancy using supportive communication techniques and a demonstration of word prediction software. She was happy to proceed and a timeline for intervention was agreed. The use of word prediction intervention software would be combined with aspects influenced by impairment-based approaches and incorporating some compensatory strategies. Nancy would be asked to repeatedly practise written production of a set of treatment words and phrases relevant

to Facebook use. These would be produced firstly in isolation (using a word processor) to learn the prediction software. Intervention would then move to using the target vocabulary within simulated then actual Facebook scenarios. The treatment word-list would also be available as a self-prompting tool. The justification for this approach is discussed below, with reference to Nancy's profile and relevant literature.

6.2.1 Justification

Nancy's goal was that she would be able to initiate and write short messages to family and friends on Facebook via Messenger and to be able write in response to pictures and status updates. The assessment of writing for Facebook showed that her pre-intervention ability to do this was inconsistent at single word/short phrase level. An appropriate target, therefore, would be for her to be able to produce a greater range of correct and appropriate Facebook comments and messages containing one to two words.

Nancy was able to type most initial letters of nouns in response to picture stimuli in the Nickels naming test. She could also type second letters in a high percentage of words. The single word language processing model used by Whitworth, Webster, and Howard (2014, p. 5), conceptualises the process of naming single words from an object or picture as requiring access first to the semantic system (where concepts are stored) then to the orthographic output lexicon where words and their spellings are stored. Nancy had performed at ceiling on the semantic memory subtest of the CAT and during assessment of single word spoken and written naming, she would often indicate she knew the meaning of the word. However, she was often unable to access the word form or could only produce some of its letters. This pattern of behaviour could indicate difficulties accessing the orthographic output lexicon or a graphemic output buffer impairment (Whitworth et al., 2014). Nancy's ability to partially produce written words suggested that at times she had incomplete access to spelling information. It was hypothesised that word prediction based on the orthographic detail she was already able to access independently would enable her to retrieve the rest of a word or phrase.

Use of word prediction software requires the ability to find and open the software, and to click on a word from a list of options. Nancy showed restricted computing skills in the Internet assessment and also reported lack of confidence. However, she was able to use drop-down lists and to select items using the trackpad on her laptop. She would need some specific training to learn to use new software with repeated practise to build confidence.

To benefit from word prediction software, Nancy would firstly need to retrieve at least part of the word she wanted to write. Therefore, there was justification for an additional impairment-based approach targeting word retrieval. Such an approach at single-word level could involve lexical or phonological therapy (e.g., Ball, de Riesthal, Breeding, & Mendoza, 2011; Beeson, Hirsch, & Rewega, 2002). However, it was not clear from available evidence (Thiel, Sage, & Conroy, 2015) whether this would be of functional benefit or whether it could improve her writing for Facebook. Nancy had demonstrated she would be a good candidate for impairment-based therapy. She had received impairment-based interventions under the care of her SLT who reported she had been motivated and made improvements. Should an impairment-based approach be taken, it would be important to recognise that only treated items might improve (Renvall, Nickels, & Davidson, 2013). Therefore, it was decided to include a personalised set of treatment words and short phrases for treatment (Renvall et al., 2013). The intervention would focus on repeated practise producing targeted vocabulary for writing on Facebook. Nancy would be assisted in this by the word prediction software to complete words she had been able to partially retrieve and by looking at a printed copy of the treatment word set to facilitate self-cueing when unable to retrieve a response.

6.2.2 Intervention design

Nancy's intervention took place over six weeks because she was due to attend another intensive SLT clinic after that time. Sessions were around 50 minutes as she had tolerated this duration well during assessments. She was seen 2-3 times a week for a total of 14 sessions. The planned sessions were divided over the time available. Due to

the timing of the intervention over the festive period, there was a three-week break between weeks five and six. Twelve sessions took place in Nancy’s home and three via Facebook Messenger. Details are given in Table 6-7 below.

	Weeks	1-2 →	3-4 →	5-6 →	
Time A	Sessions	1-5	6-10	11-14	Time B
Assessment		Equipment and security review	Penfriend training and practise	Penfriend training and practise	Reassessment
		Treatment item selection	Facebook scenarios	Facebook group comments and messages	
		Penfriend training	Facebook group comments and messages	Remote session (session 11)	
		Remote session (session 5)	Remote session (session 9)		

Table 6-7: Timeline for Nancy’s intervention

Equipment and security review

Nancy was not aware her posts had been visible to everyone and, on discussing this, wanted privacy to be set to ‘friends only’. This was put into place in her settings. The word prediction software chosen for the intervention was Penfriend XL (Penfriend Ltd., 1999). Penfriend software will run from a memory stick without the need for installation. As Nancy’s laptop was already outdated and slow, it was felt this option would prevent additional problems with her computer. The software was also suitable because it would predict feasible vocabulary choices by letter and had inbuilt support for spelling and grammar. There was an option to prioritise personalised and functional vocabulary via a personal lexicon. Further, spoken feedback allowed possible prediction options to be read aloud by a synthetic voice. The software allowed users the ability to hear each letter, word, or phrase vocalised as they were typed and the word prediction window could be viewed alongside or on top of other windows such as a web browser. Penfriend

was compatible with typing across all browsers and other software that involved text entry. It was also possible to change the size, colour, and background of words in the prediction window.

It was not appropriate within the context of a research project to become Facebook friends with Nancy, or for all of Nancy's friends on Facebook to be party to therapeutic interactions. Therefore, Nancy was asked to sign up to a two-member private Facebook group which had the same name as the research project. This Facebook group allowed her to interact with the researcher privately while both could keep their personal profiles private and not visible to the other.

Treatment item selection

Due to Nancy's very limited written output and need for functionally relevant items, possible words and phrases were selected for treatment that were appropriate to the language register used on Facebook and Messenger. The register of social media differs from both formal written English and from spoken forms. Currently, corpora of online interactions are rare due to confidentiality of users (Frey, Stemle, & Glaznieks, 2014). However, information published on the CANELC corpora of e-language (Knight, Adolphs, & Carter, 2014) does give insight into the most frequently occurring words and phrases used in social media. For SMS messaging, the most frequent word class is verbs, followed by nouns, pronouns, adverbs, adjectives, then articles. An initial set of possible items was chosen from Knight et al.'s (2014) top 50 words and clusters found in e-language and their list of politeness terms, and from Renvall et al.'s (2013) appendices on definitions for possible topics. Further items were added to give a large selection of words or very short phrases which could be used to initiate or respond to interactions on Facebook and which could carry meaning alone. The word list for selection was divided into categories with each one preceded by a picture to aid Nancy's understanding of the groupings. There were 193 words or short phrases on this selection list. The words and phrases from each category were read aloud one by one to Nancy who then ticked the ones she might want to use. There was no restriction on the

number of items chosen to allow Nancy to have free choice. She selected 153 from the list. Final choices were given to Nancy in the form of a laminated list. Nancy's final selected list is reproduced in Appendix O. Each word/phrase was entered into Penfriend and saved within Nancy's personal lexicon. This meant that these words would be predicted before others starting with the same letters.

Penfriend training

Therapy comprised training on features of the Penfriend software for 15-20 minutes at the beginning of each session. The remainder of each session contained repeated practise using Penfriend to type possible Facebook content. Once all relevant features had been introduced, the initial part of each session was used for repeated revision of features of the software. Penfriend familiarisation consisted of watching the manufacturer's introduction video (Penfriend Ltd., 2012) and working through simple handouts on each feature. The features covered were: font size and background colour, word prediction window, predicting words, speaking words, and abbreviation expansion. An example of the handout materials designed for the intervention can be seen in Appendix N.

Different font sizes and background colours for the prediction window were demonstrated so Nancy could choose which she felt were most comfortable for her vision and ease of reading. Once Nancy was happy with the appearance of the prediction window, she was shown how her chosen vocabulary had been added to her personal lexicon. Names of family members would be predicted after typing one letter. After adding the vocabulary list, the 'learn new words' feature was switched off. This was to prevent Penfriend learning Nancy's written errors as new words.

Practising Penfriend software comprised copying initial letters of word/phrases from a worksheet into WordPad software while observing the Penfriend window to see when it would predict the item. Initial items were pre-selected for the worksheets to ensure successful prediction after one or two letters. Therapy progressed to a task mimicking

Facebook interactions by presenting Nancy with a picture or Facebook update and asking her to make a comment. Images and status updates were chosen to correspond as closely as possible to those Nancy had on her Facebook 'wall'. If Nancy was unable to generate a word, she was encouraged to return to her laminated list for ideas. Help was provided, if needed, to narrow down word selection to a specific category.

Once Nancy was familiar with the software and could type single words successfully, sessions progressed to encourage her to seek a second word to follow on from the first. To support her with this task, specific worksheets were used containing sets of verb+noun and adjective+noun pairs. Nancy would select one word from either the verb or adjective set and type this into the prediction window. She would then attempt to type a second word to go with it (e.g., cute+puppy, eating+chips, handsome+man). If unable to produce enough letters to predict a suitable word, she was given a short list of 15 possible pairings to choose from, presented in three rows of five. One word from the pairings was taken from her vocabulary list. If Nancy was still unable to select a suitable word, her choice of words was reduced further by covering first one then two of the rows of choices. Sessions also covered scenarios where Nancy had to pretend to initiate or respond to messages from friends via Messenger. When she found the generation of responses to these made-up scenarios difficult, she was encouraged to use the 'conversation' section from her vocabulary list for ideas.

Penfriend training also included introduction to the abbreviation expansion feature of the software. Nancy was taught six simple abbreviation expansions that had been added to her Penfriend lexicon. These shortcuts allowed her to type two letters which would expand to a short phrase, e.g., iy = I love you, mc = Merry Christmas. The list of abbreviations and expansions was added to her laminated vocabulary list.

Therapy progressed to commenting on pictures and status updates on the project Facebook page. Examples of these pictures with Nancy's comment can be seen in Figure 6-2. Nancy was also asked to provide comments on the Facebook page as homework.

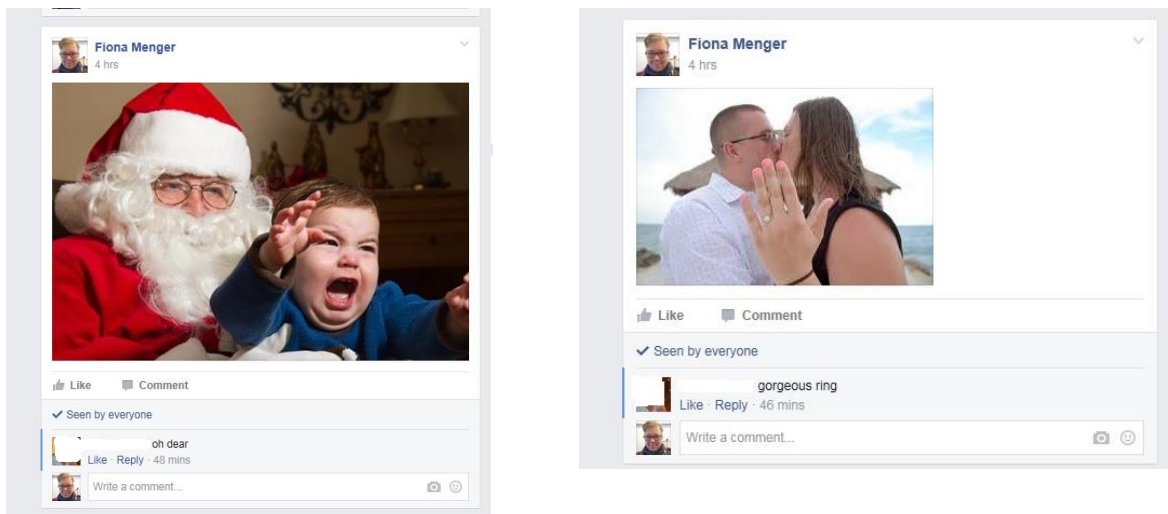


Figure 6-2. Pictures posted on the project Facebook group with Nancy's comments.

With the aim of more closely replicating Facebook interactions, three sessions were conducted remotely using Facebook Messenger. Nancy was in her home and the researcher was in her office. Nancy failed to appear online for the third planned remote session. This remote therapy concentrated on the revision of session materials and repetitive vocabulary selection practise as well as engaging in simple Facebook interactions. Nancy was asked to type items from her vocabulary list in response to a cue, to try different ways of starting conversations, and to convey what she had been doing in her day. She was also encouraged to used sticker comments and picture messages. A transcript from one of the online sessions is in Appendix N and provides examples of the clinician-client interactions that took place.

Nancy reported being impressed with Penfriend and quickly learned to use it. She practised between sessions by going over worksheets in her own time. As the interventions progressed, there were several areas of difficulty. For example, Penfriend would often predict two or more words with the same stem (e.g., excited/exciting/excitement) and Nancy found it hard to select the correct one. She was encouraged to use the text to speech function within Penfriend to listen to each of the

options and select the one she wanted. Nancy was also shown how to use this function when unsure whether the word she had selected was correct.

Occasionally, Nancy would ignore that her target word had already been predicted by Penfriend and type the next letter. This could lead to the word disappearing from the target window, even if the letters were correct. If this happened, Nancy was asked to delete a letter so she could check the prediction window again. She also occasionally used too many spaces between words. Extra spacing was not compatible with the software, and no further words were predicted. If this happened, Nancy was asked to delete back until predictions appeared. Another difficulty was that Nancy frequently attempted to name pictures rather than provide a reactive comment. When this happened, she was asked to try again, this time commenting with what she thought about the picture, rather than its name.

In the final sessions, Nancy had problems with her Internet service provider and was not connected to the Internet. This prevented any final intervention being carried out on Facebook. Instead, Nancy returned to using WordPad software and worksheets. Nancy cancelled one of the final sessions at short notice and did not appear online for a remote session. She completed all reassessments.

6.3 Measures of Effectiveness

The measures chosen to determine the effectiveness of the intervention and those selected as controls are outlined in Table 6-8. Rationale for each of these measures is described in the results section.

Measure	Predicted outcome
Nickel's written naming (with access to Penfriend)	Increase in no. of correct or recognisable items
Facebook writing assessment	Accuracy and completeness of responses

Measure	Predicted outcome
CAT written naming and picture description	Improvements when using Penfriend but not in handwritten tests
Other language assessments (comprehension of spoken words and sentences, naming objects, spoken picture description and reading words and non-words)	No change
Internet use questionnaire	No change
Internet skills assessment	No change
Social Network Analysis	No change

Table 6-8: Measures of effectiveness for Nancy’s intervention. Control measures are shaded.

6.4 Results and Discussion

All measures of effectiveness are presented below with comparison’s of Rose’s performance at times A (pre-intervention) and B (post-intervention).

6.4.1 Measures of writing

The aim of the intervention was that facilitating access to Penfriend and encouraging repeated practise using targeted vocabulary would improve Nancy’s ability to write on Facebook. The software would predict words Nancy was unable to complete, and she would be able use her vocabulary list as a self-prompting strategy if unable to produce a word. The Penfriend software might also predict some feasible next word combinations, which could allow her to produce phrase level writing. Success could be measured by the accuracy and completeness of her responses on the Facebook writing assessment, whether she used her vocabulary list, and whether her responses were from the treatment set or had extended to untreated vocabulary. If the intervention was successful, it was expected that written naming and other measures of writing outwith the context of Facebook would also improve, but only when Nancy had access to Penfriend prediction. The intervention was primarily designed to support her writing within the context of Facebook. It was not intended to change her ability to write without

the software or to improve her language skills in other contexts. Therefore, core language measures repeated without access to Penfriend (including measures of writing) were not expected to change.

At time B, subtests of the CAT were repeated. Nancy completed the CAT written picture description twice at either end of a one hour session with other language assessments in between. The first administration was typed using Penfriend and the second was handwritten. The shortened Nickels naming (58 items) and the Facebook writing assessment were also repeated using typing (as at time A) but at reassessment Nancy had access to Penfriend.

Written naming

It was predicted that the typed Nickels naming assessment using Penfriend would result in a greater number of entirely correct items, based on the assumption that if Nancy were able to partially type a word, Penfriend would predict the rest. Her score for the 58 items improved from 8/58 to 24/58 (item scored correct if all letters were present in the correct order). This was a significant change (McNemar $\chi^2 = 16.056$, $p < .001$). Table 5-3 breaks down Nancy's performance on the test at times A and B by word frequency and length. Frequency and length effects remained, with more items named of one or two syllables in length and of high frequency.

On the repeat assessment, there were 34 items that Nancy could not name (compared to 44 at time A). Of these, she could retrieve three or more letters in the correct order for four items, two letters in the correct order for 11 items and the initial letter for 15 items. There were four items for which she could not retrieve the initial letter. The number of letters Nancy could produce likely influenced her ability to select from Penfriend's choice of possible target items. Items where she only retrieved the first letter were less likely to be predicted than those when she could retrieve two or more initial letters in the correct order. When Nancy could only produce two letters, the target items often contained common combinations in English (e.g., 'medicine', 'tractor', or 'dart'). These letter

combinations may not have been sufficient for the target item to appear in the prediction window. For the 24 items which elicited a complete word response, only two were incorrect. Nancy produced plural forms of those items (*gloves* and *bottles*) by selecting the incorrect form from the prediction window.

Syllable length↓	Pre-intervention (A)			Post-intervention (B)		
	HF	LF	Total	HF	LF	Total
1	2/10	1/9	3/19	6/10	2/9	8/19
2	5/10	0/10	5/20	6/10	3/10	9/20
3	0/10	0/9	0/19	4/10	3/9	7/19
Total→	7/30	1/28	8/58	16/30	8/28	24/58

Table 6-9. Scores for Nickels written naming by length and frequency (HF = high frequency, LF = low frequency)

To determine whether the items from Nancy’s typed naming assessment were now more recognisable to others, a naïve reader who did not know Nancy was asked to look at two lists of her responses in random order and write the word they thought that Nancy was trying to type. At time A, the naïve reader identified 12% of target items (Nancy scored 14% correct), and at time B they identified 50% (Nancy scored 48% correct). Partially typed items were poorly recognised at both time points.




Writing for Facebook

For the repeated Facebook writing assessment, Nancy had access to Penfriend and her vocabulary list. She used Penfriend but had turned off the text to speech feedback option. When asked, she reported she did not want to switch on the voice feedback. Results from pre- and post-therapy are shown in Table 6-10. Field notes are presented alongside the time B data to document quotes from Nancy and notes made during the

assessment. She was observed to consult the prompt sheet for the first and third items (new grandchild and wedding pictures). Aside from what is quoted in the record of responses below, Nancy did not use any verbal rehearsal of words she wanted to write.

Nancy's writing for Facebook did not show any notable improvement. All her responses were either incomplete or complete single words. As with the pre-treatment assessment, her responses were complete for 3/6 of the stimuli. For the remaining responses, a reader may have been able to infer her intended meaning from context. It was not possible to determine from the data available whether her ability to write within the actual environment of Facebook and to her friends and family had changed. To use her Facebook profile to collect data would have crossed privacy boundaries which was not appropriate. Nancy reported within therapy sessions that she did use Penfriend whenever she was on the computer, including for Facebook, and that she found it helped with her spelling. Her daughter confirmed this, writing in an email to the researcher following the intervention, "*I think that program you installed helps her lots with Messenger & Facebook she is improving with her speech also much more confident*". These reports of improvement are subjective and were not corroborated by Nancy's performance in formal testing.

The reasons behind evidence for change on the written naming assessment and not on the Facebook assessment is perhaps because the process of naming in response to pictures representing nouns (where an image is provided) is less complex than generating an idea and then that idea into a verbal response (Levelt, Roelofs, & Meyer, 1999). For the Facebook task, the task involved responding to a composite picture that involved not only visual referents from nouns and verbs but also required processing at a pragmatic level. Nancy did not attempt to name the stimuli pictures in the Facebook writing assessment, indicating she understood the task. However, her performance in comparison with written naming assessments suggested that response generation was more challenging than picture naming.

Instructions	Stimuli	Pre-intervention (A)	Post-intervention (B)	Field notes (time B)
<p>Your friend has a new grandchild. She posts a picture. Can you comment?</p>		<p>baby boy nice</p>	<p>conditions</p>	<p><i>“lovely”</i> used prompt sheet presumed target of ‘congratulations’ wrong word selected</p>
<p>Your friend has baked a cake. She posts a picture. What do you think? Can you comment?</p>		<p>nice</p>	<p>lovey</p>	
<p>Someone in the family got married. Here are the bride and groom. Can</p>		<p>ca presumed target of ‘congratulations’</p>	<p>beautiful</p>	<p>used prompt sheet</p>

Instructions	Stimuli	Pre-intervention (A)	Post-intervention (B)	Field notes (time B)
you comment?				
A friend has been in hospital after an accident . She posts an update from A&E : What do you comment?	<i>Well folks it looks like my leg is badly broken. Surgery needed tonight then need to stay in hospital for a few days☺.</i>	sorry	sha	typed: sh s sha shar Penfriend did not predict presumed target of 'shame'
A family member posts: Can you advise?	<i>Where is the best place in Newcastle to buy a new sofa?</i>	F presumed target of name of local department store	Fi presumed target of name of local department store	<i>"I can't spell. I know what it is..it's [name of store]...can't spell"</i>
Write a status update about what		Fac presumed target of 'Facebook'	[daughter's name] (correctly produced)	<i>"telly. That's broken now" [indicating wifi for Internet] "yesterday" [wrote</i>

Instructions	Stimuli	Pre-intervention (A)	Post-intervention (B)	Field notes (time B)
				daughter's name] "yesterday hers"

Table 6-10: Facebook writing assessment responses at times A and B

Comparisons can be made between this intervention and conventional naming therapies, where generalisation to conversation is viewed as the 'gold standard' of aphasia therapy (Webster, Whitworth, & Morris, 2015). However, as Webster et al. discuss, measurement of 'real-life' interactions is complex. Approximations of scenarios such as the Facebook assessment are removed from the lived experience of people with aphasia, where motivations for communication come from within rather than from imagined scenarios. It could be concluded from Nancy's performance during the intervention and for the Facebook assessment at time B, that she lacked the ability to initiate a message in a simulated situation, as well as having difficulty with lexical access. Nancy had been provided with a means of assistance in the form of a choice of responses but may not have had the cognitive flexibility to consistently use her vocabulary list for inspiration. It is common for people to struggle with cognitive flexibility post-stroke (Purdy & Koch, 2006). Nancy's performance on the M-WCST also provided evidence for difficulties with task switching. The selection of such a large vocabulary treatment set for the intervention was designed to provide support for word finding. However, the large choice may have been too challenging for Nancy, requiring considerable semantic processing to narrow down and select a word or phrase.

Other writing

CAT subtests of writing were also repeated at time B. For the written picture description, Nancy produced handwritten and typed versions (in the same session but with other subtests between the two attempts). For the typed version, she had access to Penfriend.

Analysis of the CAT written picture description as per the manual is based on the number of information carrying words (ICWs) produced (Swinburn et al., 2004). At time A, Nancy produced six ICWs (five nouns and one verb). At time B, she produced nine ICWs, again predominantly nouns with one verb, 'sleep'. When using Penfriend at time B, she produced 11 ICWs (ten nouns and one verb). The software may have enabled her to accurately name more objects from the composite picture by allowing her to complete words she could only begin to write herself. Data from the handwritten samples supports this as both contain words started and not completed, or completed but containing errors. The typed sample produced with the assistance of Penfriend does not contain unfinished words or errors. With Penfriend, Nancy's written descriptions were still isolated single words, but her ability to describe the picture increased as she could name more of the content. These samples of her writing can be seen in Appendix P. Nancy's written performance on other CAT writing sub-tests (copying, written naming, and writing to dictation) did not show any improvement. These tests contained a small number of items and were not repeated with Penfriend. Post-therapy performance on the Nickels naming test suggested the software was beneficial for Nancy in aiding her to write nouns in response to pictures. However, further comparisons with non-facilitated writing were needed to reinforce these findings.

6.4.2 Control measures

As the intervention was not aimed at aspects of language other than writing, Nancy's performance on other CAT sub-tests could be used as control measures. Specifically, comprehension of spoken words and sentences, naming objects, spoken picture description and reading words and non-words. Results from all sub-tests can be seen in Appendix K. Nancy showed no improvement on measures of comprehension of spoken or written words and sentences, spoken picture description and reading words and non-words. On the written naming subtest from the CAT (handwritten with no access to Penfriend) Nancy had slightly poorer performance at time B. However, one sub-test from the CAT did show change in a positive direction. For spoken naming, Nancy's raw score

improved from 6/24 items named correctly at time A to 15/24 at time B. T-scores changed from 46 to 52. The CAT manual reports that a change of seven is required between two T-scores for a significant change at $p < .05$ (one-tailed). However, a chi-squared comparison of the 24 items on the spoken naming test indicated there was significant improvement across items (McNemar $\chi^2 = 7.692$, $p = < .01$), which was not predicted.

Possible explanations could be Nancy's increased exposure to language based tasks; this may have had a positive effect on naming. However, none of the items used in therapy were contained within the CAT naming assessment. Therefore, any change would not be due to practise effects. During the naming test at time A, Nancy was observed to spell one item aloud prior to attempting naming. However, she was unable to name the item until the assessor gave her a phonemic cue. At time B, Nancy was observed to write the initial letter using her finger in the air or on the table for eight items. For six of these, she was still unable to name the picture. One other possible explanation could be that repeated exposure to sets of words containing the same initial letters might have strengthened access to orthography within Nancy's lexicon, which in turn facilitated access to the phonological output lexicon. Nancy may then have used orthographic information as a strategy to cue spoken naming. Items correct at both time points were named without hesitation. Her unsuccessful attempts at finger writing may have been an attempt to visualise what she could access effortlessly for other items, an internal orthographic representation of the target word.

It is not unprecedented for therapy targeted at one language modality to lead to gains in another. For example, Nettleton and Lesser (1991) report a therapy intervention in which treatment of single word comprehension was used as part of successful naming therapy. Replication of these results would be needed to establish whether the use of a word prediction intervention could have a beneficial effect on naming for other people with aphasia and whether results could be generalised to wider contexts.

6.4.3 Other measures

Internet skills

The intervention did not target Nancy's broader ability to use the Internet; rather it was focused on the written content she could create within Facebook. Therefore, her Internet skills were not expected to change. Results here were mostly as predicted. Nancy had access to Penfriend during the assessment and used it once to type 'train times' into the search bar of her browser. The Penfriend prediction window became a barrier at one point during the time B assessment as it obscured a part of a website Nancy needed to read. Nancy did not know how to move the window herself. Word prediction built into the search bar on her chosen train tickets website helped Nancy to type the place names she needed. She continued to be uncertain as to which steps to take for each of the tasks and again, each element required assistance from the assessor. The assessment took over six minutes longer at time B but Nancy made small gains on each task representing a slight reduction in need for assistance.

Internet use

The intervention concentrated on Facebook, so it was also not expected that the amount of time Nancy spent on other Internet activities would change. The measure of frequency of Facebook use was based on a five-point scale, and Nancy had already indicated daily Facebook use. This measure was, therefore, not sensitive enough to pick up on any specifics of change regarding the amount of time spent on Facebook or on any Facebook session. Nancy's responses can be seen in Figure 6-3.

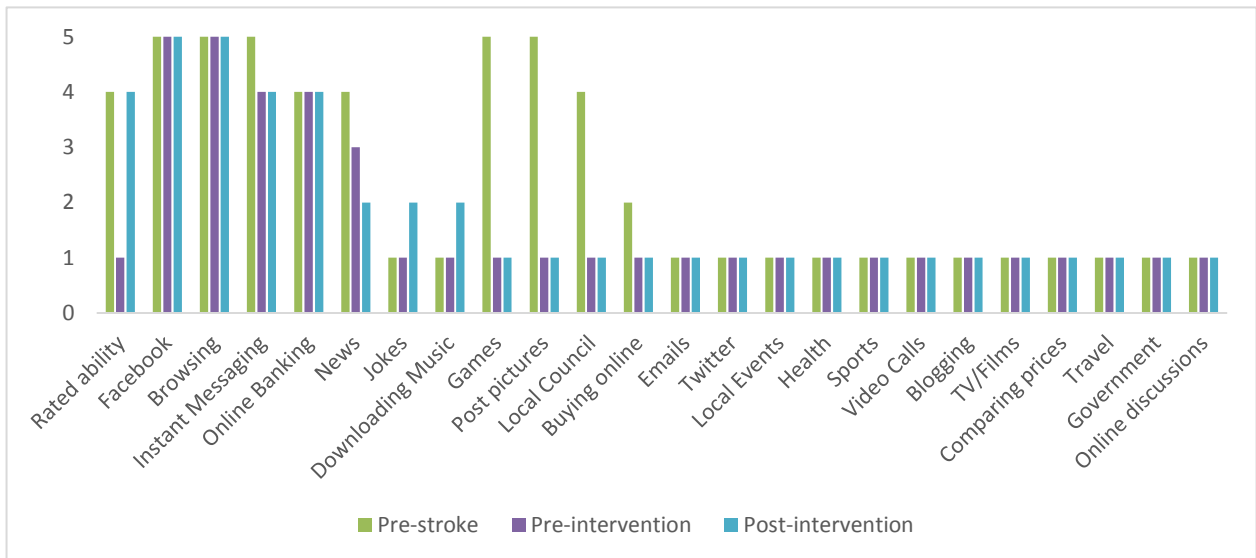


Figure 6-3. Self-rated ability and frequency of Internet activities pre-stroke, pre-intervention, and post-intervention

Her responses were broadly similar to those before the intervention. She rated her abilities higher and in line with pre-stroke skills, but did not report any return to playing games, posting pictures, looking at the local council website, or buying things online. There was a slight increase in frequency of looking at funny information and downloading music. It was difficult to ascertain from this repeated measure whether there had been any change to Nancy's Facebooking behaviour. A diary of her computer and Internet use (such as the one Violet completed for Bill in Chapter five) may have been more useful to capture how frequently she was using the site. However, as Nancy lived alone and did not see the same people each day, this was not a feasible option.

Social networks

The intervention was also not targeted at Nancy's environment. The measure of social networks was repeated as this was a possible change if increased confidence in writing led to increased contact with Facebook friends. Prior to intervention, Nancy reported ten people in her inner circle, nine in her middle circle, and two in her outer circle. These

were predominantly family and three friends. Following the intervention, she again listed ten people in her inner circle, six in the middle (three fewer) and two in the outer circle. The predominant change seemed to be not noting the names of spouses of some of her siblings. Therefore, as expected, there were no changes to her social network.

6.4.4 Motivation, compliance, and confidence

Nancy initially reported she was enjoying the therapy and displayed motivation to continue. However, her cancellations and failure to attend final sessions may have been representative of loss of momentum and motivation following the Christmas break, or perhaps a self-perception that the therapy was not effective to the degree she had hoped. Information gathered from SLT3 and her daughter indicated that Nancy had poor self-confidence for returning to pre-stroke activities. This lack of confidence may have been an important factor influencing the outcome of the intervention. Nancy may have benefited from an additional period of intervention aimed at building her confidence in her own abilities. For example, by enlisting a family member or volunteer to provide positive feedback and encouragement when she was successful in writing for Facebook.

6.5 Summary

This chapter described assessment, intervention, and outcome measurement with Nancy, who had goals around writing for Facebook. The intervention involved use of Penfriend word prediction software to aid repeated practise of a set of targeted vocabulary. The primary focus of the resulting intervention was to improve Nancy's ability to communicate with friends and family using Facebook and Facebook Messenger. Nancy demonstrated good ability to use Penfriend software to facilitate her word retrieval and the intervention significantly improved her ability to retrieve single nouns from a picture stimulus. However, there was minimal evidence to suggest that the software had any wider functional benefits. There was an unexpected finding of numerical change in assessment of spoken naming. However, it was not clear from analysis whether this truly represented an improvement as a result of the intervention.

Nancy's case provides some positive evidence for the benefits of predictive text technology for people with aphasia who have similar difficulties with writing on the Internet. It also provides useful information for discussion related to the aims of this research. The factors impacting Nancy's Internet use are in line with several discussed in Chapter three. Her aphasia and the resulting consequences for her daily participation could be seen to have considerable impact. However, other factors were also at work. For example, pre-stroke Internet skills and experience, availability of support, financial constraints, and confidence. These discussion points are returned to in Chapter nine.

Chapter 7. Rose's Case: Email Narratives

This chapter describes an assessment and intervention to address difficulties writing emails. The participant was Rose, a 72-year-old woman with post-stroke aphasia. Section 7.1 presents results from assessment and information gathering structured around the ICF. Section 7.2 describes the intervention designed for Rose. Section 7.3 presents measures of effectiveness used with Rose and section 7.4 describes the results and evaluates the effectiveness of the intervention.

7.1 Rose's Profile

Rose was a primary school teacher who had been retired for ten years following diagnosis and successful treatment for breast cancer. She had a left middle cerebral artery infarction two years before her involvement in the study. She lived with her husband James (also retired) and two of her adult grandchildren. Rose's daughter lived abroad, and her son lived elsewhere in the UK. Rose was referred to the study by SLT4 who had been involved in her care since her stroke. She had received several blocks of SLT intervention at home and had attended an intensive period of individual and group therapy. Rose's assessment results are discussed below.

7.1.1 Body Functions and Structures

Rose had a residual right-hand weakness following her stroke. Although this had not fully resolved, she was otherwise independently mobile with no physical impairment. She was pre-morbidly left handed. Rose wore glasses for reading and reported no hearing difficulties. In conversation, Rose frequently indicated she had failed to understand by using facial expressions and by asking speakers to repeat. At times, she also responded incorrectly, suggesting she had failed to comprehend part of a message. Rose carried a notepad with her everywhere and used it either to request conversation partners to write down a message, or to write words she was struggling to find in conversation. She also used the notebook to refer back to previously written information.

Rose used a range of vocabulary in conversation and her expressive language comprised complex structures. She produced lengthy conversational turns which conveyed meaning and involved complex structures but which contained phonological and semantic errors. She made repeated attempts to produce some words, which affected the fluency of her speech. Rose reported using several strategies to aid her communication. These included using a hard copy dictionary and thesaurus to help with word finding, and referring to a paper list, provided by her SLT, of common verbs and auxiliary forms.

Language assessments

Rose’s auditory comprehension was notably impaired in comparison with reading comprehension tasks. In the CAT subtests, T-scores for single word written and spoken comprehension were 65 and 53 respectively and for sentences were 67 and 46. For auditory comprehension tasks, she often requested repetition of test items and looked closely at the assessor’s face. Naming was also impaired with phonological errors and conduit d’approche. Word and non-word reading contained similar errors to spoken naming. Spoken and written picture description tasks showed an ability to produce some complex sentence structures and to convey appropriate information. All scores for language assessments can be seen in Table 7-1.

CAT Subtest	N	Raw Score	T-Score
Semantic memory	10	10	60
Comprehension of spoken words	15	15	53
Comprehension of written words	15	15	65
Comprehension of spoken sentences	16	10	46
Comprehension of written sentences	16	15	67
Spoken picture description	--	36	--

CAT Subtest	N	Raw Score	T-Score
Naming objects	24	18	51
Reading words	24	14	48
Reading complex words	3	0	40
Reading function words	3	2	49
Reading non-words	5	2	51
Writing: copying	27	27	61
Writing: picture names	5	5	67
Writing to dictation	5	3	47
Written picture description	--	35	--

Table 7-1: Language assessment results: Rose

Assessment of cognition beyond linguistic profiling

Rose scored near ceiling for the symbol cancellation assessment (CLQT). This suggested she had no significant difficulties with visual scanning, hemianopia or visuo-spatial neglect. She scored at ceiling for Mazes tasks on the CLQT demonstrating sustained attention, visual scanning ability and problem solving skills. Her performance on verbal digit repetition tasks was at the second centile, but she displayed excellent memory skills for visual forwards (90th centile) and backwards (60th centile) pointing spans. The scores for verbal digit repetition are not a valid measure of auditory-verbal short term memory due to Rose's impaired auditory comprehension and poor ability to repeat. However, her preserved ability to repeat pointing spans when presented with a visual stimulus indicated at least her visual short-term memory was unimpaired. On the M-WCST, Rose's executive functioning composite score was within the test definition of 'high average' range. Therefore, assessments suggested no non-verbal cognitive or short-term memory deficits. Results from the above measures can be seen in Table 7-2.

Cognitive test/subtest	N	Raw	Percentile
Wechsler digits forward	12	0	<2
Wechsler digits backward	12	2	2
Wechsler visual memory forward	12	9	90
Wechsler visual memory backward	12	6	62
CLQT mazes	8	8	--
CLQT symbol cancellation	12	11	--
M-WCST categories correct	6	6	69
M-WCST executive function composite	--	--	82

Table 7-2: Assessment of cognition beyond linguistic processing: Rose

Additional diagnostic assessments

Rose performed at or near ceiling for core language assessments with the exception of auditory comprehension at sentence level, naming, and reading aloud. As the CAT does not provide assessment of reading beyond sentence level, it was necessary to carry out additional testing to identify whether she had any impairment of reading for longer pieces of text. Higher level reading comprehension was investigated using the Discourse Comprehension Test (Brookshire & Nicholas, 1993). Rose completed the six reading comprehension paragraphs in just over 13 minutes. Her raw score of 38/40 showed performance for longer passages of written information was above the mean for standardised controls reported in the assessment manual. Rose’s performance on the CAT suggested significant impairment in naming for nouns but did not assess her ability to retrieve verbs. As her spoken output was beyond single word level, it was also important to ascertain whether she had any difficulties with verb retrieval. Spoken verb naming was assessed using the Verb and Sentence test (Bastiaanse, Edwards, &

Rispens, 2002). Rose scored 31/40. This score was above the mean for aphasic controls (22.04) but well within the impaired range (1-38). The non-aphasic mean for VAST controls is 38.8. Further detail on all additional diagnostic assessments is available in Appendix M.

7.1.2 Activity and Participation

Internet use: Rose's perspective

The Internet questionnaire revealed Rose had been an avid Internet user before her stroke, using her PC and iPad to book holidays for herself and others, to make free Internet-based calls to her daughter abroad, and to send regular emails. She used the Internet to seek information on subjects of interest and for general browsing. She did not feel her skills had been affected by the stroke; she was still able to use the Internet for a broad range of purposes. The changes she conveyed were subtle and became more apparent in her qualitative comments during the Internet questionnaire than in her quantitative responses to the questions. Two activities were performed more frequently since her stroke. One was using Facebook, and the other was video calling. Rose made comments throughout the questionnaire, allowing additional qualitative data to be collected alongside her responses.

She reported that due to the mild right-sided weakness, her right hand was poorly coordinated and she had to use her left hand to operate a computer mouse. Her difficulties with understanding meant she could not use the phone to report a fault with any aspect of her computer use or Internet service. This also meant she found it difficult to understand people in computer shops. Speaking about her emailing skills, she reported she made grammatical and spelling mistakes and now took much longer to complete an email. She reported she felt self-conscious that others would judge her writing as poor.

Rose reported she was still able to use the Internet independently apart from needing some help from her husband with writing. However, some aspects of her use had

changed post-stroke. For example, the information on local events she used to receive via email was of less use to her now as she would avoid participating in such events. Emails containing jokes or amusing content she received from friends were now difficult for her to understand (she did not stipulate whether this was written or audio/video). She used to email pictures to people regularly, but as she could no longer use her right hand well she had stopped attending her photography club. Her grandchildren and a friend helped her with the computer if she encountered difficulties. Rose reported she had forgotten some of the things she learned at an Age Concern course she completed before her stroke on introduction to computers. As a result, she was now doing some things less frequently (e.g., streaming music).

Internet skills

Rose used her iPad to complete the Internet skills assessment. She performed extremely well across operational, formal, and strategic Internet skills. She completed all tasks quickly and with very limited assistance, scoring 97.8%. Assistance comprised two verbal prompts to advise Rose that she had missed information or instructions. Her scores and times taken for each task can be seen in Table 7-3.

Supporter perspective

In his interview, Rose's husband James confirmed she had been an able user of her computer before her stroke. He felt her Internet and computing skills far exceeded his own as he had no ability with computers and he was now 'too old' to learn. He was willing to help with spelling and grammar and was often asked to do so by Rose but said that she had retained many computer skills. He commented that Rose's friends and people who interact with her in the public have poor awareness of her needs. He felt that support with computers should come from someone who could recognise and compensate for her difficulties.

Task	N	Score	Time taken
Switch on/operational	8	8	00:08
Weather/operational	20	20	01:04
NETA/formal	28	27	02:01
Train information/formal/strategic	36	35	03:18
TOTAL	92	90	06:31

Table 7-3: Internet assessment scores: Rose

SLT perspective

Rose's SLT (SLT4) reported that discussions around goal setting had confirmed that Rose could continue to carry out basic Internet tasks such as searches, booking travel, or seeking specific information, e.g., train times. Post-stroke, Rose had been able to access therapy resources on both her PC and iPad via apps and websites although the SLT had carried out the installation of iPad apps on her behalf. Rose had also used text to speech on her iPad to hear information as well as reading it. She used this as a means to practise her auditory processing skills. The SLT felt that the main issue for Rose about using computers and the Internet was that of speed. Her perception was that Rose was now slower than she used to be and found that fluent written communication no longer came easily to her.

Speech and language therapy sessions with SLT4 had not provided any input related to access to computers or using the Internet. SLT4 reported sessions had focused on improving Rose's auditory comprehension and on reducing the number of errors in her expressive language. SLT4 had worked for a few sessions on writing emails, instructing Rose to write a sentence, get the iPad to speak it aloud for her, then to copy and paste it into an email. The SLT felt that this intervention was minimal and said she hesitated to

call it ‘therapy’. She also reported that her perception of Rose’s husband James was that he was a ‘technophobe’ and that Rose would not ask him for help with computers. Rose’s priority in therapy had been expressive language but the SLT had persuaded Rose that she also needed to work on comprehension. When Rose had discussed trying to improve her email writing, SLT4 felt her therapeutic skills in this area were limited beyond what she called ‘normal writing therapy’. She had asked Rose to send her an email every week to help her to practise but had considered this an addition to other aspects of therapy rather than an explicit goal. She reported that she had measured outcomes for other aspects of Rose’s intervention (e.g., auditory comprehension and spoken output) more carefully than any input related to improving her emailing skills.

7.1.3 Environmental Factors

Rose completed the Social Network Analysis independently. Her completed social network diagram contained six people in the inner circle, eight in the middle circle, and 16 in the outer circle. Her primary social support came from her husband, her close family, and friends. She reported that many of her friends were too busy to help her out but identified one woman who had helped her with using the Internet. Her grandchildren had also helped. A summary of her responses to the social network analysis can be seen in Table 7-4.

Section of diagram	No. of people
Inner circle	6
Middle circle	8
Outer circle	16
TOTAL	30

Category	No. of people
Spouse	1
Family	7
Friend	22
TOTAL	30

Table 7-4: Social Network Analysis: Rose

Rose also provided information on her means of contact with others during the Internet questionnaire. She reported that she had a large social network of friends and family although she kept in touch with others less frequently since her stroke. Rose reported that she recently had a bad experience with some of her friends, as she could not understand them while out in a café. She felt upset that they did not make more of an effort to include her in their conversation. She reported that people who used to telephone no longer called her, or if they did, the phone calls were very brief. She expressed a wish to be able to respond at length to long and humorous emails sent by some of her friends.

7.1.4 Personal Factors

In conversation, Rose frequently expressed frustration and annoyance at the consequences of her stroke, and that she was no longer able to do what she did before. She felt upset at being unable to take part in things, or not knowing what was going on. When discussing her writing, she frequently reported feeling inadequate and 'stupid' compared to her previous ability and expressed concern that others would think badly of her. Rose's husband reported in his interview that she was the 'organiser' amongst her friends and family. Rose's SLT commented that her perception of Rose was that she played a matriarchal role within her family. She commented that Rose was a proud woman, who struggled with changes to her role amongst her friends and family, and

found her language difficulties upsetting and frustrating. Her husband also touched upon changes to her independence, discussing the distress she experienced as a result of losing her 'gift' for writing.

Goal-setting

The topic of setting goals had been raised during early assessment sessions as Rose had initiated discussion around areas she could improve. Rose was, therefore, asked to think further about her priorities in anticipation of the formal goal-setting session and to write them down. At the fourth assessment appointment, Rose presented a handwritten list containing five aspects of computer use concerning her. These were: emails, how to embed photos within emails and letters, using the copy and paste function, making PDFs, and how to use QR codes. Of these aspects, she identified that email was the most important. As Rose had already identified email as a priority, during the formal goal-setting session she was asked to prioritise aspects of email by level of importance. Rose was able to read well and had already been clear on which aspects of her Internet use were of most importance. Therefore, pictorial resources on different types of Internet use for goal-setting were felt to be inappropriate and were replaced with more specific written options related to writing on the Internet. Rose was given a list of a range of types of email and other types of writing on the Internet and asked to sort each one onto a scale from most to least important. The options presented and Rose's rating are given in Table 7-5. Rose reported she was content to get her message across even if there were mistakes, stating that although she felt she should proofread her writing, often she did not, hoping that others would still understand. She stated, "*yes, I should do that. Sometimes I don't and I go [gestures sweeping hand motion] and off it goes, off it goes*". She explained that increasing the length and variety of her emails to friends was important, as she felt she wrote the same simple phrases repeatedly and struggled to find words when writing. She would often seek help with finding the correct word from James.

Despite confirming she was happy to send emails containing mistakes, Rose was also keen to improve grammar and spelling, noting that she often made mistakes with verb endings. She reported that sometimes she wrote notes on paper as a strategy to collect her ideas before sending an email. During the goal-setting process, Rose made several comments illuminating her feelings about her difficulties. She remarked, '*It takes so long. So long*'.

<i>Level of priority</i>	<i>Email/online writing tasks</i>
5	Sending emails to friends and family Sending official emails Emails to arrange appointments Getting message across despite mistakes Writing longer emails with more variety Using iPad to send emails Increasing speed of writing
4	Correct grammar and spelling Accuracy of emails Including pictures Using PC to send emails Checking what you have written
3	Writing complaint emails Sending attachments
2	Writing on Facebook

<i>Level of priority</i>	<i>Email/online writing tasks</i>
1	Filling in online forms

Table 7-5: Rose's priorities from the goal-setting session.

Following her prioritisation of aspects of online writing, Rose was asked to look again at the aspects she had rated at the most important end of the scale. As she had prioritised the iPad over her PC as a tool for writing emails, she agreed with the researcher that the iPad should be used in intervention. Rose had identified during the Internet questionnaire that emailing took her a long time and that she felt the content of her emails was less interesting than before. During goal-setting, she had reported she viewed content and length as more important than grammar and spelling, although grammar and spelling were still important to her. She wished to send official as well as informal emails, and the type of content would vary depending on the purpose of the email. From this information, it was identified that a possible goal was to be able to write longer and more varied emails in less time using the iPad, and to be happier with her own writing. It was therefore important to obtain baseline measures on length and content of emails, as well as on Rose's satisfaction with what she had written.

7.1.5 Further data collection: email writing and editing

Email writing assessment

An informal assessment of emailing was devised to capture Rose's ability to write informal emails to friends and family, to arrange appointments, and to send an official email or a complaint. These types of emails were prioritised by Rose during goal-setting and were broadly similar to spoken narrative definitions used by Whitworth, Leitão, et al. (2015): recount, procedural, and exposition. Rose typed emails using the notepad app on her iPad to avoid any accidental sending of the resulting text to one of her contacts

and completed one of each of three narrative types. She was given the instructions below:

1. Write an email telling me about a holiday you have been on (recount email).
2. Write an email to a friend arranging to meet them for lunch later this week (procedural email).
3. Write a complaint email to a restaurant manager about very loud music in his restaurant (exposition email).

During initial sessions, Rose had demonstrated a strategy of using written notes to aid her with spelling and word finding. In order to ascertain whether this was also helpful to her in writing emails, she was instructed that she could take notes before each task if she wished. Each email was timed from after she had read the instruction to when she stopped writing. After each email, Rose was asked to rate her satisfaction with the piece of writing on a 0-4 point visual scale containing frowning/smiley faces at each rating point. The emails she produced are in Appendix P. The recount email took her 18 minutes 54 seconds, and contained 68 words. This was a rate of 3.6 words per minute (wpm). She rated the piece of writing at one on the scale. The procedural email took her 9 minutes 40 seconds, contained 41 words (4.2 wpm), and she rated it at two. The exposition email took her 18 minutes 8 seconds, contained 88 words (11.1 wpm), and was also rated two. The assessment indicated that although Rose could formulate appropriate and meaningful emails, she was slow and not satisfied with her performance. The sentences in the emails were grammatically complex but contained errors. They were also limited in expressing details. Rose was not satisfied with what she produced. She remained frustrated at what she felt was very poor ability to write.

Identification of errors

Rose had indicated as part of her goal-setting session that she often did not proofread her writing, but that correct grammar and spelling were relatively important to her. Her

email narrative assessments contained errors in the use of conjunctions, auxiliary and main verb selection, verb and noun agreement, and prepositions. It was therefore relevant to establish if Rose was unable to identify mistakes in her writing or if the errors she made could be corrected via more thorough proofreading. A piece of recount narrative writing was taken from the online Guardian newspaper (Oberfell, 2016) and edited to contain errors similar to those Rose made in her writing. This was chosen in place of her own work, as it was then possible for it to contain several examples of all the errors which occurred in her writing. The piece contained 719 words and scored 6.2 (grades 7-8) using an automatic Dale-Chall readability calculator (My Byline Media, 2017). As Rose was educated to degree level, the piece was likely to be well suited to her pre-stroke reading level. Rose was given a printed version of the piece to read and told it contained grammatical errors. It was single spaced in 12-point Calibri font. She was asked to mark the errors she could spot and to correct them if able. The researcher was present when Rose carried out the task. This task was also administered with two control participants who received the task via email and timed themselves carrying it out. Control 1 was a 72-year-old woman with college level education. Control 2 was a 69-year-old man with secondary school level education. Rose's responses compared to controls are given in Table 7-6.

	Rose	Control 1	Control 2
Time taken (mins:secs)	08:55	09:37	05:37
Verb selection errors (5 in text)	0	5	4
Conjunction errors (5 in text)	1	1	3
Verb and noun agreement errors (8 in text)	1	5	6
Prepositional errors (3 in text)	1	1	3
Auxiliary omission errors (6 in text)	1	5	6
Other (plausible corrections/changes to structure)	0	2	2
TOTAL	4	19	24

Table 7-6. Rose vs controls in correct identification of grammatical errors

Rose performed poorly on the grammatical correction task in comparison with the two control subjects. She was worse at identifying verb selection errors, incorrect verb and noun agreement, as well as omission of auxiliaries. She also identified correct sentences as incorrect on three occasions, while both control subjects did this only once. This assessment highlighted that although Rose was an efficient and able reader in terms of time, she was poor at identifying subtle grammatical errors similar to those she produced herself.

7.1.6 Emotional wellbeing

Rose's responses on the CDP emotional scale indicated she felt valued, and was not lonely or embarrassed (all rated zero). She felt quite able and had low levels of unhappiness and under confidence (rated one). Her most negative emotions were feelings of worry and lack of contentment (rated three). She reported moderate anger, frustration, determination and lack of control (all rated two). The scores for this assessment can be seen in Table 7-7.

Emotions	Score
Total score (/56)	21
Angry	2
Frustration	2
Determined	2
Unhappy	1
Worried	3
Content	3
Under confident	1
Lack of control	2
Able	1
Lonely	0
Embarrassed	0
Valued	0
Feelings about the future	2
Feelings about today	2

Table 7-7: CDP Emotional Scale: Rose

7.2 Intervention

Possible interventions were considered using the decision-making framework outlined in Chapter four. Rose was consulted on this process and possible options for intervention were discussed. Length of the intervention and frequency of visits were also discussed and agreed. The intervention chosen consisted of an impairment-based therapy with a focus on written narratives. This was guided by the therapy protocol produced by Whitworth, Leitão et al. (2015). As part of this approach, Rose was taught strategies to

add to those she already used to aid her writing. She was introduced to word prediction software on the iPad as a piece of compensatory technology to assist with writing. This involved training in the use of word/grammar prediction software and opportunities to practise using the software. Justification for this approach is discussed in section 7.2.1 below and a detailed description of the intervention follows in section 7.2.2.

7.2.1 Justification

Rose's ability to write emails was impaired at both sentence and narrative level. She wished to improve these aspects in terms of length and variety of content but also grammatical correctness. Studies with a focus on impairment-based interventions for functional written language are reviewed by Thiel et al. (2015). They report that there is more evidence for interventions at single word level than for sentences or narratives and conclude there is currently limited guidance on interventions to support everyday functional writing. Some aphasia treatment studies have shown generalisation to spontaneous writing, (e.g., Murray, Timberlake, & Eberle, 2007) and there is some evidence that targeting written noun and verb production may be useful (Jacobs & Thompson, 2000; Salis & Edwards, 2010). However, there is no available evidence for therapies targeting written narratives in aphasia. Recent research on therapy targeting spoken narrative production (Whitworth, Leitão, et al., 2015) demonstrated that therapy targeting word, sentence, and narrative levels simultaneously was effective in improving spoken language at macrostructure and microstructure discourse levels. Though this therapy approach did not target written discourse, an explicit focus on word, sentence, and narrative levels could equally be applied to email narratives. Rose had already developed several strategies to help her to participate in face-to-face interactions. Her use of a notepad, dictionary, thesaurus, and word lists had been developed either independently or following suggestions from SLT4. Given her ability to use strategies to good effect, the visual planning resources used by Whitworth, Leitão, et al. to help their participants structure spoken narratives were incorporated into the intervention to assist

Rose to plan the structure of emails. Whitworth, Leitão, et al.'s work on different types of narrative was also relevant to the different types of email Rose wished to produce.

These strategies, alongside intact non-verbal cognitive abilities, suggested that Rose would be responsive to developing further strategies and might be able to use more focused note taking and planning to support her writing in treatment.

Several types of compensatory technology were considered. Rose had good non-verbal cognition and Internet skills and would not find it difficult to adapt to new technologies. Voice recognition software was ruled out as Rose's spoken output was characterized by repeated phonological errors and she had a rapid rate of speech. Her written output was also more accurate than her spoken production. Grammar checking software (Grammarly Inc., 2016) was also considered. This software had the potential to detect Rose's errors in written text and aid her ability to correct her emails. The email narratives were entered into Grammarly's free online service to determine whether it would identify errors made in aphasic writing. The software detected only one error in the first narrative ('writing' corrected to 'write'). In the second narrative, two errors were detected, correcting 'to Monday' to 'on Monday', and appropriately adding a question mark at the end of a sentence. In the final narrative, four errors were detected; one error of spacing, two verb errors, and one queried word confusion. However, Grammarly failed to pick up on several of the more subtle aspects of Rose's aphasic language. It also did not address information content, one of Rose's concerns about her emails. One of Rose's goals was to reduce the time it took her to produce a piece of writing. However, she had expressed that she favoured getting her message across over correct grammar. This suggested her motivation to take extra time to check the finer points of grammar would likely be low. Given her performance on the identification of errors assessment (section 7.1.5), it was also likely that Rose would be unable to judge whether Grammarly suggestions improved her writing. This might impact her ability to choose or reject suggested changes. A screenshot of Grammarly analysis of Rose's exposition narrative is provided in Figure 7-1.

Word/grammar prediction software was a possible means to aid Rose with next word retrieval and to help her to build sentences. This type of software requires good cognitive skills to switch between a mouse, keyboard, and prediction window. People with poorer non-verbal cognitive skills find it difficult to master (Thiel, 2015). Rose had excellent non-verbal cognitive and Internet skills and could likely use word prediction software, if taught. As Rose wished to use her iPad, the Co-Writer iPad app was considered. There is some positive evidence on use of Co-Writer and other predictive writing software for people with aphasia (Armstrong & MacDonald, 2000; Behrns et al., 2009; Thiel, 2015). A review of this work can be found in Chapter one.

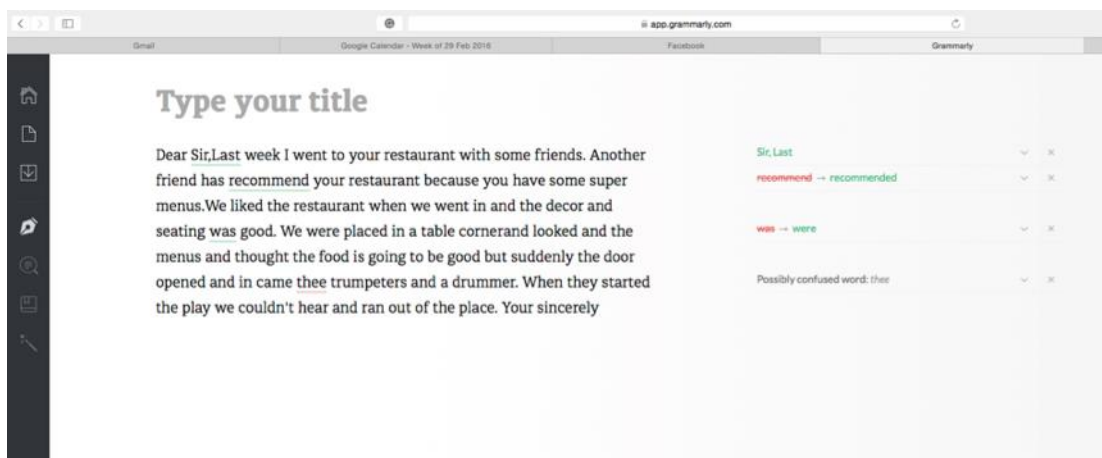


Figure 7-1: Grammarly checking of Rose's exposition narrative

Word/grammar prediction was recommended to Rose, as it would offer her the opportunity to use the software to aid spelling, and to predict auxiliary verb forms and correct morphology, improving the accuracy of her narratives. She could also use 'topic dictionaries' to enable faster access to appropriate vocabulary. Work by Thiel (2015) and Behrns et al. (2009) suggested that prediction would not improve speed of writing. However, errors such as auxiliary selection and verb/noun agreement could be avoided

by use of prediction. It was possible that, in Rose’s case, a reduction in time spent on word finding might increase her speed of writing.

The iPad was chosen for the intervention as Rose was already using it regularly and had reported she favoured its portability and ease of use over her PC.

7.2.2 Intervention design

Rose favoured visits twice weekly as she took part in other activities over the course of a week. She was due to visit a family member for an extended holiday later in the year so also wished the intervention period to last no more than eight weeks. To increase the intensity of the intervention, she was willing to carry out therapy activities in her own time.

The first part of the intervention involved training Rose for a two-week period to use Co-Writer software. The second part was a structured programme of narrative therapy for email writing. As Rose had good non-verbal cognitive skills and had performed so well on the Internet assessment, it was anticipated that learning to use the Co-Writer software would be relatively quick. This aspect of the intervention was scheduled to last two weeks (four sessions). The narrative therapy was designed to take longer over four weeks, reflecting the complexity of this part of the approach. The aim was to take into account Rose’s preference for the frequency of visits while at the same time delivering intensity as close as possible to Whitworth, Leitão, et al.’s (2015) intervention. In preparation for the intervention period, Co-Writer software was downloaded onto Rose’s iPad. The timeline of Rose’s intervention is depicted in Table 7-8.

	Weeks	1-2→		3-6 →	
Time A	Sessions	1-5	Time B1	6-16	Time B2
Assessment		Co-Writer training	Email narratives assessment	Narrative therapy intervention for email writing	Reassessment

Table 7-8: Timeline for Rose's intervention

Email narratives were chosen as the most appropriate means to measure change in Rose's emailing ability, as they offered a close representation of the type of emails she wrote regularly and could be analysed for speed of writing, length, and content. She produced these with the researcher present but without any assistance. The production of each email was timed. Different instructions were used each time to elicit the same types of email, but avoiding potential practise effects. Emails mirrored the types of narratives defined by Whitworth, Claessen et al (2015) in their work on spoken narrative structures (see Table 7-9). At each time point, Rose was informed she could make notes but was not given any further instructions. Co-Writer was available to her at times B1 and B2.

	Pre-intervention (A)	Post-Co-writer training (B1)	Post-narrative therapy (B2)
Recount	<i>Write an email telling me about a holiday you have been on.</i>	<i>Write an email telling me about a day trip you have been on.</i>	<i>Write an email telling me about a place you have visited.</i>
Procedural	<i>Write an email to a friend arranging to meet them for lunch later this week.</i>	<i>Write an email to a friend arranging to visit them next month.</i>	<i>Write an email to a friend arranging to go to the cinema together next week</i>
Exposition	<i>Write a complaint email to a restaurant manager about very loud music in his restaurant.</i>	<i>Write an email to the manager of a hotel complaining about the poor state of your hotel room last month.</i>	<i>Write an email to a company explaining that the washing machine you bought last week is not working properly.</i>

Table 7-9: Email narrative task instructions.

Co-Writer training

Co-Writer training comprised four one-hour sessions. Table 7-10 provides information on the content of each session. All instructions were given in both spoken and written

form to aid Rose with auditory comprehension and each session followed a set worksheet. The content of the therapy was guided by a series of worksheets prepared in advance by the SLT. Content of the worksheets can be seen in Table 7-10 and selected examples can be found in Appendix N.

Worksheet no.	Content
1	What is Co-Writer How does Co-Writer work? How to use Co-Writer to send emails Looking for prediction on each word Practice using Co-Writer by copying sentences and paragraphs Suggestions for further independent practice
2	Introduction to topic dictionaries Practice using topic dictionaries when copying a themed passage Adding personal words Starting a personal biography
3	Revision of previous worksheets Practice writing recount narratives (Calvin and Hobbes stories) Practice writing procedural narratives (making a cheese toastie)
4	Further Co-Writer practice Recount narrative (Calvin and Hobbes) Procedural narrative (giving directions) Exposition narrative (letter to the editor in response to news item)

Table 7-10: Content of Co-Writer worksheets

During session one, Rose was introduced to the Co-Writer app and asked to begin by copying simple sentences from a worksheet into Co-Writer. She was encouraged to look to the prediction window while typing each word and to look to see whether the next word she wanted to use had appeared. She was then shown how to copy text from Co-Writer into an email message and send it (to the researcher). Some examples of the

handouts introducing Rose to Co-Writer can be seen in Appendix N. Rose quickly learned how the software worked and could scan and use prediction well. For subsequent sessions, worksheets on topic dictionaries were introduced (vocabulary unique to a particular topic, e.g., tennis, baking), and on how to add personal words (vocabulary Rose might use frequently). The focus in each session was on using the software and sending text typed in Co-Writer via email. There was no language intervention in the form of linguistic cues or support to decide format or content of her writing. Throughout training, Rose was prompted to pay close attention to the prediction area of the screen, and to keep checking to see if the next word was predicted. Work focused on copying sentences and paragraphs from news stories then moved onto self-generated narratives. These were: 1) *recount emails*: (a) a personal biography; (b) retelling of sequence pictures and describing a wordless story using Calvin and Hobbes wordless cartoons (Watterson, 2001), 2) *procedural emails*: writing to give directions from one location to another using a map, and 3) *exposition emails*: composing letters to a newspaper editor about local news stories. After each session, Rose was asked to complete any pieces of work left unfinished and to work on another piece of writing to email to the researcher before they were due to meet again.

Narrative Therapy

The intervention progressed to eleven sessions of narrative therapy over a period of just over five weeks. The content of this aspect of the therapy was also guided by a series of worksheets prepared in advance by the SLT and supplemented by materials provided by A Whitworth (personal communication, February 19, 2016). The content of each of these worksheets is describe in Table 7-11 with examples in Appendix N.

Worksheet no	Content
1	Introduction to narrative therapy Explanation of: the aims of narrative therapy, different types of email narratives, and structure of therapy sessions

Worksheet no	Content
2	<p>Recount narratives</p> <p>Explanation of recount narratives. Step by step instructions for writing a recount email about a 6 picture sequence</p> <p>Introduction to mind-maps, brainstorming nouns and verbs, constructing and linking sentences</p> <p>Introduction to reviewing own narratives via self-checklist</p>
3	<p>Procedural narratives</p> <p>Explanation of procedural narratives. Task scenarios to prompt writing procedural emails</p> <p>Review of mind-maps, brainstorming, constructing, and linking sentences</p> <p>Review of reviewing own narratives via self-checklist</p>
4	<p>Exposition narratives</p> <p>Explanation of opinion (exposition) narratives. Task scenarios to prompt writing exposition narratives</p> <p>Repeat of steps used in worksheets 1 and 2</p>
5	<p>Next steps</p> <p>Recap of previous sessions</p> <p>Task scenarios for one procedural narrative and one recount narrative to complete in own time</p> <p>Reminders of step by step process</p>
6	<p>Replying to actual emails</p> <p>Task 1: reply to the fake email on the worksheet with your news</p> <p>Task 2: pick one of your own emails and compose a reply</p> <p>Reminders of step by step process</p>
7	<p>The Golden Rules</p> <p>Laminated step by step instructions on constructing email narratives</p> <p>Self-rating sheet to review emails</p>

Table 7-11: Content of narrative therapy worksheets

To begin, Rose was given a written information sheet informing her that it was now time to move onto a second stage of the therapy. Resources and protocol for narrative therapy were kindly provided by A Whitworth (personal communication, February 19, 2016). This included mind map templates for each type of narrative. An example of one of the mind maps can be seen in Figure 7-2. The therapy followed the protocol described in Whitworth et al. (2015) with a focus on written rather than spoken narratives. Any deviations from the protocol specific to writing are detailed below.

Rose was asked to look for photographs of herself and her family from the past to help her to describe events (recount e-mails) and to consider articles in her daily newspaper she would like to write about (exposition e-mails). Visual depiction of recipes and maps were used as initial stimuli for emails giving instructions (procedural emails).

Stimulus materials were initially provided but as therapy progressed, Rose began to write about aspects of her own life, and to initiate and respond to real emails. Work on each narrative followed the predetermined sequence from the protocol, with each step outlined for Rose on handouts. This was the same across narratives, with the key differences seen only in the type of mind maps used.

The first step was for Rose to brainstorm the words needed for her narrative on a piece of plain paper for 10-15 minutes. Initially all narratives were worked on collaboratively. Support was provided with word finding by a combination of encouraging Rose to use circumlocution, providing forced alternatives, or giving written letter cues. When Rose felt the brainstorm had generated enough words, she was encouraged to highlight nouns and verbs in different colours, and to underline descriptive words. This provided Rose with visual feedback on her word generation. She was asked to consider whether she had enough of each type of word to make her email interesting, or whether she could think of more.

Rose then wrote full sentences using the words generated by brainstorming. These were initially written longhand underneath a visual reminder of simple subject-verb-

object sentence structure. By the second session of therapy, it was agreed that it was more efficient for Rose to complete this step using her iPad. She could then edit what she had written and add content to form a narrative. Feedback was given on vocabulary choice, verb morphology errors and omissions and Rose was prompted to look at areas where she could improve the sentence.

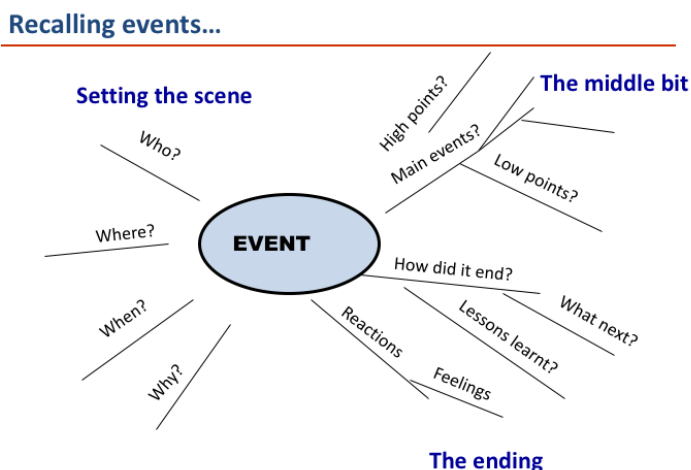


Figure 7-2: Example of mind-mapping support (recount narrative)

She then wrote her email narrative based on her mind map. In doing so she also referred to a handout from Whitworth et al.'s resources on linking sentences together to form more complex narratives. She used Co-Writer to construct the message, so that she also had access to the word prediction functions she had learned in the preceding two weeks. Rose and the researcher looked at a print out of the resulting email together, highlighting verbs and nouns in different colours, underlining descriptive words, and circling conjunctions. Rose then rated each narrative using an eight-point feedback sheet (from the provided therapy resources). There was a 1-10 scale for: finding the verb, finding the nouns, completing sentences, setting the scene, getting the main ideas, linking ideas, the ending, and whether it was a clear story overall. Each narrative was

discussed using the feedback sheet and Rose decided whether she wanted to change any aspect of the email. She did so if needed, and then sent the email to the researcher.

The amount of time spent working on each type of narrative was partially dictated by Rose. She was encouraged to move on from each narrative to try another of a different type but was given a choice of what she wanted to work on in her own time. Her homework often carried over into the therapy session so Rose could receive feedback on her independent work. This meant there was more of a focus on her preference for recount emails.

The use of mind maps changed slightly during the intervention. From session six, brainstorming shifted at word level directly onto the mind map. This allowed Rose to generate vocabulary related to specific areas of the mind map while simultaneously thinking about narrative structure. In session eight, a generic mind map was introduced for all narratives. Rose had experienced difficulties retaining the names for each type of narrative and had also commented that some aspects of the mind maps were not relevant to the emails she was trying to write. The simplified mind map was to enable her to add her own elements of structure, and to remove the need to select the 'correct' mind map before starting each email. The simplified mind map is depicted in Figure 7-3.

Sessions focused on rigidly following the steps to produce each email. If the session exceeded one hour and the email was not completed, Rose would finish it in her own time, and work through self-rating of the narrative with the researcher during the next session. In the final sessions, Rose was provided with guidance to assist her in writing future emails. This included instructions on how to use the generic mind map and a laminated set of 'Golden Rules' to follow for writing an email. This document provided Rose with step-by-step instructions on following the principles adopted during the intervention. Some examples of handouts from the intervention, including the 'Golden Rules' document, can be seen in Appendix N.

Basic email mind map...

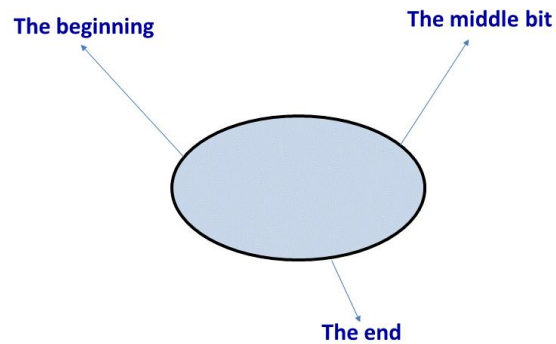


Figure 7-3: Simplified email mind map

7.3 Measures of Effectiveness

The measures chosen to determine the effectiveness of the intervention with Rose and those selected as controls are outlined in Table 7-12. Rationale for each of these measures is described in the results section.

Measure	Predicted outcome
Email narratives assessment	Increase in: length of narratives, speed of writing, linguistic variety, and satisfaction with emails
CAT written picture description	Increase in length of sample, speed of writing, and linguistic variety
CAT comprehension of sentences	No change
CAT repetition of words and non-words	No change
Internet assessment	No change

Measure	Predicted outcome
Internet questionnaire	No change

Table 7-12: Measures of effectiveness for Rose’s intervention. Control measures are shaded.

7.4 Results and Discussion

All measures of effectiveness are presented below with comparison’s of Rose’s performance at times A (pre-intervention) and B (post-intervention). As there were two aspects to this intervention, the email writing assessment was repeated at times B1 (post-Cowriter therapy) and B2 (post-narrative therapy). The emails Rose produced can be seen in Appendix P.

7.4.1 Effectiveness of Co-Writer software

It was predicted that Rose would be able to use the Co-writer software to support her word finding, by using the grammatical prediction to identify possible next words when she was writing sentences. This could potentially include selection of auxiliary verb forms and correct morphology. Rose’s use of Co-Writer to predict words during the assessments at times B1 and B2 is described in Table 7-13. During the assessment, the researcher made a note of each word Rose had produced using word prediction. This data was only collected for the procedural and exposition emails. A breakdown of the types of words she used the software to predict at time B1 can be seen in Figure 7-4.

At time B1, Rose used prediction for (in order of frequency) heavy verbs, nouns, light verbs, prepositions, adjectives and pronouns, conjunctions, and one determiner. She continued to use Co-Writer during narrative therapy, and during the assessment at time B2. However, her use of predictions decreased considerably.

Type of email narrative	(time B1)	(time B2)
recount	12	4
procedural	29	2
exposition	21	12

Table 7-13: Use of Co-Writer for prediction: Percentage of total word count

Notes made during the assessment describe how she predominantly used Co-Writer to select one of the suggested words to complete words she had already partially typed. She did not use Co-Writer to look for predictions for the next word in a phrase or sentence. Her use of the software also waned following the second part of the intervention.

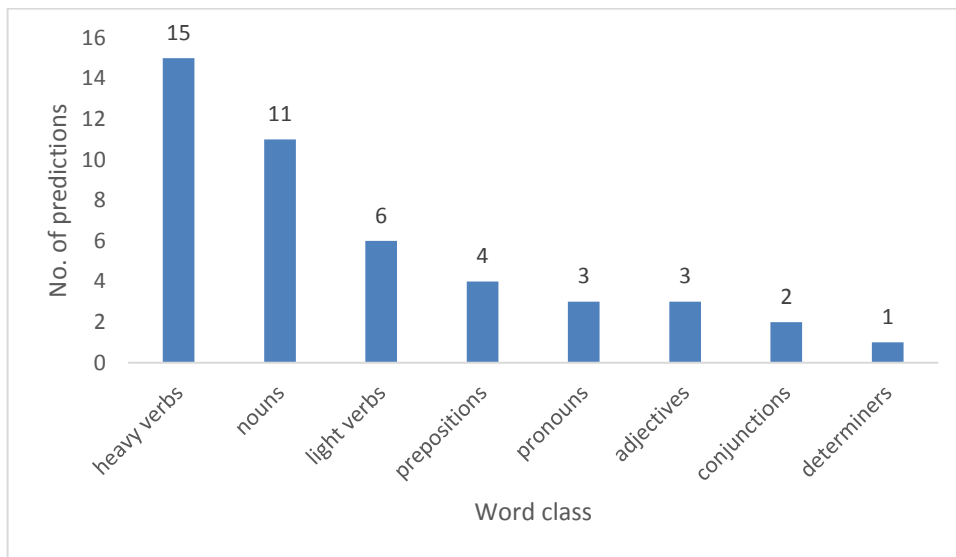


Figure 7-4: Use of prediction by word class at time B1 following Co-Writer training (exposition and procedural narratives combined)

The skills required to switch focus or to carry out activities with increasing task demands may be difficult for people with aphasia (Brownsett et al., 2014; Murray, 1999). Following Co-writer training, Rose used word prediction software but not as predicted to assist her with sentence construction. Further, her use of Co-Writer to complete partially typed

words was not sustained at the same level following the narrative therapy intervention. Although she still used the software, her use had decreased and she prioritised narrative planning and sentence construction over any focus on prediction.

7.4.2 Measures of writing

Rose's goals were that emails should be longer, more varied, and take less time to write. She also wanted to be happier with what she could produce in an email. There were, therefore, four elements to assess: length of narratives, speed of writing, linguistic variety, and satisfaction with emails. Each of these elements are discussed below with a description of analysis used to established whether her goals were achieved.

The email narratives from times A, B1, and B2 were analysed using CPIDR software (Brown, Snodgrass, Kemper, Herman, & Covington, 2008). CPIDR provides a word count and these counts were used to compare length of each email narrative and to calculate mean length for the three narratives at each time point. Each email narrative was timed. Word count was also used to calculate the rate of words written per minute. CPIDR software was also used to provide an automated measure of the number of propositional ideas and the propositional density of Rose's email narratives. Propositional idea counts from CPIDR correspond roughly to number of verbs, adjectives, adverbs, prepositions, and conjunctions in a piece of discourse. These counts are divided by the total word count to provide a measure of propositional density within a given text. Propositional density has been used in aphasia as a measure of informativeness (Bryant et al., 2013) and it has been shown to discriminate performance between normal and aphasic performance in spoken discourse (Fromm et al., 2016). Spencer, Craig, Ferguson, and Colyvas (2012) found propositional density of written language remained stable as subjects aged but there was within subject variability, especially for shorter texts. To date, however, propositional density has not been investigated regarding its potential as an measure of change following interventions for aphasic spoken or written language (Bryant et al., 2013). It is not known whether the measure is sufficiently sensitive to measure change. However, use of a computer

programme for analysis allowed for greater reliability of part of speech coding than human raters would provide (Brown et al., 2008) and gave a possible quantifiable measure of change in Rose's written discourse.

Length and speed of emails

It was anticipated that the Co-Writer training would increase the amount Rose could write by allowing her access to automatic prediction, which would aid building of phrase and sentence structures. This would, in turn, increase her speed and accuracy of writing, leading to longer narratives. The use of discourse planning strategies taught via narrative therapy was predicted to support Rose with word finding and sentence construction, and with linking sentences together within narratives. This would further increase the length of Rose's emails. However, due to an increased need for planning, it was not anticipated that this would increase speed of production. Figure 7-5 shows a comparison of number of words and words per minute (WPM) over the three email assessments and for the mean. Length of emails improved stepwise at points B1 and B2 for all narratives and for the mean of the three narratives. However, the number of words Rose produced per minute did not improve in the same direction. Rose's speed of production increased for her recount emails after both Co-Writer and narrative therapy but not for the procedural or exposition emails, or for the mean.

The results indicated that the combination of both therapies was successful in increasing the length of Rose's emails, particularly the recount email. Co-Writer did not improve her speed of writing overall but following this part of the intervention, she did increase the number of words she produced. Thiel et al. (2016) and Behrns et al. (2009) also reported that use of word prediction slowed their participants down. This type of trade-off between speed and accuracy may be reflective of difficulties with attentional focus following neurological impairment (Brownsett et al., 2014; Murray, 1999). Data collected during the assessment demonstrated that Rose was using the software to complete single words rather than predict the next item in a sentence. Although this suggests she was not using the software as hoped, Rose's use of Co-Writer did appear to facilitate

increased length of emails. Focused and repeated practice may have influenced the length of her emails, but equally, Rose may have been using the prediction window as a resource to help her with finding her next word.

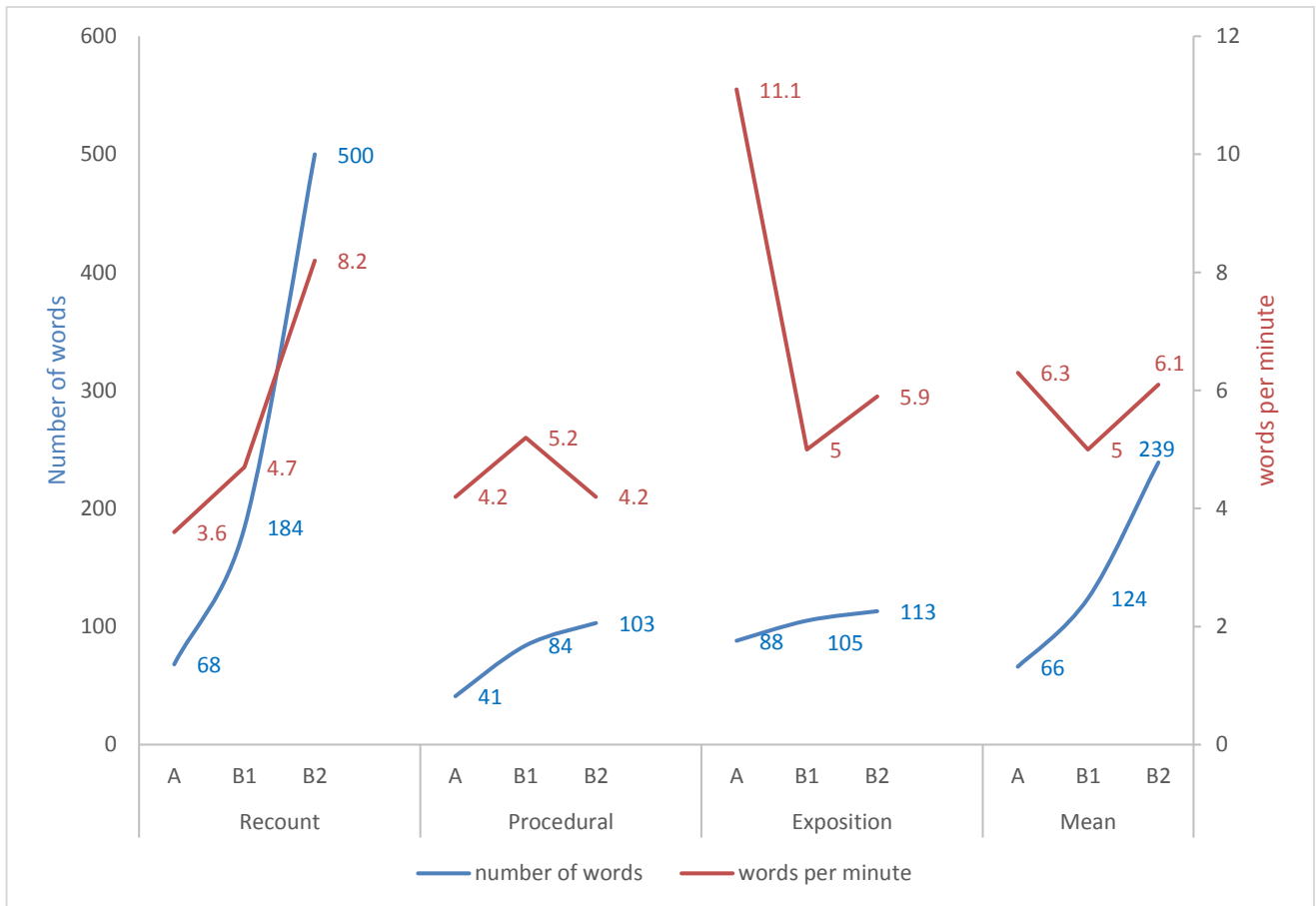


Figure 7-5: No. of words and words per minute for email narratives

Narrative therapy, alongside her minimal use of Co-Writer at time B2, appeared to improve Rose’s speed of writing for the recount email. However, this change was not seen in any of the other narratives or for the mean. This finding was not predicted. Narrative therapy was expected to take Rose longer due to the increased time needed to plan the narrative in advance. The differences in speed and length seen between the

recount and other narratives could perhaps be explained by a preference for these types of email narratives and by the familiarity of the vocabulary involved. Rose spent considerably more time working on recount email narratives. The amount of time spent working on these may have had a positive impact on outcomes in comparison with other narratives. Recount emails were all based on her own experiences rather than made up scenarios for the procedural and exposition emails. Personal and evaluative language may be more motivating and natural for people with aphasia to produce. This 'emotional motivation' (Armstrong & Ulatowska, 2007, p. 771) may have facilitated word finding. Procedural and exposition emails were also relatively constrained tasks and less flexible in terms of length and content.

Linguistic variety of emails

It was predicted that narrative therapy would give Rose greater awareness of narrative structures. This would lead to greater changes to variety and content of her narrative than word prediction alone. Narrative therapy alongside Co-Writer would lead to emails containing a greater amount of information and with more diverse use of the parts of speech given additional focus in the therapy: nouns, verbs, adjectives, and conjunctions.

Word counts showed that Rose was producing longer emails across all narratives, following both the Co-Writer training and the narrative therapy. This increased length was also reflected in higher propositional idea counts (as might be expected). However, any increase in variety and interest of her emails was not reflected in the propositional density measures. This included the recount narrative, which displayed the greatest amount of change in email length. The CPIDR propositional idea and propositional density counts for Rose's three email narratives and for the mean can be seen in Table 7-14. Propositional density may not be a sensitive enough measure of changes to variety and content within written narratives, particularly for people with aphasia (Fromm et al., 2016). It was therefore important to look at other possible measures to identify any changes in variety to Rose's narratives.

Type of email narrative	Time A	Time B1	Time B2
Recount	35 (0.52)	88 (0.48)	201 (0.5)
Procedural	17 (0.42)	42 (0.5)	46 (0.45)
Exposition	43 (0.42)	52 (0.5)	65 (0.45)
Mean	32 (0.45)	61 (0.49)	104 (0.47)

Table 7-14: CPIDR propositional idea (and propositional density) counts for Rose's email narratives.

Analysis of sentence length and verb argument structures provided a different means of quantifying the content and variety of Rose's narratives. Mean sentence length was calculated using an online word counting tool (Rocca, 2017) and can be seen in Table 7-15. The number of different verb argument structures were counted by hand, following Thompson and Shapiro (1995). This data is presented in Table 7-16.

	A	B1	B2
Recount	10	14	17
Procedural	9	10.1	12.4
Exposition	14.2	9.4	15.7
<i>Mean</i>	<i>11.1</i>	<i>11.2</i>	<i>15</i>

Table 7-15: Mean sentence length within Rose's email narratives

Recount narratives showed the greatest amount of change in sentence length and number of argument structures following both aspects of the intervention. Sentences were longer and Rose was using more two argument structure verbs in sentences to build her narratives following both interventions

No. of arguments->	A			B1			B2		
	1	2	3	1	2	3	1	2	3
Recount	1	7	0	2	19	3	5	41	5
Procedural	1	0	3	0	10	2	2	10	3
Exposition	2	9	1	1	16	0	1	14	0
<i>Mean</i>	<i>1.3</i>	<i>5.3</i>	<i>1.3</i>	<i>1</i>	<i>15</i>	<i>1.7</i>	<i>2.7</i>	<i>21.7</i>	<i>2.7</i>

Table 7-16: No. of argument structures in Rose's email narratives

Finally, to provide a measure of discourse structure, Rose's emails were also analysed using the Curtin University Discourse Protocol (Whitworth et al., 2015) coding system for discourse cohesion. Rose's emails at all points contained identifiable orientation or introduction to the start of the narratives. The most notable changes from points A to B1 and B2 were the number of events covered in the recount emails and in the number of methods/steps covered in the procedural email. These figures demonstrate that for the recount emails, Rose was providing increasingly more information on events she had experienced during a trip or holiday. For the procedural narrative, she was giving her correspondent more detailed instruction on the details around a future meeting. This analysis can be seen in Appendix P. Rose's emails can also be related to the data seen in her handwritten notes when planning each email. In her recount email at point A, she started to write the email longhand then progressed to bullet points. For the recount email at time B1, she used bullet point planning in a list format. At time point B2 she split the structure of her plan into the beginning, middle, and end of the email using the mind map, and then listed what she wanted to cover at each point. Similarly, with the procedural emails, there was more of a focus on detail of the where and the when at the mind-mapping planning stage. These changes in content were not seen with the exposition emails. As they were based on a hypothetical complaint situation, Rose may

have found word generation very difficult for the task. The additional need to present a detailed argument within constrained vocabulary may have been more linguistically demanding.

Satisfaction with emails

It was predicted that Rose would feel more satisfied with her own emailing skills, and would rate them higher at points B1 and B2 when asked to judge their quality. Her ratings can be seen in Table 7-17. Her self-perception of her performance on email assessments changed by 1 to 1.5 points at each assessment for the recount emails, but she was less confident of her abilities for the procedural or exposition emails. Her self-awareness was therefore reflective of her actual performance. She was happier with the emails containing more depth and variety of content. This perhaps shows some self-awareness of where she had improved.

	RECOUNT			PROCEDURAL			EXPOSITION			MEAN		
	A	B1	B2	A	B1	B2	A	B1	B2	A	B1	B2
Self-rating	1	2.5	3.5	2	2.5	2.5	2	2	2.5	1.7	2.3	2.8

Table 7-17: Rose's self-rating of email narratives.

7.4.3 Other measures of writing

Rose’s performance on the CAT written picture description was at ceiling when scored according to test procedure. However, it was possible to compare the two samples of the handwritten picture description to establish whether Rose was using any discourse strategies to increase the linguistic variety in another type of narrative (purely descriptive based on a picture). The prediction was that Rose would be better at narrative planning beyond the context of her emails.

No differences were seen in formal scores for the CAT written picture description. Rose did not approach this handwritten task any differently at the second assessment, for example, by using any of the narrative organisational strategies she had learned. The two pieces of writing contained 57 (A) and 59 (B2) words and are reproduced in Appendix P. The CAT written description at time A contained two one-argument-structure sentences, six two-argument structure sentences, and no three-argument structure sentences. The written description at time B2 had the same number of argument structures save one fewer one-argument structure sentence. Analysis using the Curtin Discourse Protocol revealed that the description at B2 contained one more orientation to character (Rose included reference to the baby's mother), one more initiating event (Rose stated that the baby's mother had gone out), and the addition of a concluding and evaluative statement ('what a mess!'). The description at time A contained three grammatical errors and the description at time B2 contained none. Description B2 also demonstrated more complex and appropriate use of conjunctions (e.g., but, because) and more correct tense structure. Any changes from time A to B2 were, therefore, very subtle but were positive and related to Rose's goals of producing more content and variety with fewer mistakes.

7.4.4 Control measures

It was anticipated that no change would occur in spoken language (comprehension and production) as this was not the target of the intervention. The most appropriate control measures were those that Rose found more difficult but had potential to change (i.e., neither at ceiling, nor at floor). These were the CAT comprehension of spoken sentences and reading aloud of words and non-words. Rose's impaired language as measured by these CAT subtests did not change significantly (per the CAT manual) between the two periods of intervention. The change from a raw score of 14/32 to 20/32 on comprehension of spoken sentences was examined using a chi-square test, and this determined that there was no statistically significant difference in Rose's performance at times A and B2 (McNemar's $X^2 [1] = 2.25, p = .1$, one-tailed). Statistical comparison was

also carried out for her previously impaired performance on word and non-word reading sub-tests (combined). There was no significant difference between times A and B2 (McNemar's $X^2 [1] = 0.36, p = 0.5$, one-tailed). These results were as predicted as intervention had not focused on these areas of difficulty.

The Internet assessment was repeated as per study protocol. Rose had performed at ceiling at time A and this was not expected to change. It was anticipated that Rose might again provide some qualitative data during the Internet questionnaire that would capture some more subtle aspects influenced by the intervention.

As predicted, Rose's performance at time B2 on the Internet assessment did not change. She again scored 98% with two prompts needed to go back to check information she had missed. She completed all the tasks two minutes faster than on her first attempt, finishing the assessment in just over four minutes.

Rose's self-reported frequency of carrying out a range of online activities is presented in Figure 7-6. There were some subtle changes following intervention, including slightly increased amount of email and Internet browsing, increased use of the Internet for information on local events, local council, health, price comparison, for booking travel, buying things on line, and for playing games. It was not anticipated that frequency of Internet use would change. However, Rose had been using her iPad rather than her desktop computer to carry out therapy activities and was perhaps also using it more for other reasons while it was close by.

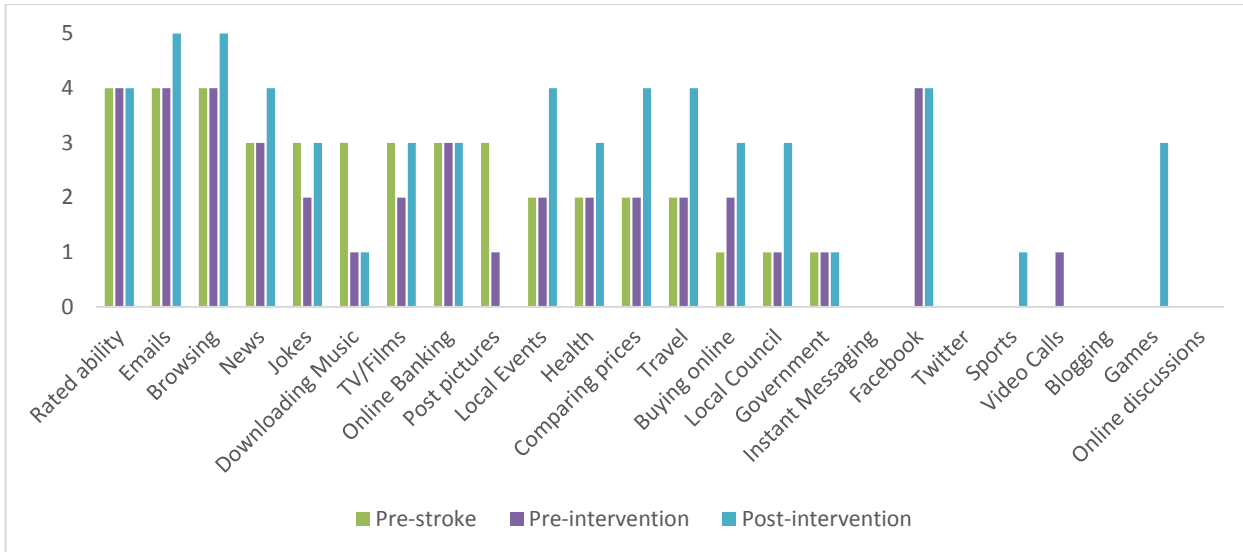


Figure 7-6: Self-rated ability and frequency of Internet activities pre-stroke, pre-intervention, and post-intervention

Such increase in use following a change in the main device Rose used is encouraging as to the benefits of iPads or other easily accessible tablet devices as a means to support and encourage people with aphasia with Internet use. Rose had the Internet readily available to her at all times, and her focus on email may have enhanced her Internet use in other areas. With regard to writing, she confirmed during the questionnaire discussion that she did still use word prediction and found it helpful, but that she often forgot it was there and felt she should remember to use it.

The intervention was not targeted at Rose’s environment. Therefore, the interview with her husband was not repeated. The measure of social networks analysis was repeated as this was a possible area of change if increased confidence in emailing led to greater contact with friends and family. Results are available in Appendix K and changes can be seen in an increase in the number of friends Rose listed post-intervention. It is feasible that an increase in emailing and practise sending messages to real-life friends had

increased contact with people she previously did not count as close enough to be part of her social network.

7.4.5 Outcome in relation to goals

The results above confirm that the intervention was successful in enabling Rose to produce longer emails. However, whether Rose's emails were more informative and interesting remains partially unanswered. Her recount and procedural emails contained more information content which was of use to the reader, but measures of propositional density did not change and she continued to prefer two argument structure sentences. Measures of informativeness and interest are difficult to quantify, and are also subjective. Rose was a harsh critic of her own abilities, and may have found that others did not judge her as harshly as she perceived. However, she did feel happier over time about her own performance. This can be considered as a success of the intervention.

7.5 Summary

This chapter described assessment, intervention, and outcome measurement with Rose, aimed at improving the length and narrative structure of her emails. Rose's ICT skills had remained intact following stroke, but one symptom of her aphasia was impaired writing, which impacted her ability to communicate via email. An intervention was designed based on the combination of an impairment-based therapy targeting narrative structures and the use of word prediction software as an additional aid to writing. The most effective part of the intervention to improve Rose's emailing skills was the impairment-based approach, targeting her language skills directly and teaching strategies to enhance written narratives. Although she did use word prediction to complete partially typed words, it did not increase her speed of writing or support her word finding.

The intervention was successful in that it did provide Rose with the means to write longer emails, particularly those to friends telling of recent events in her life. However, she only appeared to improve her speed of writing when the topic was familiar to her.

There appeared to be a trade-off between speed and length of emails when planning and paying closer attention to the content of a piece of writing.

Chapter nine returns to issues around interventions to support aspects of writing arising from Rose's case and those of Nancy (Chapter six) and Oliver (Chapter eight).

Chapter 8. Oliver's Case: Access to Online Messaging

This chapter describes assessment and intervention with Oliver, a 79-year-old man whose stroke had impaired his writing ability. Oliver wanted to return to online correspondence with friends and family. As with previous participant chapters, section 8.1 presents results from assessment and information gathering structured around the ICF framework. Section 8.2 describes the intervention designed to support Oliver. Section 8.3 discusses measures of effectiveness used with Oliver and section 8.4 presents the results and evaluates the effectiveness of the intervention.

8.1 Oliver's Profile

Oliver was a retired engineer and teacher who lived with his wife Pauline. Pauline was also a retired teacher. The couple had five adult children between them and several grandchildren. Three of their children lived abroad. Oliver had a left total anterior circulation stroke six months prior to referral to the research and two months prior to referral he had been discharged from an inpatient stroke rehabilitation unit to the care of a community multi-disciplinary supported discharge team. Oliver was still receiving daily physiotherapy from therapy assistants. His SLT (SLT5) was part of the supported discharge team and had taken over his care when he returned home. Earlier SLT involvement had been with therapists working in acute care and on the rehabilitation ward. SLT5 described Oliver's difficulties as very mild expressive language impairment but a significant dysgraphia. She or an SLT assistant had been visiting Oliver weekly since his discharge from hospital and their focus had been to provide him with therapy for his writing difficulties. Their visits stopped four weeks prior to his referral to this project.

A description of all assessments and interview data follows in sections 8.1.1 to 8.1.6.

8.1.1 *Body Functions and Structures*

Oliver had a right-sided hemiplegia with dense weakness and no functional ability in his right arm. He had been right handed. He was independently mobile for short distances with a stick. Between his referral into the project and the first appointment, Oliver fell and fractured his hemiplegic arm. Pain from the fracture was well managed with paracetamol

and occasional codeine, therefore the broken arm was not considered to be a reason for exclusion from the research. A member of the rehabilitation team had queried Oliver's vision during the initial months post-stroke and referred him to ophthalmology. The resulting report was not available but Pauline conveyed the information that the ophthalmologist had found no stroke-related visual impairment and SLT5 confirmed this report. Oliver had mild age-related hearing loss that predated his stroke. He experienced post-stroke fatigue and became very drained following assessments or after physiotherapy.

Language assessments

Oliver gave no indication of not understanding others. He could interact verbally without any apparent difficulty, save occasional word finding problems. Oliver and his wife reported he had initially experienced more marked difficulties with expressive language post-stroke but at time of referral into the project (six-months post-stroke) his language difficulties were now predominantly with writing. He reported no difficulties with reading.

Oliver scored close to or at ceiling on all CAT language assessments apart from subtests focused on writing. He reported he was unsure of spellings and was unable to complete words when writing. He also reported that using a pen with his non-dominant left hand was challenging, and he experienced cramping pain in his left hand and arm after writing. In the CAT writing to dictation subtest, the items he found difficult were 'idea' (low imageability item) and 'undrinkable' (morphologically complex item). Oliver reflected that he was slow to respond across all types of assessment and had to think more about the items in tests than he would have prior to stroke.

For the CAT written picture description, Oliver produced 37 handwritten words in 14 minutes 43 seconds (2.5 wpm). His attempt contained five complete complex sentences relevant to the picture with errors in the words 'sleeping', 'hifi' and 'attention'. He made five self-corrections by scoring out letters or parts of words. All his text was in block capitals and he was inconsistent with use of full-stops. His written picture description is

available in Appendix P. All scores for Oliver’s language assessments can be seen in Table 8-1.

CAT Subtest	N	Raw Score	T-Score
Semantic memory	10	10	60
Comprehension of spoken words	15	15	55
Comprehension of written words	15	15	55
Comprehension of spoken sentences	16	16	65
Comprehension of written sentences	16	16	67
Spoken picture description	--	44	--
Naming objects	24	23	66
Reading words	24	24	69
Reading complex words	3	3	67
Reading function words	3	3	62
Reading non-words	5	3	54
Writing: copying	27	27	61
Writing: picture names	5	5	67
Writing to dictation	5	3	52
Written picture description	--	20	--

Table 8-1: Language assessment results: Oliver

Assessment of cognition beyond linguistic profiling

Oliver demonstrated impaired performance on the second (more complex) Mazes subtest from the CLQT. During this test, his route directly crossed one of the walls of the

maze. This indicated a mild deficit either with visual spatial skills or with executive functioning/planning abilities. Visual processing was unimpaired for the Symbol Cancellation assessment (also CLQT) and measures of verbal and visual short-term memory (Wechsler) were between the 42nd and 67th percentiles. Oliver’s executive functioning composite score for the M-WCST was within the test definition of ‘average’ performance. Results from all of the measures of non-verbal cognition can be seen in Table 8-2.

Cognitive test/subtest	N	Raw	Percentile
Wechsler digits forward	12	8	67
Wechsler digits backward	12	6	50
Wechsler visual memory forward	14	8	57
Wechsler visual memory backward	12	5	42
CLQT mazes	8	3	--
CLQT symbol cancellation	12	12	--
M-WCST Categories Correct	6	6	76
M-WCST Executive Function Composite	--	--	68

Table 8-2: Assessment of cognition beyond linguistic processing: Oliver

Additional diagnostic assessments

Oliver had reported ongoing problems with writing. However, very few items on the CAT highlighted any level of impairment and there was a need to assess writing in more detail. As both Oliver and the researcher had observed that his performance was slow across a range of tasks, it was also of interest to investigate speed of processing.

Written language subtests from the Psycholinguistic Assessment of Language Processing in Aphasia (PALPA) (Kay, Coltheart, & Lesser, 1992) were used to

investigate writing in more detail. To reduce the possibility of cramping in his hand from holding a pen for writing and to replicate the experience of writing online, Oliver was asked to type responses rather than handwriting. Oliver remarked that the letters on the keyboard 'danced' in front of him. He noted that this only happened when trying to write and that he did not experience any similar distortions when reading on a screen or paper. Oliver made no errors on the PALPA (39) letter length spelling assessment, taking nearly 15 minutes to complete the 24 items. He used verbal letter-by-letter rehearsal for each item and looked carefully for the letters on his keyboard. He was observed several times to look at and hover his finger over the letter he was seeking but to not select it. He commented during the task that he would previously have had no difficulties with writing at that level. He self-corrected two errors (*ccup* -> *cup*, and *squage* -> *square*). Oliver was given only the first 20 out of 40 items of the PALPA regularity and spelling assessment (Kay et al., 1992) because he found the process extremely slow and effortful. His one error was for the word 'giraffe', which he produced as first '*jeraffe*', then '*geraffe*'. He also initially produced 'caravan' as 'cararan' but corrected his error. The 20 items took him 22 minutes 21 seconds to complete. Oliver was then asked to spell the same items aloud. This was considerably faster, taking him one minute and 53 seconds. Errors were 'squirrel' -> '*s-q-u-i-r-e-r*', 'giraffe' -> '*j-e-r-a-f-f-e*', and 'photograph' -> '*p-h-o-t-o-g-r-a-f*'. He took three attempts to correctly spell 'elephant'. The faster oral spelling but persisting mild difficulties suggested the motoric aspects of spelling and the searching for letters on a keyboard contributed a great deal to speed of response. Finally, Oliver completed all 24 items of the PALPA (45) assessment of non-word spelling. This was only carried out orally to spare Oliver the burden of further typing and to investigate spelling without the additional complication of impaired motor control. This assessment was not timed. Oliver completed all items

quickly and made no errors¹⁴. Detailed results for these further diagnostic assessments are available in Appendix M.

Assessment of speed of processing was carried out using the digit substitution test from the Wechsler Intelligence Scale (Wechsler, 1981). Oliver's scaled score was in the ninth percentile, which was one and a third standard deviations less than the mean. However, performance on this assessment may have been affected by the need to use his non-dominant hand for writing.

Oliver's difficulties with writing were complex, with a combination of factors to consider. He could spell aloud much faster than he could write or type. However, oral spelling was still impaired. He made regularisation errors when spelling irregular words but had preserved ability to spell non-words orally. Oliver also had problems with recognition and selection of letters from a computer keyboard. His visual field had been tested and was intact. Due to hemiplegia, Oliver was writing and typing with his non-dominant hand and experienced cramping and discomfort in that limb. Finally, Oliver was also easily fatigued and found it difficult to attend to tasks for long periods.

Viewed in isolation, Oliver's difficulties with spelling had features in common with surface or orthographic dysgraphia (Beauvois & Dérouesné, 1981). However, all the above factors needed to be taken into consideration. His difficulties with scanning and selecting letters from a keyboard during assessments may have been related to the complexity of the task. Oliver had first to retrieve the word and its letters from his lexicon, scan the keyboard to select those letters, and then use his arm and finger to type each one in the right order. The task represents a heavy burden of language, memory, and motor processing; therefore, the combination of elements may have been sufficient to impair Oliver's speed of response considerably.

¹⁴ Scoring was adapted to consider feasible spellings of the researcher's accent.

8.1.2 Activity and Participation

Oliver commented that he still sometimes found it difficult to find the right words in conversation and for writing. He described the impact of his difficulties perceiving letters on a keyboard, saying, "*there are times when I just cannot pick out a letter*" and "*when I'm reading I don't have any trouble but as soon as the transition from that to actually putting down on paper - writing it down is difficult*". He also reported that numerical tasks that were effortless for him before his stroke were now difficult. For example, he would find it hard to figure out the difference between two dates. He also noted that although he had no difficulties with reading, he was finding that subtitles on the television (used for hearing loss prior to his stroke) were disappearing before he had time to process them.

Internet use: Oliver's perspective

During the Internet questionnaire, Oliver described his Internet skills as "*... adequate for me. I could write emails I could send letters I could communicate effortlessly*". He reported that before his stroke, his most frequent Internet activities were emailing, looking at the sports and the news, and browsing. He also regularly made video calls, downloaded music and video, bought things online or compared prices before buying. After his stroke, the frequency of some of these activities had changed. He reported now rarely emailing rather than weekly, no longer looking at local events, and accessing the news only rarely instead of daily. He previously downloaded music every week but now did this rarely. He continued to look at sports every day, to regularly FaceTime his daughter (more often now than before), to use the BBC iPlayer, and to browse the Internet. Oliver owned a smartphone but was not using it to access the Internet at the time of the questionnaire. He did not mention whether he used his phone for calls and texts. He reported that he felt lacking in confidence and selected that his Internet skills had decreased from three to two on a five-point scale. He said that he struggled to remember passwords for various websites. He also reported that before his stroke he would spend long periods sitting at his laptop. Now, due to fatigue and difficulties with

sitting for any length of time, he could only use the computer sitting at a desk or table for much shorter periods.

Internet skills

Oliver carried out the Internet assessment on his MacBook (his main computer), which was running OS X Yosemite 10.7.5. He completed all of the assessment, experiencing the greatest difficulty with the strategic/informational task. He needed verbal suggestions on how to start all the tasks, after stating that he did not know how to begin. He could use the trackpad, find and click on links, navigate using the back button, enter an URL by copying it into a search bar letter for letter, and scroll up and down pages. He reported feeling uncertain about his choices throughout and asked for reassurance for each element. Linguistic aspects included the need to enter place names and dates to search for train tickets. Oliver did not need assistance but was observed to spell aloud the items he needed to enter in search boxes. He also initially entered a place name in the 'from' rather than the 'to' box and corrected his own error. He made a mistake typing one of the place names which he self-corrected by deleting and re-typing. Oliver's scores and times taken for each task on the Internet assessment can be seen in Table 8-3.

Supporter perspective

Oliver's wife Pauline reported that before his stroke he '*wasn't much interested*' in computers or the Internet. She commented that he used his Apple laptop as a writing and learning tool but that he was "*not really a computer person*" and never had been. He would prefer to read an actual paper than look at one online. In contrast, she described herself as a regular Facebook user. She reported Oliver would previously take a long time over activities like email, and would often swear at the computer in the process. However, he would look up information online and particularly liked a question and answer website. He had also used an app to help him to learn German. She felt that Oliver was now frustrated and that he was convinced he was losing abilities. She

remarked that she did not feel this was the case and that he was now aiming to do things he had not been interested in before his stroke.

Task	N	Score	Time taken
Switch on/operational	8	8	--
Weather/operational	20	17	04:33
NETA/formal	28	26	03:48
Train information/formal/strategic	36	23	11:57
TOTAL	92	74	20:18

Table 8-3: Internet assessment scores: Oliver

Pauline had engaged with the Internet for the first time a few years ago after buying an iPad. She reported this had been a very positive experience for her. She said much of her husband’s activity on his iPad had been led by her, giving examples of looking up information on the Internet movie database and reading e-books. She did not help Oliver with his laptop as she felt she only had the skills to use an iPad. She also expressed that Oliver preferred to do things himself rather than with her help. She reported that Oliver’s primary use of the iPad was to read newspapers. When asked what she thought her husband would like support with on the Internet, she replied the ability to react to problems like error messages, or to be able to get back to what he was doing if the grandchildren had been playing on the iPad before him. Pauline expressed that Oliver did not like her watching him on the computer. She expressed her opinion that Oliver’s right hemiplegia was the largest barrier to him returning to use his phone and his computer and that becoming more dextrous with his left (non-dominant) hand would help.

SLT perspective

Oliver's SLT (SLT5) was interviewed six weeks following her last session with him and she referred to his notes at several points. She recalled that he initially presented with a high-level expressive aphasia. He had word finding difficulties for mainly low-frequency words but was also dysgraphic for writing and typing. SLT5 had recorded that Oliver reported letters on a keyboard 'danced in front of him' and she had instigated the referral to ophthalmology. Oliver had conveyed to her that he perceived his speech as adequate and was accepting of his mild word finding difficulties. He was more distressed by his difficulties with writing and typing. The SLT and a rehab assistant had worked with Oliver over four sessions towards a goal of being able to write a short email. They had supported him to use a combination of typing with his non-dominant hand, and the inbuilt speech recognition and word prediction features on his iPad, and speech recognition. He had achieved a very brief email towards the end of their involvement but the process had been painstakingly slow and he had needed verbal prompting to facilitate his use of the technology. SLT5 remembered that Oliver had often reported during their time together that he found the SLT sessions very mentally taxing (her term). He had ongoing difficulties with fatigue, and she had advised him to take breaks when tired and switch to using speech to text instead of typing. She had also suggested that he could use a blank card to cover the letters on a keyboard so he could focus on a row at a time.

8.1.3 Environmental Factors

Oliver started to complete the Social Network Analysis with the researcher but struggled to remember some names. This may have been some residual expressive language difficulties or an impaired aspect of memory. He asked if he could complete the diagram with help from his wife in their own time. Pauline returned the diagram at the next session. It contained 14 names in the inner circle, mostly their children and grandchildren, with one friend. The middle circle contained eight names, six friends and two family members, and the outer circle contained the names of six neighbours and

one person whose relationship with Oliver was not specified. Pauline did not document how often Oliver saw the people in their network but frequently reported during sessions that he would be receiving a visitor later that day, or that they would be seeing friends or neighbours. The couple’s young grandchildren were also frequent visitors. A summary of Oliver’s responses can be seen in Table 8-4.

Section of diagram	No. of people
Inner circle	20
Middle circle	8
Outer circle	7
TOTAL	35
Category	No. of people
Spouse	1
Family	17
Friend	8
Other/not specified	9
TOTAL	35

Table 8-4: Social Network Analysis: Oliver

One environmental factor for consideration was the amount of support Oliver received with using computers and the Internet. Oliver reported he still mostly used the Internet independently. However, he noted that “*occasionally I get myself not flustered but that I don't know where to turn with the Internet now and Pauline helps me*”. He felt that his wife had excellent Internet skills and enough time to help him. His son was also a ‘*whizz with computers*’ and provided some help, but Oliver reported there were times when he wanted a solution to something, and there was no one there to provide help at that time.

Oliver's wife said that they got on well together and had always done so. However, she did not like to help with computer problems. When she did, Oliver complained that she was 'hovering over him' or that she was showing off her skills. SLT5 confirmed that Pauline was 'hands off' during therapy, mostly catching up on what they had been doing at the end of the session.

Oliver reported he struggled to sit at length on a kitchen chair to use his laptop and was most comfortable in his recliner chair. He could use his laptop and his iPad from a reclined sitting position but preferred his newly purchased iPad. Oliver's laptop had luminous stickers placed over the delete and enter keys. He reported these stickers had been put on his laptop by therapists not long after his stroke to help him find the important keys.

8.1.4 Personal Factors

Oliver commented during the Internet questionnaire that since his illness he had not been using his phone or his computer to stay in touch with people and that he would like to change this. He said, "*It's not that I've been distant from them, but I've just been letting Pauline do that.*" He was often emotionally labile during sessions, and one of the main triggers for becoming upset was discussing a friend who had recently died. This man had been his main email correspondent, and they had exchanged long messages he described as '*banter*'. Oliver remarked several times how much he missed this relationship. It was not only the ability to send emails that he missed but also the correspondence with a friend he had recently lost. Oliver would also often mention his pre-stroke ability, stating that he used to be good at spelling, articulate and adept at mental maths. He was upset and frustrated by this loss of ability, and was always determined to do well in assessments. He preferred to take as long as he needed to be reassured that he was correct in his responses, and sought reassurance regarding his performance.

Oliver expressed a significant sense of loss of abilities, and feelings of grief about the loss of a close friendship. His stroke had resulted in physical disability, increasing dependence, and the difficulties with writing. These consequences likely impacted considerably on his quality of life (Hilari, Needle, & Harrison, 2012).

Goal-setting

During the goal-setting discussion, Oliver rated his most important priorities as emailing, instant messaging, and writing on a screen. He rated instant messaging (to him this represented iMessage or WhatsApp) as equally important as emailing but reported he felt that emails were more 'him'. Figure 8-1 illustrates Oliver's organisation of pictures at the top end of the scale. During the discussion, he also reported feeling out of touch with others since his stroke, commenting that he felt he should get back to being in contact with people himself, rather than via his wife. He also said that his wife often responded to messages before he got the chance.

Oliver's favoured means of communication was email. However, he was aware that many of his friends and family used WhatsApp for shorter messages. Oliver recognised that messages on WhatsApp were '*short and sharp*' and in that way, they differed from email. He acknowledged that online messages were the preferred means of contact by one daughter and some other family members and he wanted to use the same system. Oliver reflected and reported that he would be happy with a focus on writing shorter messages with WhatsApp. However, he was not clear on the details around this goal, only stating that he felt he needed to work on communicating and interacting more with others.



Figure 8-1: Oliver's priorities from the goal-setting session.

During a subsequent meeting, the researcher spoke with him again about his goals for intervention. He reported he had been attempting to write emails to friends and again said he was keen to work on his writing and spelling but that he would be happy to work on *'whatever approach you feel is best'*. Whilst Oliver was struggling to generate specific goals, it was clear that his priorities were around writing. He had identified a need to be more active in his correspondence with friends and family. As he had commented several times that it now took him much longer to write, the researcher suggested that a possible goal would be to aim to reduce the time it took him to produce messages. In addition, as he had expressed a wish to send more messages rather than rely on his wife to do so, another suggested goal was to increase the number of messages he sent to others. Oliver agreed that this would be appropriate.

8.1.5 Further data collection: Online writing

Core assessments did not provide sufficient information on Oliver's ability to write the type of language used for online written communication. Therefore, he also completed part of the email assessment developed for use with Rose (see Chapter seven). Fatigue and reduced speed of processing meant that to complete the three narratives from the original design would be a large burden of assessment; therefore, he was only asked to produce a recount email. The recount was chosen as this was closest to the types of messages he wished to send. Oliver was asked to compose a message (within the Notepad app on his iPad) telling a friend about a recent holiday. Extensive notes were made during the assessment, to capture the process of error identification, deletions, and corrections. The text he produced and the researcher notes can be seen in Appendix P.

Although Oliver could produce a short, appropriate and grammatically correct email, the process took nearly 27 minutes, producing just over one word per minute. In writing the email, he made numerous errors requiring correction, had difficulties with using punctuation, and problems with word processing functions on the iPad, for example, with spacing and returns. He reported he found the assessment mentally taxing and frustrating.

Oliver and Pauline were given a paper form to keep a record for one week of how many messages Oliver received from others (sent directly to him) and how many he sent in return. As Oliver found this physically difficult to complete, Pauline recorded the means of sending the message (email, Facebook Messenger, iMessage, etc.) and the name of the correspondent. Over the course of a week, Oliver had received eight SMS messages to his phone from the same friend, and had sent her seven replies.

8.1.6 Emotional wellbeing

Oliver's responses on the CDP revealed few negative emotions in relation to his stroke and communication problems. His score was 11/56, and the most negative ratings were

lack of ability (rated three), unhappiness (rated two), lack of control (rated two), and lack of confidence (rated two). The scores for this assessment can be seen in Table 8-5.

Emotions	Score
Total score (/56)	11
Angry	0
Frustration	0
Determined	0
Unhappy	2
Worried	0
Content	0
Under confident	2
Lack of control	2
Able	3
Lonely	0
Embarrassed	0
Valued	0
Feelings about the future	1
Feelings about today	1

Table 8-5: CDP Emotional Scale: Oliver

8.2 Intervention

Possible interventions were considered using the decision-making framework outlined in Chapter four. The goal-setting discussion was then revisited with Oliver by summarising his priorities, suggesting appropriate goals, and outlining recommended interventions. A

plan and timeframe for the intervention was then agreed. The agreed intervention involved the use of voice recognition technology and typing shortcuts for sending messages to friends and family. Oliver was encouraged to use all types of messaging available to him on his iPad to increase his opportunities for interaction with others (email, WhatsApp, iMessage, SMS, etc.) and to adopt a strategy of using frequent short online messages instead of longer emails. The intervention provided repeated support to learn and practise use of voice recognition technology and typing shortcuts. Oliver was also introduced to a range of accessibility features on his iPad and, through a process of experimentation, chose settings best suited to his needs. The justification for each aspect of the agreed intervention is discussed in section 8.2.1 below with a detailed description of the intervention in section 8.2.2.

8.2.1 Justification

The demands of writing for Oliver drew on several aspects of cognition and motor control and were also fatiguing (see section 8.1.1). However, he had largely intact expressive speech and language skills. Therefore, speech recognition was an appropriate technology to compensate for his much more impaired writing and to generate text faster than he could by hand. It would allow him to use his high-level expressive language to produce written language and was available without the need to buy any additional software on his iPad and mobile phone.

To trial speech recognition and determine how well an iPad could recognise Oliver's speech, he was asked to read aloud the well-known 'Rainbow Passage' (Fairbanks, 1940) while the researcher operated the dictation button on an iPad. Oliver could read the passage aloud without error, although he paused and repeated some sections. The original text of the Rainbow Passage and the results from dictation are presented in Table 8-6. Although there were differences between the dictated and original text, the iPad inbuilt recognition showed very good recognition of Oliver's speech. Oliver was not asked to dictate punctuation during the trial, which can explain one of the main differences between the original and dictated text. The original passage contained 98

words, and the dictated passage contained 97, of which 75 were correctly dictated. These figures gave a dictation accuracy rate of 77%.

It was important to recognise that Oliver had already been introduced to speech to text dictation via his iPad by his SLT and an SLT assistant (see section 8.1.2 on SLT perspective). Oliver could not remember this intervention and had not adopted the use of speech recognition in any functional way. A more intensive and focused approach involving guided practise might be of more benefit. On checking with the SLT, it was confirmed that they had used the inbuilt iPad microphone and had experienced some difficulties with recognition accuracy. A more sensitive microphone might, therefore, be more effective. For this intervention, Oliver would also be provided with written material to remind him of what was covered in each session and homework to reinforced the learning of new skills.

Original passage	Dictated text (differences are underlined)
<p>When the sunlight strikes raindrops in the air, they act as a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond his reach, his friends say he is looking for the pot of gold at the end of the rainbow.</p>	<p>When the sunlight strikes raindrops <u>on there that like a prison</u> and form a rainbow rainbow is a division of white light into many beautiful colours these take the shape of <u>a large Ronak</u> with its path high above and <u>it ends</u> apparently beyond horizon <u>there are</u> according to legend <u>that is according to legend</u> a boiling <u>point</u> of gold at one end people look <u>palooka</u> but no one ever finds it <u>reminds</u> looks for something beyond his reach his friends say that he is looking for the pot of gold at the end of the rainbow</p>

Table 8-6: Rainbow passage original text and as dictated

The use of text shortcuts or abbreviation expansions could be of benefit for storing regularly used phrases underneath shorter combinations of letters, for example, hf = 'great to hear from you'. Use of expansion of text from abbreviations would reduce the burden of typing for Oliver, and might allow him to produce regularly used phrases with less effort. However, there would be an added cognitive burden to recall the abbreviations and expanded phrases. This would be countered by providing Oliver with a written guide to abbreviations to keep in a place he could easily access.

Oliver had been attempting to return to emailing and expressed a desire to correspond with friends and family independently. He was distressed by his impaired writing and wanted to be more independent with Internet skills. He did not want to receive help with technology from his wife and she also preferred him to work independently. Related to this wish, he had expressed a need to regain some control over his independent online communication with others. Enabling independent access to writing for messaging purposes might, therefore, increase this type of interaction. Oliver was willing to work on his difficulties and to receive regular therapy sessions. However, he experienced fatigue, and found therapeutic activities physically and mentally draining. His previously preferred means of online contact had been email. Unfortunately, he had lost his main email correspondent. The majority of his friends and family preferred shorter messages and communicated via a range of different services (iMessage, WhatsApp, Facebook Messenger, and SMS). The ability to send shorter messages via different services would enable Oliver to be in touch with different people using their preferred means of communication. Shorter messages sent via dictation or using text shortcuts would also require less effort than a longer message via email. Oliver's iPad was his preferred device as he could use it while sitting comfortably in his chair. It had sophisticated voice recognition and the ability to send online messages via iMessage, Facebook Messenger, SMS, and WhatsApp (the latter two via a connection to his phone). His iPad also provided a range of options for changes to the user environment which might

facilitate his ability to select letters on a keyboard. For example, settings can be adjusted to meet user preferences for aspects such as keyboard size, length of keypress, brightness, and zooming.

8.2.2 Intervention design

An outline of the planned intervention suggested that ten sessions would be needed to cover all aspects. Sessions were kept to 30-40 minutes to avoid fatigue and took place over five weeks (two per week). Oliver was given explanatory handouts for each area covered, so he could recap at his leisure, and refer to information when needed. Table 8-7 provides an outline of the intervention over the five weeks.

	Weeks	1→	2→	3-4 →	5→	
Time A	Sessions	1-2	3-4	5-6	9-10	Time B
Assessment		Review of accessibility settings Voice recognition training WhatsApp setup	Accessibility review Voice recognition training Text abbreviations Daily diary Editing dictated text	Dictation practise Correcting errors iPhone accessibility settings Messaging troubleshooting	Dictation practise Troubleshooting	Reassessment

Table 8-7: Timeline for Oliver’s intervention

Accessibility settings

The initial session introduced Oliver to accessibility settings on his iPad. Each setting was demonstrated; then Oliver was asked to decide whether he felt it would aid him with using the on-screen keyboard or with use of his iPad. Table 8-8 outlines the settings tried and Oliver’s decision.

Accessibility setting	<i>Oliver's Decision</i>
Text size	<i>Chose slightly larger than default</i>
Bold text – puts all text on device in bold (including keyboard)	<i>Retained setting</i>
Reduce transparency (makes objects on screen more opaque)	<i>Found the effect too subtle to discern any difference. Rejected setting.</i>
Button shapes (places a clear shape around any menu item which can be selected)	<i>Retained setting</i>
Reduce white point (reduces intensity of bright colours)	<i>Rejected setting</i>
Darken colours	<i>Rejected setting</i>
Assistive touch (easy to find and adjust settings like volume, rotate screen, lock screen, screen shot, Siri)	<i>Retained setting using top-level commands for easy access to: screenshot, volume up/down, Siri, home screen.</i>
Key repeat (sets how quickly a key repeats)	<i>Rejected setting</i>
Slow keys (allows user to specify duration of press before iPad accepts keypress)	<i>Rejected setting</i>
Zoom (enlarges part of screen)	<i>Rejected setting</i>
Text replacement ('hides' longer phrase under shortcut keys, e.g., ax = full address)	<i>Retained setting and entered a shortcut for his address</i>

Table 8-8: Accessibility settings and Oliver's decision

Oliver was provided with a handout detailing these functions for future reference and whether he had decided to keep or retain them.

WhatsApp

WhatsApp was not available as a stand-alone app on the iPad but could be viewed within a web browser via a QR code scanned by a mobile phone. Oliver and Pauline expressed interest in learning how to achieve this and were given a demonstration along with written instructions. The web page was saved as an icon on the iPad home screen so that only one tap was needed to access the page. WhatsApp on his iPad allowed Oliver to send messages using a larger screen and keyboard than that available on his phone. Although Oliver found the process of transferring WhatsApp to his iPad quite demanding, once set up, it was available for his independent use. Pauline could also carry out this process independently, and they agreed that she would support her husband with this aspect if needed.

Text abbreviation

Oliver had initially opted to learn to use text abbreviation to reduce need for typing and had liked the feature when reviewing accessibility settings. He was given a handout specifically on this feature and worked with the researcher to save 14 abbreviations to his device. The saved phrases were stored under implausible letter/number combinations to prevent inadvertent use while typing another word. Despite being initially keen to use text abbreviations, Oliver later reported he preferred voice recognition and found it more convenient to use just one strategy.

Voice recognition

Introduction to voice recognition on iPad began by providing Oliver with an external microphone¹⁵ which clipped to his shirt collar, placing the recording device nearer to his mouth. Autocorrect was turned off to prevent any automatic changes to text and to allow Oliver to monitor his dictation accuracy. He was provided with a handout containing step by step instructions and images to explain that voice recognition could be used anywhere you could use a keyboard, by pressing the microphone button to the left of the space bar on the on-screen keyboard. Oliver was advised to look for the line moving in an audio wave to show the iPad was hearing his speech and to tap 'done' when he was finished. Oliver wanted to send messages using a variety of different applications. To ensure consistency when practising dictation, all intervention targeting writing was carried out using the iPad Notes app and then transferred to messaging applications Mail, Messenger, and iMessage (the feature was not available for WhatsApp). Oliver was shown the location of the notes app, how to start a new piece of writing, and how to share that writing with other applications. Contact lists were synchronised between his phone and his iPad so that both could be used for messaging. Each of the main functions of the Notes app were then demonstrated. Oliver was asked to copy each step, then to demonstrate that he could use the app independently.

Initial practise of voice recognition involved counting 1-100, saying the days of the week, the months of the year, the lyrics of 'Happy Birthday', and the names of Oliver and Pauline's children. Oliver managed to dictate all these accurately and without effort so he suggested he should try a poem he had learned by heart as a child. Again, he could dictate accurately by saying the poem line-by-line with breaks between dictations.

¹⁵ The microphone purchased was a GHB Clip-on Microphone Mini Lapel Mic Hands Free 3.5mm for Smartphone.

Practising dictation moved to self-generated narratives, e.g., 'my first car', and 'my first job' or in response to questions such as 'what did you do this morning?'. Oliver was given verbal and written guidance on how to dictate simple punctuation (e.g., comma, full stop, question mark) and practised these during sessions, for example, by placing a comma after each number in a sequence or ensuring each sentence had a full stop. More advanced dictation commands were provided in a handout for Oliver to digest in his own time. These were predominantly aspects of punctuation but also included special characters such as € and @ and how to dictate smiley face emojis.

As Oliver practised using dictation, he was consistently able to monitor when the iPad had not produced his desired text, but he was less able to correct his errors. To improve his ability to edit his mistakes, he was given specific correction exercises, and shown how to move the cursor to points where errors or extraneous text occurred. Oliver was then able to repeatedly practise deleting and correcting using either a clearer voice or by typing. This exercise is provided as an example of therapy materials in Appendix N.

Oliver continued the work started in intervention sessions in his own time. He was asked to dictate a daily diary and send it to the researcher via email. Oliver completed this task between each intervention session, at times describing two to three days in one email. He would also send messages based on informal discussions he had had with the researcher. An excerpt of one of these messages can be seen in Figure 8-2, where Oliver emailed the researcher about a cycling accident they had both witnessed during the televised Olympic coverage. He reported he enjoyed the homework and that he and his wife were 'having fun' with dictation. It was suggested that his daily diary would be useful in keeping others up-to-date with his rehabilitation progress and that he should consider emailing or messaging it to friends and family. He began this by dictating an email to his daughter explaining the intervention, and asking her to reply to his emails.

Thank you for your message Fiona.

The latest on Annemiek van Vlieuten , as reported by the Dutch cycling Federation , is that she is "okay". She only has three cracks in her spine and concussion.

Professional cyclists are made of stern stuff.

They are seldom confused with professional footballers.

When I was cycling I could hold my own going up hill..... the descents I left to those with no imagination.

I wish Miss van Vlieuten a speedy recovery .

Figure 8-2: Excerpt from Oliver's 'daily diary' email practise

Troubleshooting

The final two sessions were devoted to reviewing all handouts and to troubleshooting. Just before the final two sessions, Oliver had acquired an iPhone and began to also use its inbuilt dictation capability for messaging. He reported he had no difficulties with physical access and could switch the dictate button on and off using his left thumb. He also began to bypass use of the Notes app and to dictate text directly into messaging apps. Oliver had several questions around specific aspects of messaging apps. He wanted to know the difference between audio and dictated messages, how to tell the difference between an SMS message and one sent via the Internet, and how to send a message via Facebook without knowing a person's mobile phone number. These were addressed by talking through a handout providing information related to his questions. Oliver reported he found the written information helpful, as he had difficulties retaining what was said to him. His wife confirmed that he kept all the handouts in a folder and revisited it in the evenings. Pauline also consulted this information and reported she had learned a lot and tried out anything that was new to her.

Oliver reported he had experienced large passages of text appearing when he was trying to dictate. It appeared he was inadvertently using the copy and paste function

through pressing the screen for slightly too long. This was an infrequent occurrence and was managed by teaching him to use the dedicated ‘undo’ button on the iPad on-screen keyboard.

During the final session, Oliver stated that he felt able to continue using speech recognition alone and that the therapy had ‘*taught me all I needed to know*’.

8.3 Measures of Effectiveness

The measures chosen to determine the effectiveness of the intervention and those selected as controls are outlined in Table 8-9. Rationale for each of these measures is described in the results section.

Measure	Predicted outcome
Email narrative assessment	Increased length of emails, reduced speed of writing
Record of online messaging	Increased frequency of online messages sent and received. Wider range of correspondents
Handwritten CAT picture description	No change
PALPA spelling subtests	No change
Internet skills assessment	No change
Internet questionnaire	No change

Table 8-9: Measures of effectiveness for Oliver’s intervention. Control measures are shaded.

8.4 Results and Discussion

All measures following the intervention (time B) are presented below alongside discussion of the predicted outcome and actual results. To establish whether there was maintenance of any change to use of online messaging, Oliver and Pauline also completed the record of messaging three months following all other reassessment.

Oliver was also sent an email at the three-month follow-up to ask for an update on his writing skills. He replied to the email one month later.

8.4.1 Measures of writing

The intervention aimed to enable Oliver to improve his speed of writing and to enable him to increase his interaction with others via Internet or text messages. It was predicted that a repeat of the email narrative assessment would show that Oliver was now able to write more text in less time. In addition, the record of messaging would show that Oliver's interactions via text-based communication had increased. It was hoped any changes to his messaging behaviour would be maintained in the longer term and seen three months later in another record of messages sent and received.

Oliver's recount emails from times A and B can be seen in Appendix P, alongside real-time notes made by the researcher on his errors and corrections. To ensure the content was different to the first assessment but very similar in remit and style (see Chapter seven section on additional diagnostic assessments), Oliver was given slightly different instruction for the time B email. He was asked to write to a friend about a day trip he had taken and was informed he could produce the piece of writing using any means available to him.

Length and speed of emails

Oliver used dictation on his iPad to produce a detailed and grammatically complex email containing 192 words in just under 27 minutes. This was a rate of seven words per minute, which was seven times faster than his original email. The email also contained 161 more words than his original email of 31 words. Oliver had achieved his goal of writing faster. He was also able to produce longer pieces of text. However, the process of producing an email was not without effort. Notes made during the reassessment show that there were several dictation errors that Oliver corrected. The iPad also failed to recognise some of the names he wished to use, so these had to be entered by typing. He twice forgot to press the dictate button and had to begin his sentence again. Oliver

used the dictation commands 'full-stop' and 'comma' effectively. He did not commonly use dictation to correct mistakes, preferring to do this by typing. When sending the resulting email, he used inbuilt word prediction within his email programme to find the researcher's email address. He also used iPad word prediction when typing the words 'holiday' and the name of the city he had visited in the subject line.

Type and frequency of online messaging

Oliver and Pauline kept records of his online communication over the course of one week at times A and B and sent a further record by post three months later. These are summarised in Table 8-10. At time B, there were some incomplete entries where the means of communication was recorded but not whether it was sent or received or the person involved. These entries were disregarded. At time A, Oliver was only using SMS messaging, and all messages were from or to one person. At times B and at follow-up he was sending and receiving messages via a range of different services to seven different friends or family members. The number of messages received from others and sent by Oliver increased following the intervention and were maintained three months later. The pattern of messages differed from time B to the record at the three-month follow-up. At time B, Oliver and Pauline had recorded messages from and to the same people on the same day using several different messaging services. At this time, Oliver and Pauline had reported 'having fun' with dictation, and involving their friends in Oliver's practise. It is likely that at time B, Oliver was experimenting with what he had learned and asking his friends and family to support him in his rehabilitation by sending messages using different services. By time B2, there was more consistency of messaging service used with different people, suggesting the experimentation had ended and messaging had become part of daily routine.

	A		B		three-month follow-up	
	Received	Sent	Received	Sent	Received	Sent
Email	0	0	7	3	0	0
Facebook Messenger	0	0	2	2	2	1
SMS	8	7	5	4	2	1
WhatsApp	0	0	4	2	15	11
iMessage	0	0	1	1	2	0
Facetime	0	0	2	0	1	1
TOTAL	8	7	21	12	22	15

Table 8-10: Record of use of messaging at times A, B, and at three month follow-up

8.4.2 Control measures

The intervention was not designed to improve Oliver’s impaired spelling, motor difficulties, or speed of processing. It was therefore predicted that his handwritten language would not improve, nor would his scores on formal assessments of writing. Oliver’s handwritten CAT picture description attempts from time A and time B can be seen in Appendix P. His attempt at time B was again written in block capitals and contained inconsistent use of full-stop punctuation. On both occasions he made several self-corrections, scoring out words within sentences or overwriting letters. He reported no arm cramping at time B. Table 8-11 compares measures of Oliver’s handwritten picture description at the two assessments.

	Time A	Time B
No. of words	37	78
Time taken (mins:secs)	14:43	34:26
WPM	2.5	2.3

	Time A	Time B
CAT score	20	40
No. of complete sentences	5	9
No. of errors	3	2

Table 8-11: Comparison of measures for the CAT handwritten picture description at times A and B

The results suggest that although Oliver could produce considerably more written language at time B, he needed more time to do so and the number of words he could produce per minute was unchanged. His attempt at time A contained spelling errors in the words ‘sleeping’, ‘hifi’ and ‘attention’ and at time B he again misspelled ‘attention’ and omitted the last two letters from the word ‘there’. Due to there being no restriction in the time allowed for Oliver to complete the picture description at either time, it was not appropriate to compare T-scores. However, the change in the number of words produced and the number of complete sentences may reflect the fact that he had spent much time during the intervention focusing on the content of pieces of written language. It is difficult to ascertain whether the cramping and arm pain he experienced at time A had a significant impact on his performance during the initial assessment. At time B, when he did not report any pain or discomfort, he may have felt more able to continue writing and produce a longer piece of writing.

Oliver’s score on the writing to dictation subtest of the CAT also changed from a T-score of 58 to 62. However, this subtest contains only five items scored letter by letter. The change reflected ability to complete two items (totalling 11 letters) at time B which he had not managed at time A. This was not a significant change per the CAT manual.

Oliver’s PALPA spelling assessment subtest results are summarised in Table 8-12. The assessment at time B was carried out using his MacBook to replicate the conditions of time A. His scores at time A were at or near ceiling but the process was painstaking;

Oliver had needed to spell aloud each item letter by letter prior to typing each word. His scores were unchanged at time B, but he completed both assessments faster. He also did not use any letter-by-letter verbal rehearsal as he had done at time A.

There is evidence in the above results to show that Oliver’s written language and spelling ability without the use of dictation had improved during the intervention period. He was able to write more and his ability to spell to dictation was more efficient. This may also have been due to a period of intensive focus on literacy while he was learning to use speech recognition and practicing by sending messages. Given he was still in the relatively early months post-stroke, it would be unwise to rule out the possibility that change may have been because of spontaneous recovery. Oliver’s speed of handwriting did not change and was considerably slower than published norms (Burger & McCluskey, 2011). This reduced handwriting speed was most likely due to an ongoing need to use his non-dominant hand and no positive change to his motor skills.

PALPA subtest	Letter length spelling		Imageability and frequency spelling	
	A	B	A	B
Score	24/24	24/24	19/20	19/20
Time taken	00:14:48	00:11:03	00:22:21	00:14:06

Table 8-12: Results from PALPA spelling assessments.

8.4.3 Other measures

Oliver’s broader ability to use the Internet was not targeted during the intervention so it was anticipated that his skills on the Internet assessment would not change. No other aspects of Internet use were targeted beyond messaging so no change was expected on most items of the Internet questionnaire. As a result of the intervention, Oliver was expected to indicate an increase in frequency of emailing and online messaging.

Internet skills

Unfortunately, the repeat Internet assessment was not video recorded due to an equipment failure. However, the assessment was scored within the session and it was possible to obtain timings from an audio recording. Oliver's performance on the assessment at time B was very similar to time A. He again needed verbal prompts to help him complete each of the tasks, and both assessments took twenty minutes.

Internet use

Responses from the Internet questionnaire on self-rated Internet skills and frequency of carrying out online activities online are depicted in Figure 8-3. Oliver's responses show an increase in frequency of emailing, instant messaging, and Facebook to greater than pre-stroke levels. He also indicated increased use of online news, sports, jokes and funny content, and watching TV/films. The results here confirm the findings from the record of messages sent and received; Oliver was communicating more with others via online messaging. Other changes may have been due to his use of the iPad. He frequently had the device on his lap to practise dictation and sent messages, so it was readily available for other types of use.

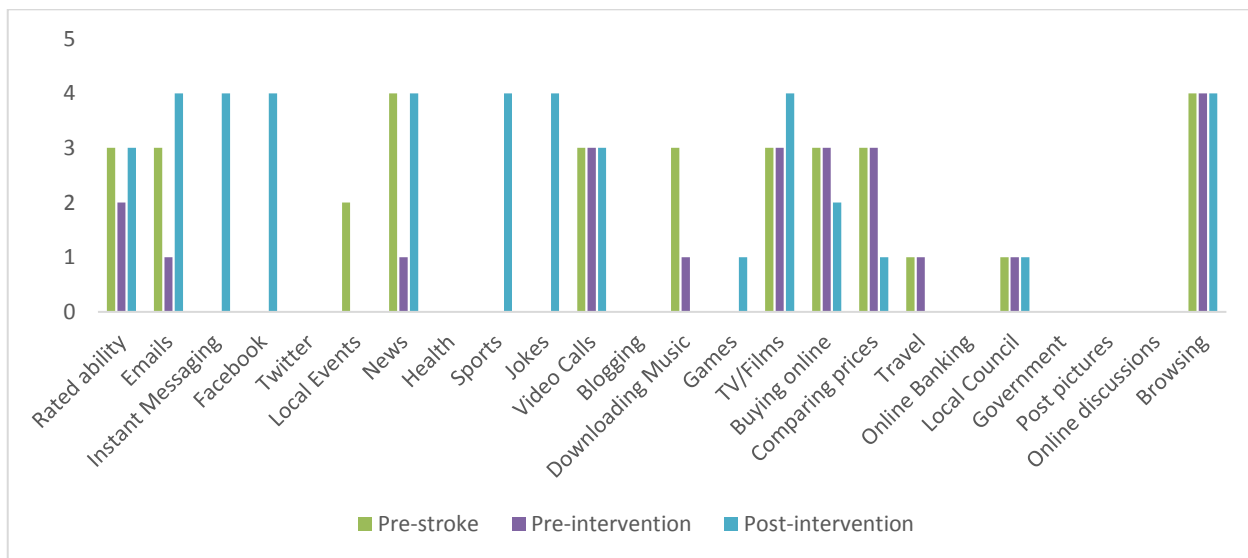


Figure 8-3: Self-rated ability and frequency of Internet activities pre- stroke, pre-intervention, and post-intervention

Social networks

The measure of social networks was not expected to change as Oliver already had a large network of supportive friends and family. The intervention was designed to increase his independence in communicating with existing friends and family rather than to expand his social network. Oliver completed the social network diagram at time B with his wife but it was handed back partially incomplete without definition of his relationship to each of the people on the diagram. There was no increase in the number of people in his network. This was as expected.

8.4.4 Timing and intensity

Oliver had been introduced to voice recognition on his iPad during his previous involvement with SLT5 and an SLT assistant. It is important to consider why this intervention demonstrated evidence of behavioural change while earlier intervention did not. The first possibility is that during the early stages of intervention Oliver was experiencing considerable psychological adjustment to his stroke. He had very recently returned home following a stay in an inpatient rehabilitation ward and had many professionals visiting him. He admitted he found it difficult to remember what the therapist had suggested. When the previous intervention was discussed informally, his wife confirmed that he was not retaining information at that point of his recovery, stating, '*you were all muddled then*'. This may have influenced his ability to retain new information. Further, the intervention provided as part of this research involved a more systematic and personalised introduction to voice recognition, with guided and frequent practise, written information, and ability to adjust aspects of the intervention based on Oliver's response to individual aspects. This combination of timing and means of delivery may have contributed to a more positive outcome.

8.4.5 Maintenance

The record of messages sent and received showed that Oliver had maintained the frequency of online messaging with friends and family. He sent an email to the researcher one month later with an update on his progress. In this, he stated that he was no longer using speech to text dictation as he now preferred normal typing plus word prediction on his iPad. He reported that the 'dancing' of letters had ceased but that he was still hesitant and slow, particularly when feeling under pressure. This update may reflect that Oliver was still slowly recovering from his stroke. As a result, one aspect of the intervention was no longer necessary for him to send messages. However, he had retained the strategy of messaging rather than emailing, was using the iPad as his primary device, and continued to make use of the accessibility features it provided.

8.5 Summary

This chapter described assessment, intervention, and outcome measurement with Oliver, whose problems with writing post-stroke were causing distress and difficulties with producing online written language. Oliver took part in an intervention using voice recognition and strategic use of an iPad to send shorter online messages via a range of different message providers. This was successful in supporting him to access writing for communicative purposes and to increase his independent contact with family and friends. The outcome was positive in that twelve months following his stroke he could correspond independently using a range of Internet and phone messaging services.

Assessment across ICF components revealed that Oliver's difficulties with writing and typing stemmed from a complex combination of physical and cognitive impairment with a background of environmental and personal changes. His Internet use, and his ability to write online had changed due to his stroke. However, there were also several external factors to consider, such as fatigue, the death of his main email correspondent, and the messaging services preferred by his family and friends. For Oliver, it was necessary to

consider an intervention for his writing that would compensate for language and motoric difficulties and use a means of sending messages acceptable to all involved.

Findings from Oliver's case are in line with previous work (Bruce et al., 2003; Cauter & Woolf, 2016) demonstrating it is possible to use speech recognition to aid writing for people with aphasia whose spoken output is superior to written language skills. In this study, it was possible that some changes were due to spontaneous recovery of both writing and spelling during the intervention period. However, the intervention demonstrated that teaching of speech recognition features on iPad alongside targeted practise was effective in changing Oliver's behaviour post-stroke. Dictation offered him a temporary solution to difficulties with writing, a solution he no longer needed as time progressed.

Discussion of wider themes emerging from Oliver's case are returned to in Chapter nine.

Chapter 9. Discussion

Chapter one introduced the main aims of this thesis and related research questions, which were addressed in two stages (chapters two to three and chapters four to eight). This final chapter returns to the aims of the thesis in a discussion bringing together the two stages of this research. The aims are addressed in turn.

9.1 Barriers and Enablers to Internet Use

The first aim of this research was to investigate the barriers and enablers experienced by people with aphasia in relation to using the Internet.

- *How do people with aphasia use the Internet?*

This initial question was addressed in Chapters two and three, with section 3.3 in Chapter three discussing the findings. Although the spectrum of Internet use by people with aphasia was very similar to a matched sample without aphasia, there were identifiable differences. There was, of course, heterogeneity of Internet use within the aphasia sample, varying from no engagement with the Internet to use by proxy and full independence. Each case study also illuminated considerable differences between participants regarding pre- and post-stroke Internet use and individual priorities.

- *What types of difficulties with Internet use can be attributed to aphasia?*
- *What other factors might contribute to ability to use the Internet with aphasia?*

Findings from the questionnaire and the intervention studies provided insight into how aphasia and several other factors influence Internet use. Questionnaire participants chose possible explanations for not acquiring or improving Internet skills with the main barriers being lack of confidence, aphasia, health and physical problems, being too old, and lack of support (section 3.2). The regression model described under section 3.2 - 'Predictors of Internet use' revealed that the only significant predictor for Internet use was age, with older people less likely to say they used the Internet. Aphasia as a predictor variable was just above the level of significance. However, the regression explained only 37% of the variability in predicting Internet use/non-use. This suggested

that other factors beyond those considered were likely to play a role. The data generated from the questionnaire and case studies is not sufficient to draw any definitive conclusions on what these factors might be. However, they did provide valuable insight into several areas. These were: 1) the role of aphasia as a barrier to Internet use, 2) the impact of factors such as age, health and physical disability, 3) provision of support, and 4) the impact of online environments. Each of these is discussed below, starting with the unique contribution of aphasia.

9.1.1 Aphasia

Findings from the questionnaire showed that the majority of people with aphasia identified that their aphasia was a barrier to acquiring or improving Internet skills. However, very few people selected aphasia alone. This suggested that aphasia was perceived as a considerable barrier, but for the majority of people with aphasia it was not the only contributory factor. It should be noted that the participants in the case studies were recruited based on referring SLTs' assessment that aphasia had led to difficulties with Internet use. However, only one participant emerged (Rose, Chapter seven), for whom aphasia could be identified as the sole barrier to her goal to write longer and more interesting emails to her friends and family. As far as it could be ascertained by the assessments used, Rose's non-verbal cognitive skills were unimpaired. Other assessment data indicated she had retained competent Internet skills developed before her stroke. Rose had access to up-to-date equipment, assistance with technology when needed from her grandchildren, and she had no physical difficulties. Her aphasia affected face-to-face and telephone conversations and writing. It negatively impacted Internet skills when seeking advice or technical support and when emailing. With the other case study participants, there was a clear influence of aphasia, but there were also other factors involved. Bill (Chapter five) had also been a previously adept Internet user. However, the severity of his stroke impaired not only his language skills across all modalities, but also aspects of non-verbal cognition and motor function. He had, therefore, lost many vital skills needed to use the Internet effectively (e.g.,

remaining oriented online, use of dominant limb, verbal and written communication). Bill's external support network either lived far away or lacked digital skills. Nancy (Chapter six) and Oliver (Chapter eight) could both be described as people who had been relatively recent adopters of technology and whose pre-stroke Internet skills were limited to a narrow range of use. For Nancy, aphasia affected her verbal and written communication as well as her confidence as a communicator. Although still able to access and navigate Facebook as she had before her stroke, she was no longer able to contribute written content. As a result, she reported that her level of online interaction was restricted. Nancy lived alone and had limited previous experience of computers. Her main supporter, her daughter, also reported low confidence with technology. Oliver's impaired spelling contributed to his difficulties with writing online messages but was entangled with other aspects of his impairment (e.g., speed of processing, fatigue, hemiplegia). His main source of support (his wife) reported skills confined to one area of technology (iPad use) and expressed that she was unwilling to alter their relationship dynamic by getting involved with his computer skills.

Despite the finding that aphasia was considered a barrier to Internet use for many participants in the questionnaire, there were people with severe aphasia who reported being independent for many online activities. Self-perception of disability may not always go hand in hand with ability or potential. The findings from the case studies provided evidence that it is possible to design interventions to remediate or compensate for aphasia-related difficulties with the Internet. Further research in this area is of great importance to inform evidence-based practice. Then, armed with evidence and appropriate resources, SLTs can empower people with aphasia to engage with the Internet or work with them in rehabilitation to return to previous Internet skills.

9.1.2 Age

Findings from the questionnaire highlighted age as a stronger predictor of Internet use than the presence or absence of aphasia. Age as an influential factor was revealed in the regression analysis and in questionnaire participants' perceptions of age as a barrier

to improving or acquiring Internet skills. Age and its relationship to Internet use is discussed in detail in the literature, covering both barriers to Internet use and the experiences of older adults when using technologies (e.g., Chang et al., 2015; Quan-Haase et al., 2016). Some people may perceive that disability and age are related, and that once someone is older with a major disability it is not possible for them to learn new skills. Others may believe that age alone is a barrier to acquiring new skills. Rose's husband James expressed this view in his interview, stating he was 'too old' to adopt any new technologies. However, age in many cases may be a confounding variable. Crabb and Hanson (2014) suggested cognitive abilities and technological experience may be better predictors than age. Van Deursen & Helsper (2015) also argued that a dichotomous view of age is not helpful. Older adults are a diverse group and may also have differing self-perceptions of age (Montepare & Lachman, 1989). A variety of psychological, environmental and social factors can influence whether they use the Internet, and whether they do so successfully or not. Despite this, the complex factors influencing Internet use amongst the older population are also relevant for older adults with aphasia. Stroke risk increases with age (Bhatnagar et al., 2010) therefore people with aphasia are most commonly older adults. However, the sub-group of older adults with aphasia is also a heterogeneous population, and individual variation should be taken into account.

The influence of age on Internet use and skills should be discussed with respect to evolving attitudes to technology and a generation of individuals growing up in a world where the Internet is part of everyday culture. For the older participants in this study, the Internet represents a new technology, something they needed to embrace and learn towards the end of their working lives and into their retirement. Unfortunately, the study did not recruit a younger person with aphasia or someone who had goals to return to the workplace. For such an individual the profile of previous skills, and the influence of environmental and personal factors would likely have been quite different. However, it can be argued that the process of decision-making would have been similar to the process carried out with the existing case studies. A holistic profile of Internet use and

skills would take into account external influences on an individual with aphasia's ability to return to previous Internet activities, and systematic consideration of possible routes to intervention would also be appropriate. For the time being at least, older adults with aphasia present SLTs with additional challenges related to initial engagement with the Internet. In addition, there will always be aspects of ageing that might influence successful use of the Internet, e.g., deteriorating hearing, vision, dexterity, and cognitive skills.

9.1.3 Health and physical problems

Many participants in the study selected the categories of 'health/physical problems', and 'stroke' as barriers to acquiring or improving Internet skills. Further options in the questionnaire design did not allow for subtleties of interpretation or detailed description of the nature of any impairment (e.g., hemiplegia, memory) and different health related problems may play different roles in influencing Internet use and skills. For case study participants, more detailed information on the nature of physical problems emerged. Difficulties included fine motor control of a mouse or trackpad (Nancy, Bill, and Oliver), physical manipulation of equipment (Bill) and symptoms of cramping and fatigue (Oliver). Aphasia is correlated with overall stroke severity and people with aphasia are more likely to have additional physical disabilities (Pedersen et al., 1995). Detailed assessment of physical disability is vital in providing appropriate support, as there are several possible adaptations for different physical and cognitive difficulties (Simpson, 2009). Within clinical settings, multidisciplinary teams have a role in providing detailed and accurate diagnosis and interventions for different sequelae of stroke and aphasia. For example, a Physiotherapist may be involved in rehabilitation of fine motor control to use a mouse or depress individual keys on a keyboard, or an Occupational therapist may advise on equipment or strategies to access everyday technologies.

9.1.4 Confidence

Confidence in individuals' own Internet skills was another commonly chosen barrier in responses to the questionnaire and was selected by people both with and without aphasia. Dutton et al. (2013), also report lower levels of confidence in Internet skills amongst retired adults. The source of any lack of confidence is unclear, but perhaps likely to stem from different experiences and beliefs. Issues with limited confidence were illustrated by Nancy and Oliver. Both reported lack of confidence was a barrier to improving Internet skills. It was not clear how stroke and aphasia impacted on their confidence or their insight into their own Internet skills. However, profile data for both (e.g., Nancy's responses to the questionnaire on previous Internet use and Oliver's wife's interview) indicated that skills and confidence related to Internet use were poor prior to their aphasia. Dickinson, Eisma, and Gregor (2011) reported on a group for older novice users of technology and found that building confidence took a considerable amount of time. In addition, mistakes could cause a decline in confidence and upset the progress learners had already made. These insights suggest supporting people with aphasia who have poor confidence in their own Internet skills will bring additional challenges. Existing poor confidence in computer skills may be worsened by aphasia and associated physical disabilities. Both Nancy and Oliver made efforts to convey that they were upset by the difficulties they experienced during formal testing and that their performance did not fit with their self-perceptions. Such changed sense of identity may have considerable emotional consequences for people with aphasia (Shadden, 2005). Mistakes made when trying to use technologies could negatively affect feelings of self-worth and deter people from trying again. This may be one possible explanation for the people with aphasia who reported in their questionnaire that they had used the Internet in the past, but had stopped doing so. The questionnaire responses did not provide this level of insight. Therefore, for a more nuanced understanding of the causes of lack of confidence in using the Internet amongst people with aphasia, more qualitative enquiry may be needed.

9.1.5 Provision of support

In the questionnaire, participants were asked to state whether they used the Internet or not. However, findings from additional questions on proxy use and need for support indicated there was a continuum of Internet use from fully independent to use by proxy. This was evident for people with and without aphasia. Therefore, a dichotomous distinction between 'users' and 'non-users' is probably not appropriate. Support with the Internet by a proxy appears to be common amongst older adults and people with disabilities (Dutton et al., 2013). Within the sample, family and friends of both people with and without aphasia were offering help with Internet activities and using the Internet on their behalf. All case study participants also relied on others for support to some degree. Rose (Chapter seven) needed her husband to call their Internet provider on her behalf, Nancy's daughter was attempting to deal with problems with Wi-Fi (Chapter six) and both Bill and Oliver relied on their spouse to read and respond to messages (Chapters five and eight). These findings suggest that many older adults and those with aphasia who are Internet users need some form of support. Such need should raise concerns about the availability of support for people with aphasia, given the evidence that this group have less diverse social networks than healthy older adults (Hilari & Northcott, 2016). Potential isolation may make those with aphasia less able to access family members or friends to help them to go online or carry out essential Internet tasks. They may also be reluctant to ask for practical support (Northcott & Hilari, 2017). There is the possibility that support offered may not always be helpful. For example, Bill's family provided instruction at too fast a pace for Bill and Violet to understand, and Oliver's wife Pauline responded to messages before her husband was able to. The potential impact of stroke-related disability on relationship dynamics (Northcott et al., 2016) was also illustrated in Oliver's case when his wife reported that her providing assistance with technology would not be appropriate within their relationship. Some may be happy with others carrying out activities alongside them or on their behalf, as demonstrated in work on traditional literacy skills of people with aphasia (Parr, 1992). This was the case for Bill, whose wife was willing to work with him, and the couple

enjoyed taking part in shared online activities. There was also an element of empowerment in this shared experience for Bill, as Violet reported there were still occasions when his skills exceeded hers or they were able to come to solutions together. However, others, like Oliver, may prefer independence over a shared experience. An important finding from the results of both stages of this research was that there is variability in the Internet use of individuals with aphasia and also in those who support them. For Bill's wife, Violet, there were other pressures on her time, and she was not very confident of her own skills. Partners of people with aphasia may also experience difficulties with using technologies. They are also likely to be older, and may have health difficulties or other factors which impact their digital skills. Violet was a good example of someone who had less interest in the Internet and poorer skills than her partner's prior to his stroke. Nevertheless, she found herself in the position of taking the lead as Bill attempted to participate in previous online activities.

The nature of support needs further exploration, particularly regarding how people with aphasia experience being supported, and how those providing help feel about their role. There are perhaps fine boundaries between helping to develop and expand skills, working in parallel with a person less able, or taking over aspects of Internet use on behalf of another person (i.e. proxy use). There are initiatives aiming to enable the most excluded social groups to get online or improve their skills (Tech Partnership, 2017), or to support older adults with computer use (Forbes et al., 2009). However, such initiatives may be inaccessible or inappropriate for many people with aphasia, suggesting a need for an introduction to Internet technologies within an adapted environment. This has been successfully trialled in some studies by aphasia researchers (Egan et al., 2004; Kelly et al., 2016), but is not universally available and still lacking a comprehensive evidence base. Specific help is available in the UK for people with disabilities to use computers and technology (AbilityNet, 2017). Aphasia support organisations also provide a variety of computer-related activities (e.g., Aphasia Center of California, 2017; Dundee University, 2017; North East Trust for Aphasia, 2017). However, access to such organisations may be dependent on what is available locally, or whether someone is

physically able to attend. Aphasia remains a poorly known condition (Code et al., 2009) and is not currently overtly recognised by government services that support people with limited digital skills. This has potential impact for people with aphasia should they require assistance with aspects of every day citizenship which involve using the Internet (e.g., benefits or passport applications, registration to vote, contacting a local member of parliament).

9.1.6 *The online environment*

The potential influence of the online environment emerged from some of the case studies. In Bill's case (Chapter five) he was distracted by extraneous content on web pages. He benefited from accessing his information in an environment where he could not inadvertently click to unrelated content. In Nancy's case, she needed prompts and pointing to help her locate the area of a web page she needed to complete the next step of a task. However, she was adept at navigating a more familiar environment, that of Facebook. These examples are illustrative of the consequences of inaccessible online environments which fail to take into account the needs of people with disabilities (Easton, 2013; Jaeger, 2012). Such potential barriers caused by online environments were not comprehensively evaluated in this research, nor was it clear which difficulties were because of aphasia per se. However, given recent attention paid to accessible written information for aphasia (Herbert et al., 2012; Rose et al., 2011), it is equally important to understand which aspects of online environments can act as barriers and facilitators. For example, what is the influence of text size and font, placement of menu bars, images, amount of information and advertising content? Which features (e.g., audio content, subtitling, screen readers) can be of assistance and which types of aphasia presentations are best supported by which accessibility tools? Future avenues of research may also investigate the potential for bespoke content, where web environments can be personalised to meet individual need (Blanck, 2014).

9.1.7 Other possible barriers and enablers

Whilst not directly emerging from this research, some other key areas warrant discussion in the context of potential barriers and enablers to Internet use for people with aphasia. These areas are important because they either feature in the digital exclusion literature or were highlighted by one of the case studies. They are: trust in the Internet, the cost of going online, and the role of social exclusion. Each is discussed below.

Trust in the Internet

Questionnaire results indicated lack of trust was not perceived as a barrier by the participants in this study. In contrast, lack of trust was the third most selected barrier in Chang et al.'s sample of older adults (2015), while Dutton et al. (2009) reported that 13% of Internet users and 52% of non-users agreed or agreed strongly with the statement 'I don't trust technologies, they fail when you need them most'. Blank and Dutton (2012) suggest that over time experience with computers and the Internet has made older people more trusting, despite an increase in experience also increasing the likelihood of experiences of fraud or viruses. Initial use of the Internet may be closely linked to perceptions of usefulness or value with a specific need or interest triggering engagement for the first time (Gibson et al., 2003). Nancy, for example, valued the use of Facebook as a means to keep up to date with what other people were doing with their lives. Rose and Oliver had both embraced technology as a means to keep in contact with family members abroad. Exposure to technology in an area where people with aphasia can see benefits is, therefore, likely to be of benefit for those lacking in both trust and experience. People with aphasia may be introduced to computers so that they can access therapy software to improve language skills (Finch & Hill, 2014; Palmer et al., 2013; Wade et al., 2003). For those who have no previous experience of computers or the Internet, introduction to technology for therapy may be a motivating catalyst for engaging with other aspects of its use.

The cost of going online

Another finding from the questionnaire was that the cost of using the Internet was perceived as a relatively small barrier and, consequently, not a major obstacle to improving or acquiring skills. In recent years, the UK government has aimed to improve broadband access within the UK (UK Government, 2012), making broadband widely available and more affordable. In addition, Internet enabled devices are available at low cost and the majority of mobile phones can access the Internet. Cost as a relatively small barrier contrasts with findings from the Dutton et al. (2009) survey, where expense was the major reason for individuals giving up using the Internet. These reductions in cost and availability over time may also account for the relatively small number of participants who said they did not have a computer or had one which was old. Some further insight into the influence of cost of equipment came from Bill's SLTs (Chapter five), who reported Bill had been able to provide his own iPad for access to therapy apps. They reported that an iPad would not have been available to Bill via the NHS and without it, he would not have had access to a range of therapy exercises. Options for intervention during this study would also have been more restricted. Bill's ability to purchase a tablet computer to access the Internet, therefore, put him at an advantage over others who may not have had the same financial freedom.

A contrast could be seen in the data collected for Nancy's case (Chapter six). Nancy and her daughter both reported cost as a potential barrier. The expense of replacing Nancy's laptop prevented her updating an outdated model. She was using less than ideal equipment to access the Internet but could not afford to replace it. Penfriend is not available as a fully functional free trial, so a full version of the software was purchased and provided on loan from Newcastle University. This version turned out to have a fault so, fortuitously, the company provided Nancy with a free download version for her own use. She would not have been able to purchase Penfriend herself. The software ran without problems on her laptop but its use might have been enhanced by an updated

version, (e.g., a bigger screen could have prevented the Penfriend window blocking visual access to part of her screen).

Although financial barriers were not highlighted as a major concern in the questionnaire data, contrasting financial situations such as the two cases discussed above can provide some insight into financial differences that might lead to inequalities in ability to purchase Internet equipment.

The role of social exclusion

The literature described in Chapter one (section 1.2) discussed the strong links between social and digital exclusion. Indicators of deprivation were not considered in the questionnaire as possible predictors for Internet use/non-use. Nor were the case study participants recruited with any view to comparing the experiences of people with aphasia with difference socio-economic backgrounds. However, it is worth noting that the participants who took part in this study were all recruited from the North East of England, an area known to experience higher than average levels of digital exclusion (Blank et al., 2017). This should be taken into account when interpreting the results. The study does not provide evidence for barriers to Internet use related to social exclusion for people with aphasia. However, there are already strong associations between social and digital exclusion (Helsper, 2008) and the study does provide evidence that aphasia is likely to lead to additional difficulties with digital skills.

9.2 Assessment, Intervention, and Outcome Measurement

The second aim of this research was to explore assessments, interventions, and outcome measures for individuals with aphasia who have goals related to Internet use.

- *How can people with aphasia's difficulties with Internet use be approached in assessment and intervention?*
- *How can effectiveness of interventions for people with aphasia be measured?*

The four case studies demonstrated how a systematic approach using the ICF as a guiding framework could produce a holistic profile of Internet use with aphasia. In addition, they illustrated how relevant interventions could be considered systematically using the decision-making framework described in Chapter four. Such an approach can draw on existing literature, but where evidence does not exist, can guide clinicians on a case-by-case basis to consider possible routes for intervention to support clients with aphasia to use the Internet. Important issues related to individual participants were discussed in the chapter pertaining to each case. A discussion of the outcomes of the cases follows below, with consideration of the successes and challenges experienced during the research. The case studies were exploratory in nature and are not intended to provide a definitive guide to assessment, intervention, or outcome measurement to support Internet use for people with aphasia. However, the findings go some way to enhancing understanding in each of these areas.

9.3 Assessment and outcome measurement

Several of the assessments used to profile case study participants' Internet use and skills were also used as outcome measures. Therefore, a discussion of findings around assessment and outcome measurement is presented together in this section.

Assessment of aphasia is a complex process, involving the hypothesised modular components of language processing (e.g., Basso, 2003; Whitworth et al., 2014) and possible additional deficits of cognition (Brownsett et al., 2014; Helm-Estabrooks, 2002). Assessment of aphasia also involves determining the impact of the condition on everyday communication and interactions and the influence of environmental and personal factors (Kagan et al., 2008). This thesis was strongly influenced by these complementary foci. The questionnaire findings discussed in Chapter three and section 9.1 above also clearly identified a need to consider factors external to aphasia in the assessment of Internet use and skills. Case study participants were, therefore, assessed across each component of the ICF framework considering their Internet skills and use post-stroke. The aim was to collect information which would provide insight into factors

influencing a person's ability to take part in Internet activities. This section of the discussion reflects on the assessments used and how useful they were for providing information and for effectively measuring outcomes.

9.3.1 Assessments of Language

Writing for social media, email and text messaging is part of everyday practice and has different linguistic characteristics than the type of writing targeted in conventional aphasia assessments (e.g., naming or picture description). These types of everyday interactions provide ongoing challenges for the ecological validity of writing assessments. In some cases, published assessments were not adequate or appropriate to assess aspects of Internet use relevant to the goals of the case study participants. To comprehensively assess these aspects and provide appropriate outcome measures, it was necessary to design additional measures. This was the case for assessment of Rose's ability to detect grammatical mistakes within written narratives, Nancy's ability to create status updates and messages for Facebook, and Oliver's ability to compose and respond to online messages. The email writing assessment initially designed for use with Rose provided useful insight and was helpful in measuring micro and macro-linguistic content in her email narratives. However, reliability and validity of this and other tools developed for the research is untested and some aspects of the assessments used could be improved. For example, neither assessment of online writing attempted to recreate the environment of where the intended text would appear. There was also no means to account for the influence of variables such as a text entry system or size of screen. The exploration of novel assessments in this research to measure aspects of online writing points to an emerging need for the development of valid and reliable measures targeting contemporary functional writing. This would allow clinicians to accurately identify where difficulties occur and provide suitable means to measure the outcomes of their interventions.

9.3.2 Assessment of cognition beyond linguistic processing

Non-verbal cognitive skills were explored with each participant via a selection of published assessments. These tests were used to determine any difficulties with visual perception, attention, memory, and executive functioning. Cognitive skills are likely to considerably impact Internet skills and confidence in using technologies (Wild et al., 2012). Because of the series of single cases it was not possible to determine any correlation between aspects of cognition and performance on the Internet assessment. However, the case studies provided illustrative examples of how differences in cognition might influence an individual's abilities. For example, on the Internet skills assessment, Bill's disorientation and need for assistance with planning steps towards a task could be related to impaired memory and executive functioning. Similarly, Oliver's self-awareness of slowed speed of processing was shown in the digit symbol substitution test and reflected in the length of time it took him to complete assessments. Both participants had no history of pre-stroke cognitive impairment and high levels of education, suggesting they would have performed well on cognitive tests prior to stroke. In contrast, Rose's performance did not provide any evidence for stroke-related impairment of cognition beyond her aphasia. She performed well across assessments of attention, memory, and executive functioning and demonstrated these skills during the Internet assessment. In Nancy's case, it was more difficult to determine any differences between pre- and post-stroke cognitive abilities for non-verbal tasks. A more in-depth assessment of cognition with a specific focus on stroke-related problems (Bickerton et al., 2015) may have provided further insight into any acquired difficulties. In this study, assessments of non-verbal cognition proved to be a vital part of the diagnostic and decision making process. However, further research is indicated to determine the relationship between cognition and the Internet skills of people with aphasia, and to help plan appropriate interventions.

9.3.3 Internet assessment

Results of the Internet assessment elicited information on what participants could do independently, where they needed assistance, and the nature of assistance needed. For all participants, it was possible to complete the assessment within one session. There was variation of time participants needed to complete all the tasks. In Bill's case, this aspect was an important outcome measure for investigating his efficiency at retrieving information on news and sports (via a more tailored version of the assessment).

It was not possible to conclude from the assessment of Internet skills which areas of difficulty pre-dated stroke and aphasia. To gain this information, data had to be collected from other sources, such as case history, supportive conversation with the person with aphasia, and an interview with their primary carer. Although the assessment tasks were designed to tap into a range of Internet skills they did not assess factors such as how people would cope with a familiar online environment (e.g., a website they had previously used on a regular basis), nor did they cover more interactive forms of Internet use (e.g., commenting on a blog or taking part in an online discussion).

Litt (2013) provided a literature review on measuring Internet skills. All measures featured in Litt's review are heavily reliant on linguistic skills; including those involving observation as they largely require those being assessed to understand a series of written or verbal instructions. Therefore, an accessible means to assess Internet skills of people with aphasia is a clear area of need. The assessment developed for this research was modified to meet the needs of people with aphasia and took a systematic approach to assessment of skills and of the need for assistance. Qualitative observation of video recorded performance also allowed for greater insight into the impact of the online environment and the types of difficulties participants experienced. The assessment, therefore, has potential as an ecologically valid measure of Internet skills for use with the aphasia population.

However, aspects of the assessment may have been affected by external variables such as motor control, means of access, age, the operating system of the device being used, and broadband speed. Although the hierarchy of assistance provided the assessor with guidelines of when and how to offer assistance during the Internet assessment, reliability of administration (within the same person and between persons) might be difficult to achieve as people take different routes to achieve tasks or lose direction along the way. In addition, the video equipment recorded according to head movement of participants and, although this gave a broad indication of where people were directing their focus, it was at times difficult to interpret. A fixed camera or screen capture with additional data from keyboard tracking would provide easier to interpret data. However, this type of data collection would bring ethical considerations into play related to installing potentially intrusive software onto private devices.

9.3.4 *Internet questionnaire*

The aim of the Internet questionnaire in the case study chapters was to establish the level of current Internet use and how previous use had changed (if at all) in type and frequency following stroke and aphasia. Most of the participants could understand the concepts 'before stroke' and 'now' and could convey their experience of any changes following stroke. For Bill (Chapter five), this level of complexity proved too demanding and materials had to be further simplified. Finding out previous levels of digital literacy also proved challenging, and although relevant information was gathered from the person with aphasia and a carer, it was still difficult to objectively describe previous levels of skills. Access to this information can be equated to gathering case history information on previous levels of traditional literacy (Parr, 1996). The questionnaire would benefit from further trials as an information gathering and goal-setting tool. It would then be possible to establish whether it could be used with a range of aphasia severities and as a stable and reliable measure of change. In seeking information as part of a holistic case profile, the most important aspects were to determine how the person previously used the Internet and how that had changed.

Traditional literacy (reading and writing) is important for digital literacy. For younger generations, digital skills and the ability to use the Internet for information are vital and traditional and digital literacy are closely intertwined (Smith & Smith, 2010). It is now increasingly important for SLTs to understand previous levels of computer use as well as individuals' motivations, preferences, and skills. Such information gathering should now be part of a routine case history when working with people with acquired disorders of language and communication. It is equally important to determine non-existing or emerging Internet skills as it is to discover use of technologies fundamental to every aspect of an individual's life. This information is vital to ensure a holistic assessment of a person, and to plan appropriate interventions. Within this process, it is important to recognise that individuals may be sensitive to questioning about previous levels of ability or unable to produce an accurate self-assessment of their skills. Findings from this research point to a need to employ clinical flexibility in the assessment and goal-setting process and to expand the range of data collection methods available. Resources related to Internet skills and use should be adopted as part of a toolkit to determine the impact of aphasia on everyday participation.

9.3.5 Social networks

The Social Network Analysis (Antonucci, 1986) was used to gather information on the nature and closeness of social support available to the participants. It was simple to administer with each person (although most needed facilitation with word finding and writing). It gave a basic indication of the immediate and wider support networks around each person. Supplementary information was needed from the Internet questionnaire and the interviews to establish which friend or family member provided help with which aspect of Internet use. Information about the digital skills of those in a person's network was also useful. For example, many of Bill's friends who lived abroad were reported to have limited skills in using video calling and would be unable to use it as an alternative means of keeping in touch. In contrast, Rose lived with her adult grandchildren, who had a range of skills to share. This insight suggests that when considering interventions to

support aspects Internet use, the digital skills of those around a person with aphasia should also be considered.

As well as identifying who might provide in-person support with technologies, it was important to have some insight into who the case study participants wanted to communicate with online. None of the four participants who worked on online communications aimed to expand their social networks. Instead, their focus was on either the quality (Nancy, Chapter six and Rose, Chapter seven) or quantity (Oliver, Chapter eight) of their online interactions. Despite this, Rose (Chapter seven) did show an increased number of friends in her network following the intervention. This finding of a growth in personal networks using Antonucci's method of analysis (Antonucci, 1986) was also seen in Caute and Woolf's (2016) study on voice recognition to improve communicative email writing for a person with mild aphasia. This measure was not originally designed to reflect change and its reliability for such use is not known. It is worth noting that there was some inconsistency in pre- and post- reporting of social networks for two of the other participants (Bill and Rose) when change was not anticipated. Whilst none of the participants in this study had goals around expanding online social networks, goals in this area are not unlikely. The potential role of the Internet for expanding social networks may have implications for emotional wellbeing and quality of life of people with aphasia. This is discussed in the following section.

9.3.6 Emotional wellbeing

The CDP Emotional Scale was used to provide insight into the impact of stroke and aphasia on each participant's emotions. This aided intervention planning. However, the CDP does not have good reliability for the emotional scale (Chue, Rose, & Swinburn, 2010). Whilst it was of value in the assessment process, it was not an appropriate or useful outcome measure for the interventions in each case study. Positive aspects of the intervention for emotional wellbeing were captured in Bill's wife Violet's post-intervention interview, when she discussed some of the emotional benefits of the intervention for herself and for Bill (Chapter five, section 5.4). However, potential outcomes for

emotional wellbeing and quality of life warranted further exploration for each of the cases. Future research in this area should consider use of a more robust quality of life measure (e.g., Doyle, McNeil, Hula, & Mikolic, 2003; Hilari, Byng, Lamping, & Smith, 2003). However, the sensitivity of these measures to examine the role of the Internet to people's quality of life is unknown. Qualitative or mixed methods may be more appropriate to investigate the role of the Internet in relation to quality of life with aphasia. Research with other communication impaired populations may provide useful guidance (e.g., Hynan, 2013; Raghavendra, Newman, Grace, & Wood, 2015). Chapter one (section 1.1.) discussed the potential benefits of the Internet for people with aphasia for living with a long-term condition or for quality of life. It is, therefore, of clinical importance to identify whether people who are socially isolated following aphasia could benefit from interventions to improve Internet skills, thereby enabling them to access information and take part in online interactions.

9.4 Intervention

The process of designing the case-study interventions (described in Chapter four) was based, wherever possible, on evidence and insights from the aphasia literature. The format of interventions was largely similar in structure and execution to 'traditional' speech and language therapy (Byng & Black, 1995). Each one was based on clearly defined aspects of intervention, for example, transparent goals, production of session plans, means of decreasing or increasing levels of difficulty, focused cueing strategies, and provision of accessible information.

9.4.1 Effectiveness

In three out of the four case studies, there was evidence that the interventions led to improvement in Internet-related goals. The use of multiple measures designed to capture data across the ICF framework meant there were several means of considering effectiveness of intervention for each participant.

In Bill's case (Chapter five), it was possible to improve access to information by providing training for basic iPad skills, simplifying the online environment, and by increasing the computer related confidence and skills of his main supporter. Positive change could be seen in the tailored Internet assessment and this was confirmed by his wife's record of his browsing behaviour and by her interview. The effectiveness of this intervention could be seen in positive evidence for change in a simple record of both Bill and Violet's behaviours and from Violet's report on the benefit of the therapy. This type of supported adjustment to Internet use due to living with aphasia might be compared to Parr's (1996) work on assessment of the literacy skills of people with aphasia, which highlighted that some individuals were satisfied with being supported by others when reading. With respect to digital literacy, there is a need to address previous levels of technological competence and behaviours in the context of living with aphasia. Speech and language therapists can then provide interventions for people with aphasia to achieve levels of Internet use that may need to be heavily supported, but can still provide satisfaction from the experience. The challenge is then to measure life participation outcomes related to Internet use that put the person with aphasia at the centre of any judgement of what represents '*meaningful life change*' (Kagan et al., 2008, p270).

In Nancy's case (Chapter six), it was more difficult to demonstrate any effectiveness of the intervention. The measure designed to capture ability to write for Facebook did not reveal any functional gain related to Nancy's goals. In her case, assessment of typed written naming provided positive evidence to support the use of word prediction software to improve her written language. Nancy's intervention demonstrates the challenge of measuring generalisation beyond formal assessment (Webster et al., 2015) and introduces ethical dilemmas around whether it is appropriate to access a person's social media profile to determine whether they are carrying out successful interactions. Another challenge when working with Nancy was in determining the influence of personal motivation and confidence for the intervention, a factor which may have influenced the outcome (see section 6.4.4). In Nancy's case, a measure of her

satisfaction with what she was able to produce on Facebook was not used. Nancy and her daughter were also not asked to keep any record of Nancy's online interactions. Such measures might have demonstrated effectiveness of the therapy in more subtle ways.

For Rose (Chapter seven), length and content of email narratives were improved via an impairment-based language intervention. Effectiveness for Rose was measured via micro and macro-linguistic analysis of her email narratives and via a rating of her satisfaction with the emails she produced. A repeat of the Internet questionnaire captured some qualitative data on her views on predictive writing software. There are currently numerous ways to measure the content, structure, and informativeness of narratives in aphasia (Bryant, Ferguson, & Spencer, 2016) although these are predominantly designed for use with spoken narratives. Written and spoken language in aphasia are demonstrably different (Behrns, Wengelin, Broberg, & Hartelius, 2009) and email could be argued to have its own characteristics and varying linguistic registers dependent on its purpose. Rose's narrative level language required a complex level of analysis in order to demonstrate change in the length and complexity of her emails. Such complex measurement is time consuming and requires specialist skills. It is interesting to note that Rose's SLT felt challenged in this area, viewing her actions to support Rose with emailing as an adjunct to areas of therapy she felt more comfortable with. The above discussion can also be applied to Oliver (Chapter eight), whose favoured means of written communication were email or text messaging. In his case, effectiveness could again be seen in linguistic measures of written language, and in a record of his messaging behaviour over the course of a week. There was again a need to design measures to capture the outcome of his intervention. These complex challenges of measuring effectiveness for Rose and Oliver suggest a need for SLTs to have access to tools for accurate and detailed assessment of online forms of narrative writing such as email and text messaging.

Some of the case-study interventions also led to unexpected benefits for participants, which were captured by the breadth of assessment across ICF components. In their responses to the Internet questionnaire, Rose (Chapter seven) and Oliver (Chapter eight) both demonstrated an increase in frequency of Internet activities not targeted by the intervention. Bill (Chapter five) showed an increase in his Internet activities recorded in a diary of activities. In these cases, a possible reason for this was that they had moved to using an iPad as their main device. For Bill, the repeated interview with his wife suggested that working with the couple had led to them trying out more of the iPad's features together. There were also unexpected benefits for Nancy, who demonstrated an improvement in spoken naming skills; a change which was captured by a repeat of language assessments following the intervention.

9.4.2 Meeting individual needs

The case study research focused purely on people with aphasia who had used the Internet prior to their stroke. However, each of the participants had different levels of previous use and skills. Data from questionnaire responses gave an indication of the diversity of levels of Internet use within the aphasia population. It is important to consider these likely differences when designing appropriate interventions.

Questionnaire participants with aphasia who were at considerable risk of digital exclusion were those who had never used the Internet or who had stopped following their stroke. For the most excluded individuals with aphasia, it is crucial to consider the best ways to introduce/re-introduce them to the Internet and to ensure long-term support. Most questionnaire participants (both with and without aphasia) wanted to develop their skills. For people with aphasia who report Internet skills along a spectrum of ability (seen in both the questionnaire results and the case studies), the challenge is considering pre-stroke levels of digital literacy and establishing appropriate and achievable goals. Finally, there are 'next generation' Internet users, who access the Internet in different places using a variety of devices (Dutton & Blank, 2011) and for whom aphasia has impacted previous online activities purely due to linguistic difficulties

(as was the case for Rose, Chapter seven). Each of these groups will have considerable variation in the factors influencing their Internet use and skills. Further evidence is needed to inform decision-making around types of interventions to meet diverse needs.

9.4.3 *Timing of interventions*

Another important consideration is regarding when to offer intervention to people with aphasia related to Internet use. This issue was mentioned during interviews with SLTs in stage two, with several clinicians noting that people with aphasia's early goals were predominantly focused on their speech, and Internet skills were not given priority. Oliver's failure to remember or apply some early intervention around speech recognition but a success with later introduction to the technology provides a useful illustration of issues around timing of therapy (Chapter eight). The most appropriate time for Internet-focused interventions is likely to differ between individuals and relate to previous online activities and priorities for rehabilitation. Consultation with people with aphasia about their rehabilitation suggests there is a strong wish to return to previous activities (Worrall et al., 2011). The role the Internet plays in a person's life is likely to strongly influence the level of priority it is afforded when setting goals for rehabilitation.

The question of when to offer interventions also raises issues for those working or volunteering in the third sector. Charitable aphasia organisations are, perhaps, more likely to provide support with computer and Internet skills to people living with aphasia as a long-term condition. Key stakeholders should be asking whether people with aphasia are receiving the type of support they need or want with Internet and computer skills and whether third sector organisations feel they have the skills and resources to provide that support.

9.5 Implications for Clinical Practice

The findings from the questionnaire data and the case studies presented in this research suggest several key implications for clinical practice when working to support people with aphasia with Internet use. Firstly, the research provides a strong argument that

people with aphasia are at considerable risk of digital exclusion. Therefore, SLTs as advocates for people with aphasia should explore initiatives and means of service provision to address this risk and work towards inclusion of people with aphasia in digital environments. Goals around Internet use and skills should also be explored as part of routine practice in aphasia rehabilitation. Secondly, the research established that Internet use and skills will exist across a wide spectrum both pre- and post-aphasia and can be influenced by many factors. Therefore, assessment aimed at identifying barriers and enablers to Internet use for people with aphasia should adopt a comprehensive and holistic approach. Individual's goals for Internet use should be considered in the context of such a profile, taking into account personal preferences and motivations. Thirdly, the exploration of possible interventions for the case study participants highlights that interventions related to Internet skills for people with aphasia may take a variety of forms. Where possible, evidence for interventions should be sought from available literature. However, in the absence of a comprehensive evidence base, guidance can be drawn from considering goal-oriented interventions in a systematic way. This could involve: impairment-based approaches, use of compensatory strategies, use of supportive technologies, modifications to the hardware or software environment, and/or means of providing support from others. Interventions may consist of one approach in isolation but are most likely to involve several in combination. People with aphasia should also be actively involved in a process of decision-making around which approach may be the best fit for their needs. Finally, the case studies identified that change resulting from interventions in this area may be seen in a different area of measurement than that targeted by an intervention. Therefore, outcome measurement should be comprehensive and flexible, and may need to include both quantitative and qualitative measures of change.

9.6 Limitations

There are several limitations of this research that should be acknowledged. Firstly, the initial stage, although representative of quite a large sample of people with aphasia in

terms of the demands such a population places on data collection, was not based on significantly large numbers to form any definitive conclusions. The sample was also taken from within the North-East, a region with higher than average levels of digital exclusion (Blank et al., 2017). This might have led to results presenting a bleaker picture of Internet use and skills than might be seen elsewhere in the UK where Internet use is more prevalent.

The main limitation of the second stage of the research was that the case study participants recruited were all older and retired individuals, whose Internet use was predominantly for leisure and everyday communication. The study would have benefited from the inclusion of younger participants with previously well-established Internet skills, who had goals to return to the workplace or to use a range of Internet enabled devices and online services. Further, the case studies were largely exploratory as part of a new field within aphasiology, and as such cannot be discussed with respect to stringent criteria for n=1 studies or considered as acceptable levels of evidence with design that would stand up to critical review (Durieux, Pasleau, & Howick, 2011; Tate, Perdices, McDonald, Togher, & Rosenkoetter, 2014). Many of the assessments and outcome measures used within the studies were developed specifically for this research. They have not been tested on wider populations and therefore their reliability and validity is unknown.

9.7 Future Research

This study identifies several areas where future research is needed. One area is around the assessment of Internet use and skills. The Internet skills assessment used with case study participants provided useful data but future development of assessment tools in this area should involve comparative data on how healthy older adults and those with physical disabilities would respond to the same tasks. It would be important to determine how people with aphasia might present with distinct difficulties related to impaired language. Future research could also include consideration of how to assess Internet skills in a simpler but nevertheless reliable and valid way, for example, via an

observational checklist. As part of this process, consultation with people with aphasia, SLTs, and other health professionals would be of value to include potential end users in a process of participatory design (Davies et al., 2004; Hinckley, Boyle, Lombard, & Bartels-Tobin, 2014; McGrenere et al., 2003).

Future research is also needed to investigate how auditory and written comprehension with aphasia is influenced by the way written and verbal information is presented online. The myriad of ways in which information can be found on the Internet makes it complex to determine someone's ability to comprehend such information, and at present there are no tools available to aid assessment in this area. Although the Internet assessment gave some information on whether participants were distracted by aspects of websites that were not related to their goals, more sophisticated methods such as eye-tracking and recording of routes a person takes during an online task could provide further insight into how to best modify online environments for people with aphasia.

There are also no available tools to assess the ability of people with aphasia to produce online content, e.g., status updates, online comments, or instant messages. The Internet allows users a number of different means of communicating information or entering text and the features of online communication represent a rapid period of linguistic change. The assessments used in this research aimed to target the particular features of writing for email or for Facebook and were designed for use with a conventional keyboard. There are a range of different data that could be collected if further assessments in this area were to be developed (e.g., no. of keystrokes used, no. of deletions, timings, on screen versus 'real' keyboards) and there is also potential for computerised analysis of such data as well as standardisation of assessment of more contemporary forms of writing.

Finally, there is the issue of current service provision to support people with aphasia with their Internet use. This research demonstrated that people with aphasia are at risk of digital exclusion. However, such risk is not currently highlighted in policy guidelines, perhaps due to the limited guidance for evidence-based interventions in this area.

Interventions that do exist to support Internet use appear to be mostly provided by the third sector within group settings. However, it is unknown how much SLTs are currently doing with respect to these types of interventions in rehabilitation or what barriers they encounter when delivering interventions in this area. This research showed positive benefits for a tailored approach delivered on an individual basis. Means of service delivery is, therefore, an important consideration and the evidence presented in this thesis is not sufficient to suggest that one-to-one interventions are the best means of providing support. Group interventions have also demonstrated positive outcomes (Egan et al., 2004; Kelly et al., 2016). However, the benefits of group therapy at an individual level are not clear, nor is there evidence for any longer-term maintenance of Internet skills. There is potential for future research on comparison of models of service delivery, or perhaps investigation into a hybrid of individual and group delivery of interventions; participants could be considered individually with regard to their needs and goals, and intervention carried out in a group environment where there is peer support and encouragement.

9.8 Conclusions

This thesis set out to investigate the barriers and enablers to Internet use experienced by people with aphasia and to explore assessments, interventions, and outcome measures for individuals with aphasia who have goals related to Internet use. The above discussion has outlined how these aims were addressed. The contribution of this thesis has been to describe the unique experiences of people with aphasia in using the Internet, and to highlight the role of aphasia to digital exclusion. The research demonstrates that understanding of the interaction of a range of factors can inform the design and evaluation of tailored interventions to support Internet use with aphasia. This knowledge and the key principles outlined above will serve as a base for future studies in this area, providing guidance for clinical practice and identifying areas for future aphasia research.

With the rapid growth of the Internet and online interactions, the world is “*increasingly textually mediated*” (Barton & Lee, 2013). This is reflected in this thesis where three of the four studies focused on online writing. Such linguistic change presents considerable challenges for people with aphasia as the use of online writing continues to evolve and represent much of how we present ourselves to the world. However, online interactions need not all consist of text-mediated behaviours. They could, for example, involve shared online experiences (e.g., listening to music or watching video), nonverbal games, or picture sharing (Allen et al., 2008; Ulmer, Hux, Brown, Nelms, & Reeder, 2016). There is an ongoing need for people with aphasia to be represented in research (Brady, Fredrick, & Williams, 2013) (Brady, Frederick, & Williams, 2013). In the area of technology development, they should be viewed as experts within the design process (Wilson et al., 2015). Their involvement would ensure that the needs of those with aphasia are met in a future which will undoubtedly involve further rapid developments.

This area of research in aphasiology is still in its infancy. The tools of communication are no longer solely the anatomy and physiology of speech, pen and paper, or the pragmatics of face-to-face interaction. How people communicate and interact has fundamentally changed. The SLT profession needs to adapt to empower those who wish to engage with technologies and for whom stroke and aphasia has made this difficult. An important next step is to fully acknowledge the role of the Internet in every day communication and interaction, both in everyday practice and in clinical research. This is a considerable challenge but there is an ongoing responsibility for clinicians to strengthen the evidence base as those involved with the support and rehabilitation of people with aphasia embrace the digital age.

References

- AbilityNet. (2017). We are AbilityNet. Adapting Technology. Changing Lives. Retrieved from <http://www.abilitynet.org.uk/>
- Al Mahmud, A., Dijkhuis, S., Blummel, L., & Elberse, I. (2012). Postboard: Free-form tangible messaging for people with aphasia (and other people). In *CHI 2012* (pp. 1475–1480). Austin, Texas. <https://doi.org/10.1145/2212776.2223658>
- Al Mahmud, A., Gerits, R., & Martens, J.-B. (2010). XTag: designing an experience capturing and sharing tool for persons with aphasia. In *NordiCHI 2010* (pp. 325–334). <https://doi.org/10.1145/1868914.1868953>
- Al Mahmud, A., & Martens, J.-B. (2010). Re-Connect: Designing Accessible Email Communication Support for Persons with Aphasia Abstract. *Proceedings of the 28th of the International Conference Extended Abstracts on Human Factors in Computing Systems - CHI EA '10*, 3505. <https://doi.org/10.1145/1753846.1754009>
- Al Mahmud, A., & Martens, J.-B. (2013). Amail: Design and evaluation of an accessible email tool for persons with aphasia. *Interacting with Computers*, 25(5), 351–374. <https://doi.org/10.1093/iwc/iws025>
- Al Mahmud, A., Van de Ven, R., Slats, L., Van der Veen, E., Petkov, Z., & Mubin, O. (2014). MEA: Designing a multimodal email support tool for persons with aphasia. In *CHI 2014* (pp. 1219–1224). Toronto, ON, Canada. <https://doi.org/10.1145/2559206.2581228>
- Albright, E., & Purves, B. (2008). Exploring SentenceShaper™: Treatment and augmentative possibilities. *Aphasiology*, 22(7–8), 741–752. <https://doi.org/10.1080/02687030701803770>
- Allen, M., McGrenere, J., & Purves, B. (2008). The field evaluation of a mobile digital image communication application designed for people with aphasia. *ACM Transactions on*

Accessible Computing, 1(1), Article 5. <https://doi.org/10.1145/1361203.1361208>

Antonio. (2014). A brief history of the hamburger icon [blog post]. Retrieved from <https://blog.placeit.net/history-of-the-hamburger-icon/>

Antonucci, T. C. (1986). Social support networks: Hierarchical mapping technique. *Generations: Journal of the American Society on Ageing, Summer*, 10–12.

Aphasia Alliance. (2017). Welcome to the Aphasia Alliance. Retrieved June 2, 2017, from <http://www.aphasiaalliance.org>

Aphasia Center of California. (2017). Aphasia center of California: Recreational classes. Retrieved July 13, 2017, from <http://aphasiacenter.net/programs/recreational-classes/>

Apple Inc. (2014). iPad User Guide iOS 8.4. Retrieved August 11, 2017, from https://manuals.info.apple.com/MANUALS/1000/MA1595/en_US/ipad_user_guide.pdf

Armstrong, E., & Ulatowska, H. (2007). Making stories: Evaluative language and the aphasia experience. *Aphasiology*, 21(6–8), 763–774. <https://doi.org/10.1080/02687030701192364>

Armstrong, L., & MacDonald, A. (2000). Aiding chronic written language expression difficulties: A case study. *Aphasiology*, 14(1), 93–108. <https://doi.org/10.1080/026870300401612>

Arthur, S., & Nazroo, J. (2003). Designing fieldwork strategies and materials. In J. Ritchie & J. Lewis (Eds.), *Qualitative Research Practice: A Guide for Social Science Students and Researchers* (pp. 109–137). London: Sage Publications.

Aujla, S., Lancashire, T., & Cruice, M. (2016). Accessing the Internet: An adapted beginner's computer training course for people with aphasia [poster]. *International Aphasia Rehabilitation Conference*. City University, London.

Ball, A. L., De Riesthal, M., Breeding, V. E., & Mendoza, D. E. (2011). Modified ACT and CART in

severe aphasia. *Aphasiology*, 25(6–7), 836–848.
<https://doi.org/10.1080/02687038.2010.544320>

Barton, D., & Lee, C. (2013). *Language online: Investigating digital texts and practices*. Abingdon, Oxon: Routledge.

Basso, A. (2003). *Aphasia and its therapy*. New York: Oxford University Press.

Bastiaanse, R., Edwards, S., & Rispens, J. (2002). The verb and sentence test (VAST). *Thurston, Suffolk: Thames Valley Test Company*.

Beauvois, M. F., & Dérouesné, J. (1981). Lexical or ortographic agraphia. *Brain*, 104(2), 21–49.
<https://doi.org/https://doi.org/10.1093/brain/104.1.21>

Beeson, P. M., Hirsch, F. M., & Rewega, M. A. (2002). Successful single-word writing treatment: Experimental analyses of four cases. *Aphasiology*, 16(4–6), 473–491.
<https://doi.org/10.1080/02687030244000167>

Behrns, I., Hartelius, L., & Wengelin, Å. (2009). Aphasia and computerised writing aid supported treatment. *Aphasiology*, 23(10), 1276–1294. <https://doi.org/10.1080/02687030802436892>

Behrns, I., Wengelin, Å., Broberg, M., & Hartelius, L. (2009). A comparison between written and spoken narratives in aphasia. *Clinical Linguistics & Phonetics*, 23(7), 507–528.
<https://doi.org/10.1080/02699200902916129>

Bhatnagar, P., Scarborough, P., Smeeton, N. C., & Allender, S. (2010). The incidence of all stroke and stroke subtype in the United Kingdom, 1985 to 2008: a systematic review. *BMC Public Health*, 10, 539. <https://doi.org/10.1186/1471-2458-10-539>

Bickerton, W.-L., Demeyere, N., Francis, D., Kumar, V., Remoundou, M., Balani, A., ... Humphreys, G. W. (2015). The BCoS cognitive profile screen: Utility and predictive value for stroke. *Neuropsychology*, 29(4), 638–648. <https://doi.org/10.1037/neu0000160>

- Blanck, P. (2014). *eQuality: The struggle for web accessibility by persons with cognitive disabilities*. New York: Cambridge University Press.
- Blank, G., & Dutton, W. H. (2012). Age and trust in the Internet: The centrality of experience and attitudes toward technology in Britain. *Social Science Computer Review*, 30(2), 135–151. <https://doi.org/10.1177/0894439310396186>
- Blank, G., Graham, M., & Calvino, C. (2017). Local geographies of digital inequality. *Social Science Computer Review*, 1–21. <https://doi.org/10.1177/0894439317693332>
- Bornman, J., & Murphy, J. (2006). Using the ICF in goal setting: Clinical application using Talking Mats®. *Disability and Rehabilitation: Assistive Technology*, 1(3), 145–154. <https://doi.org/10.1080/17483100612331392745>
- Boyd-Graber, J. L., Nikolova, S. S., Moffatt, K. A., Kin, K. C., Lee, J. Y., Mackey, L. W., ... Klawe, M. (2006). Participatory design with proxies: Developing a desktop-PDA system to support people with aphasia. In *CHI 2006* (pp. 151–160). Montréal, Québec, Canada. <https://doi.org/10.1145/1124772.1124797>
- Brady, M. C., Fredrick, A., & Williams, B. (2013). People with aphasia: Capacity to consent, research participation and intervention inequalities. *International Journal of Stroke*, 8(3), 193–196. <https://doi.org/10.1111/j.1747-4949.2012.00900.x>
- Brandenburg, C., Worrall, L., Copland, D., Power, E., & Rodriguez, A. D. (2015). The development and accuracy testing of CommFit™, an iPhone application for individuals with aphasia. *Aphasiology*, 30(2–3), 320–338. <https://doi.org/10.1080/02687038.2015.1028329>
- Brandenburg, C., Worrall, L., Rodriguez, A. D., & Copland, D. (2013). Mobile computing technology and aphasia: An integrated review of accessibility and potential uses. *Aphasiology*, 27(4), 444–461. <https://doi.org/10.1080/02687038.2013.772293>

- Brookshire, R. H., & Nicholas, L. E. (1993). *Discourse Comprehension Test*. Tuscon, Arizona: Communication Skill Builders.
- Brown, C., Snodgrass, T., Kemper, S. J., Herman, R., & Covington, M. A. (2008). Automatic measurement of propositional idea density from part-of-speech tagging. *Behavior Research Methods, 40*(2), 540–545. <https://doi.org/10.3758/BRM.40.2.540>
- Brownsett, S. L. E., Warren, J. E., Geranmayeh, F., Woodhead, Z., Leech, R., & Wise, R. J. S. (2014). Cognitive control and its impact on recovery from aphasic stroke. *Brain, 137*(1), 242–254. <https://doi.org/10.1093/brain/awt289>
- Bruce, C., Edmundson, A., & Coleman, M. (2003). Writing with voice: An investigation of the use of a voice recognition system as a writing aid for a man with aphasia. *International Journal of Language & Communication Disorders, 38*(2), 131–148. <https://doi.org/10.1080/1368282021000048258>
- Bruce, C., & Howard, D. (1987). Computer-generated phonemic cues: An effective aid for naming in aphasia. *International Journal of Language & Communication Disorders, 22*(3), 191–201. <https://doi.org/https://doi.org/10.3109/13682828709019862>
- Bryant, L., Ferguson, A., & Spencer, E. (2016). Linguistic analysis of discourse in aphasia: A review of the literature. *Clinical Linguistics & Phonetics, 30*(7), 489–518. <https://doi.org/10.3109/02699206.2016.1145740>
- Bryant, L., Spencer, E., Ferguson, A., Craig, H., Colyvas, K., & Worrall, L. (2013). Propositional idea density in aphasic discourse. *Aphasiology, 27*(8), 992–1009. <https://doi.org/10.1080/02687038.2013.803514>
- Buhr, H. R., Hoepner, J. K., Miller, H., & Johnson, C. (2016). AphasiaWeb: development and evaluation of an aphasia-friendly social networking application. *Aphasiology, 31*(9), 999–1020. <https://doi.org/10.1080/02687038.2016.1232361>

- Bungalow Software. (2017). Speech Sounds on Cue. Retrieved July 14, 2017, from <http://bungalowsoftware.com/speech-sounds.htm>
- Burger, D. K., & McCluskey, A. (2011). Australian norms for handwriting speed in healthy adults aged 60-99years. *Australian Occupational Therapy Journal, 58*(5), 355–363. <https://doi.org/10.1111/j.1440-1630.2011.00955.x>
- Byng, S., & Black, M. (1995). What makes a therapy? Some parameters of therapeutic intervention in aphasia. *European Journal of Disorders of Communication : The Journal of the College of Speech and Language Therapists, London, 30*(3), 303–316. <https://doi.org/10.3109/13682829509021444>
- Caute, A., Cruice, M., Friede, A., Galliers, J., Dickinson, T., Green, R., & Woolf, C. (2016). Rekindling the love of books – a pilot project exploring whether e-readers help people to read again after a stroke. *Aphasiology, 30*(2–3), 290–319. <https://doi.org/10.1080/02687038.2015.1052729>
- Caute, A., & Woolf, C. (2016). Using voice recognition software to improve communicative writing and social participation in an individual with severe acquired dysgraphia: An experimental single-case therapy study. *Aphasiology, 30*(2–3), 245–268. <https://doi.org/10.1080/02687038.2015.1041095>
- Chang, J., McAllister, C., & McCaslin, R. (2015). Correlates of, and barriers to, Internet use among older adults. *Journal of Gerontological Social Work, 58*(1), 66–85. <https://doi.org/https://doi.org/10.1080/01634372.2014.913754>
- Cherney, L. R., Halper, A. S., Holland, A. L., Lee, J. B., Babbitt, E., & Cole, R. (2007). Improving conversational script production in aphasia with virtual therapist computer treatment software. *Brain and Language, 103*(1–2), 246–247. <https://doi.org/https://doi.org/10.1016/j.bandl.2007.07.027>

- Chiu, E.-C., Wu, W.-C., Hung, J.-W., & Tseng, Y.-H. (2017). Validity of the Wisconsin Card Sorting Test in patients with stroke. *Disability and Rehabilitation*, 8288(June), 1–5.
<https://doi.org/10.1080/09638288.2017.1323020>
- Chue, W. L., Rose, M. L., & Swinburn, K. (2010). The reliability of the Communication Disability Profile: A patient-reported outcome measure for aphasia. *Aphasiology*, 24(6–8), 940–956.
<https://doi.org/https://doi.org/10.1080/02687030903490541>
- Code, C., Papathanasiou, I., Rubio-Bruno, S., Haaland-Johansen, L., De la Paz Cabana, M., & Villanueva, M. M. (2009). International Comparisons of the Public Awareness of Aphasia: Greece, Argentina and Norway. In *The Aphasiology Archive*. Retrieved from <http://aphasiology.pitt.edu/archive/00001974/>
- Colby, K. M. (1973). The rationale for computer-based treatment of language difficulties in nonspeaking autistic children. *Journal of Autism and Developmental Disorders*, 3(3), 254–260. <https://doi.org/https://doi.org/10.1007/bf01538283>
- Communications Consumer Panel. (2010). *Delivering digital participation: The consumer perspective*. London. Retrieved from <http://www.communicationsconsumerpanel.org.uk/downloads/what-we-do/previous-projects/access-and-inclusion/FINAL DP SUMMARY.pdf>
- Communities and Local Government. (2008). *Understanding digital exclusion. Research report*. <https://doi.org/ISBN: 978-1-4098-0639-4>
- Cox, D. A. (2014). New to IOS 8 - iPad Edition Full Tutorial. Retrieved October 28, 2015, from https://youtu.be/FkGLwy9T_oE
- Crabb, M., & Hanson, V. L. (2014). Age, technology usage, and cognitive characteristics in relation to perceived disorientation and reported website ease of use. In *ASSETS'14* (pp. 193–200). Rochester, NY, USA: ACM. <https://doi.org/10.1145/2661334.2661356>

- Crerar, M. A., Ellis, A. W., & Dean, E. C. (1996). Remediation of sentence processing deficits in aphasia using a computer-based microworld. *Brain and Language*, *52*(1), 229–275.
<https://doi.org/10.1006/brln.1996.0010>
- Cruice, M., Worrall, L., Hickson, L., & Murison, R. (2005). Measuring quality of life: Comparing family members' and friends' ratings with those of their aphasic partners. *Aphasiology*, *19*(2), 111–129. <https://doi.org/10.1080/02687030444000651>
- Crystal, D. (2011). *Internet linguistics: A student guide*. London: Routledge.
- Davies, R., Marcella, S., McGrenere, J., & Purves, B. (2004). The ethnographically informed participatory design of a PDA application to support communication. In *ASSETS '04* (pp. 153–160). Atlanta, Georgia, USA: ACM.
<https://doi.org/https://doi.org/10.1145/1028630.1028658>
- De Jong-Hagelstein, M., Kros, L., Lingsma, H. F., Dippel, D. W. J., Koudstaal, P. J., & Visch-Brink, E. G. (2012). Expert versus proxy rating of verbal communicative ability of people with Aphasia after stroke. *Journal of the International Neuropsychological Society*, *18*(6), 1064–1070. <https://doi.org/10.1017/S1355617712000811>
- Deetjen, U., & Powell, J. A. (2016). Internet use and health : Connecting secondary data through spatial microsimulation. *Digital Health*, *2*, 1–17.
<https://doi.org/10.1177/2055207616666588>
- Demmans Epp, C., Djordjevic, J., Wu, S., Moffatt, K., & Baecker, R. M. (2012). Towards providing just-in-time vocabulary support for assistive and augmentative communication. In *IUI '12*. Lisbon, Portugal. <https://doi.org/10.1145/2166966.2166973>
- Devlin, S., & Unthank, G. (2006). Helping aphasic people process online information. *ASSETS'06*, 225–226. <https://doi.org/10.1145/1168987.1169027>

- Dickey, L., Kagan, A., Lindsay, M. P., Fang, J., Rowland, A., & Black, S. (2010). Incidence and Profile of Inpatient Stroke-Induced Aphasia in Ontario, Canada. *Archives of Physical Medicine and Rehabilitation, 91*(2), 196–202. <https://doi.org/10.1016/j.apmr.2009.09.020>
- Dickinson, A., Eisma, R., & Gregor, P. (2011). The barriers that older novices encounter to computer use. *Universal Access in the Information Society, 10*(3), 261–266. <https://doi.org/10.1007/s10209-010-0208-6>
- Dietz, A., Ball, A., & Griffiths, J. (2011). Reading and writing with aphasia in the 21st century: Technological applications of supported reading comprehension and written expression. *Topics in Stroke Rehabilitation, 18*(6), 758–769. <https://doi.org/10.1310/tsr1806-758>
- Dietz, A., Knollman-Porter, K., Hux, K., Toth, K., & Brown, B. (2014). Supported reading comprehension for people with aphasia: Visual and linguistic supports. *Journal of Medical Speech-Language Pathology, 21*(4), 319–331.
- Dobransky, K., & Hargittai, E. (2006). The disability divide in Internet access and use. *Information, Communication & Society, 9*(3), 313–334. <https://doi.org/https://doi.org/10.1080/13691180600751298>
- Doyle, P., McNeil, M., Hula, W., & Mikolic, J. (2003). The Burden of Stroke Scale (BOSS): Validating patient-reported communication difficulty and associated psychological distress in stroke survivors. *Aphasiology, 17*(3), 291–304. <https://doi.org/10.1080/729255459>
- Dundee University. (2017). Tap and Talk. Retrieved July 13, 2017, from <https://aac.dundee.ac.uk/tap-and-talk/>
- Durieux, N., Pasleau, F., & Howick, J. (2011). The Oxford 2011 Levels of Evidence. *OCEBM Levels of Evidence Working Group*. Retrieved from <http://www.cebm.net/index.aspx?o=1025>
- Dutton, W. H., & Blank, G. (2011). *Next Generation Users: The Internet in Britain*. Oxford, UK.

Retrieved from <http://oxis.oii.ox.ac.uk/reports/>

Dutton, W. H., Blank, G., & Groselj, D. (2013). *Cultures of the Internet : The Internet in Britain*. Oxford, UK. Retrieved from <http://oxis.oii.ox.ac.uk/reports/>

Dutton, W. H., Helsper, E. J., & Gerber, M. M. (2009). *The Internet in Britain 2009*. Oxford, UK. Retrieved from <http://oxis.oii.ox.ac.uk/reports/>

Easton, C. (2013). An examination of the Internet's development as a disabling environment in the context of the social model of disability and anti-discrimination legislation in the UK and USA. *Universal Access in the Information Society*, 12(1), 105–114.
<https://doi.org/10.1007/s10209-011-0268-2>

Edwards, Alistair, D. N. (1989). Soundtrack: An auditory interface for blind users. *Human-Computer Interaction*, 4, 45–66. [https://doi.org/https://doi.org/10.1016/0003-6870\(90\)90161-p](https://doi.org/https://doi.org/10.1016/0003-6870(90)90161-p)

Egan, J., Worrall, L., & Oxenham, D. (2004). Accessible Internet training package helps people with aphasia cross the digital divide. *Aphasiology*, 18(3), 265–280.
<https://doi.org/10.1080/02687030344000562>

Elman, R. J. (2001). The Internet and aphasia: Crossing the digital divide. *Aphasiology*, 15(10–11), 895–899. <https://doi.org/10.1080/02687040143000267>

Elman, R. J., & Larsen, S. (2010). Computer and Internet use among people with aphasia (oral presentation). In *Clinical Aphasiology Conference*. Isle of Palms, SC. Retrieved from <http://aphasiology.pitt.edu/2161/>

Engelter, S. T., Gostynski, M., Papa, S., Frei, M., Born, C., Ajdacic-Gross, V., ... Lyrer, P. A. (2006). Epidemiology of aphasia attributable to first ischemic stroke: Incidence, severity, fluency, etiology, and thrombolysis. *Stroke*, 37(6), 1379–1384.

<https://doi.org/10.1161/01.STR.0000221815.64093.8c>

Estes, C., & Bloom, R. L. (2011). Using voice recognition software to treat dysgraphia in a patient with conduction aphasia. *Aphasiology*, 25(3), 366–385.

<https://doi.org/10.1080/02687038.2010.493294>

Eysenbach, G., Powell, J., Englesakis, M., Rizo, C., & Stern, A. (2004). Health related virtual communities and electronic support groups: systematic review of the effects of online peer to peer interactions. *BMJ (Clinical Research Ed.)*, 328(7449), 1166.

<https://doi.org/10.1136/bmj.328.7449.1166>

Fairbanks, G. (1940). *Voice and articulation: Drillbook*. Harper & Brothers.

Finch, E., & Hill, A. J. (2014). Computer use by people with aphasia: A survey investigation. *Brain Impairment*, 15(2), 107–119. <https://doi.org/10.1017/BrImp.2014.17>

Forbes, P., Gibson, L., Hanson, V. L., Gregor, P., & Newell, A. F. (2009). Dundee user centre – a space where older people and technology meet. In *ASSETS'09* (pp. 231–232). Pittsburgh, Pennsylvania. <https://doi.org/10.1145/1639642.1639690>

Frey, J.-C., Stemle, E. W., & Glaznieks, A. (2014). Collecting language data of non-public social media profiles. In *Workshop Proceedings of the 12th Edition of the KONVENS Conference (2014)* (pp. 11–15). Hildesheim, Germany. Retrieved from <http://www.uni-hildesheim.de/konvens2014/data/konvens2014-workshop-proceedings.pdf>

Fridler, N., Rosen, K., Menahemi-Falkov, M., Herzberg, O., Lev, A., Kaplan, D., ... Shani, M. (2012). Tele-Rehabilitation Therapy vs. Face-to-Face Therapy for Aphasic Patients. In *eTELEMED 2012: The Fourth International Conference on eHealth, Telemedicine, and Social Medicine* (pp. 18–23).

Friederici, A. D., & Frazier, L. (1992). Thematic analysis in agrammatic comprehension: Syntactic

structures and task demands. *Brain and Language*, 42(1), 1–29.

[https://doi.org/10.1016/0093-934X\(92\)90053-H](https://doi.org/10.1016/0093-934X(92)90053-H)

Friemel, T. N. (2016). The digital divide has grown old: Determinants of a digital divide among seniors. *New Media & Society*, 18(2), 313–331.

<https://doi.org/10.1177/1461444814538648>

Fromm, D., Greenhouse, J., Hou, K., Russell, G. A., Cai, X., Forbes, M., ... MacWhinney, B. (2016). Automated proposition density analysis for discourse in aphasia. *Journal of Speech, Language, and Hearing Research*, 59(5), 1123–1132.

https://doi.org/https://doi.org/10.1044/2016_jslhr-l-15-0401

Fucetola, R., Connor, L. T., Strube, M. J., & Corbetta, M. (2009). Unravelling nonverbal cognitive performance in acquired aphasia. *Aphasiology*, 23(12), 1418–1426.

<https://doi.org/10.1080/02687030802514938>

Galliers, J., & Wilson, S. (2013). An exploratory study into the accessibility of a multi-user virtual world for young people with aphasia. In *Proceedings of the 27th International BCS Human Computer Interaction Conference*. Retrieved from

<http://dl.acm.org/citation.cfm?id=2578048.2578083>

Galliers, J., Wilson, S., Roper, A., Cocks, N., Marshall, J., Muscroft, S., & Pring, T. (2012). Words are not enough: empowering people with aphasia in the design process. In *PDC'12* (pp. 51–60). Roskilde, Denmark. <https://doi.org/10.1145/2347635.2347643>

Georgeadis, A. C., Brennan, D. M., Barker, L. M., & Baron, C. R. (2004). Telerehabilitation and its effect on story retelling by adults with neurogenic communication disorders. *Aphasiology*, 18(5–7), 639–652. <https://doi.org/10.1080/02687030444000075>

Ghidella, C., Murray, S., Smart, M., McKenna, K., & Worrall, L. (2005). Aphasia websites: An examination of their quality and communicative accessibility. *Aphasiology*, 19(12), 1134–

1146. <https://doi.org/10.1080/02687030500337871>

Gibson, L., Forbes, P., & Hanson, V. (2003). What can the “ash cloud” tell us about older adults’ technology adoption? In *ASSETS’10* (Vol. 2, pp. 301–302). Orlando, Florida, USA.

<https://doi.org/10.1017/S0144686X03001302>

Goodglass, H., Kaplan, E., & Barresi, B. (1983). *Boston diagnostic aphasia examination booklet* (Third). Lea & Febiger Philadelphia, PA.

Grammarly Inc. (2016). Grammarly. Retrieved December 9, 2016, from

<https://www.grammarly.com>

Green, M., & Rossall, P. (2013). *Age UK digital inclusion evidence report*.

<https://doi.org/https://doi.org/10.1310/tsr1504-307>

Greene, J. C., Caracelli, V. J., & Graham, W. F. (1989). Toward a conceptual framework for mixed-method evaluation designs. *Educational Evaluation and Policy Analysis*, *11*(3), 255–274. <https://doi.org/10.3102/01623737011003255>

Greig, C.-A., Harper, R., Hirst, T., Howe, T., & Davidson, B. (2008). Barriers and facilitators to mobile phone use for people with aphasia. *Topics in Stroke Rehabilitation*, *15*(4), 307–324.

Gustavsson, M., Ytterberg, C., Tham, K., Nabsen Marwaa, M., & Guidetti, S. (2016). Experiences of using information and communication technology within the first year after stroke - a grounded theory study. *Disability & Rehabilitation (Advance Online Publication)*.

<https://doi.org/10.1080/09638288.2016.1264012>

Hall, N., Boisvert, M., & Steele, R. (2013). Telepractice in the assessment and treatment of individuals with aphasia : A systematic review. *International Journal of Telerehabilitation*, *5*(1), 27–38. <https://doi.org/https://doi.org/10.5195/ijt.2013.6119>

Hammersley, M. (2008). *Questioning qualitative inquiry: Critical essays*. London: SAGE

Publications.

Hanson, V. L. (2009). Age and web access: The next generation. In *Proceedings of the W4A'09*. Madrid, Spain: Association for Computing Machinery.

<https://doi.org/10.1145/1535654.1535658>

Hanson, V. L., & Richards, J. T. (2013). Progress on website accessibility. *ACM Transactions on the Web (TWEB)*, 7(1). <https://doi.org/https://doi.org/10.1145/2435215.2435217>

Harvey, J., Hux, K., & Snell, J. (2013). Using text-to-speech reading support for an adult with mild aphasia and cognitive impairment. *Communication Disorders Quarterly*, 35(1), 39–43.

<https://doi.org/10.1177/1525740113496843>

Helm-Estabrooks, N. (2001). *Cognitive linguistic quick test*. Bloomington, MN: NCS Pearson, Inc.

Helm-Estabrooks, N. (2002). Cognition and aphasia: A discussion and a study. *Journal of Communication Disorders*, 35(2), 171–186. [https://doi.org/10.1016/S0021-9924\(02\)00063-1](https://doi.org/10.1016/S0021-9924(02)00063-1)

Helsper, E. J. (2008). *Digital Inclusion : An analysis of social disadvantage and the information society*. Department for Communities and Local Government. London, UK. Retrieved from <http://eprints.lse.ac.uk/26938/>

Helsper, E. J., & Reisdorf, B. C. (2013). A quantitative examination of explanations for reasons for Internet nonuse. *Cyberpsychology, Behavior and Social Networking*, 16(2), 94–99.

<https://doi.org/10.1089/cyber.2012.0257>

Helsper, E. J., & Reisdorf, B. C. (2016). The emergence of a “digital underclass” in Great Britain and Sweden: Changing reasons for digital exclusion. *New Media & Society*, 1–18.

<https://doi.org/https://doi.org/10.1177/1461444816634676>

Herbert, R., Haw, C., Brown, C., Gregory, E., & Brumfitt, S. (2012). *Accessible information*

guidelines: Making information accessible for people with aphasia. London, UK: The Stroke Association. Retrieved from <https://www.stroke.org.uk>

Hersh, D., Worrall, L., Howe, T., Sherratt, S., & Davidson, B. (2012). SMARTER Goal Setting in Aphasia Rehabilitation. *Aphasiology*, *26*(2), 220–233.
<https://doi.org/10.1080/02687038.2011.640392>

Hilari, K. (2011). The impact of stroke: Are people with aphasia different to those without? *Disability and Rehabilitation*, *33*(3), 211–218.
<https://doi.org/10.3109/09638288.2010.508829>

Hilari, K., Byng, S., Lamping, D. L., & Smith, S. C. (2003). Stroke and aphasia quality of life scale-39 (SAQOL-39): Evaluation of acceptability, reliability, and validity. *Stroke*, *34*, 1944–1950.
<https://doi.org/10.1161/01.STR.0000081987.46660.ED>

Hilari, K., Needle, J. J., & Harrison, K. L. (2012). What are the important factors in health-related quality of life for people with aphasia? A systematic review. *Archives of Physical Medicine and Rehabilitation*, *93*(1), S86–S95. <https://doi.org/10.1016/j.apmr.2011.05.028>

Hilari, K., & Northcott, S. (2016). “Struggling to stay connected”: comparing the social relationships of healthy older people and people with stroke and aphasia. *Aphasiology*, *31*(6), 674–687. <https://doi.org/10.1080/02687038.2016.1218436>

Hill, A. J., Theodoros, D. G., Russell, T. G., Ward, E. C., & Wootton, R. (2009). The effects of aphasia severity on the ability to assess language disorders via telerehabilitation. *Aphasiology*, *23*(5), 627–642. <https://doi.org/10.1080/02687030801909659>

Hinckley, J., Boyle, E., Lombard, D., & Bartels-Tobin, L. (2014). Towards a consumer-informed research agenda for aphasia: preliminary work. *Disability and Rehabilitation*, *36*(12), 1042–1050. <https://doi.org/10.3109/09638288.2013.829528>

- Hoffmann, T. C., Glasziou, P. P., Boutron, I., Milne, R., Perera, R., Moher, D., ... Michie, S. (2014). Better reporting of interventions: Template for intervention description and replication (TIDieR) checklist and guide. *BMJ (Online)*, *348*(March), 1–12.
<https://doi.org/10.1136/bmj.g1687>
- Holland, A. L. (1970). Case studies in aphasia rehabilitation using programmed instruction. *Journal of Speech and Hearing Disorders*, *35*(4), 377–390.
<https://doi.org/https://doi.org/10.1044/jshd.3504.377>
- Holland, A. L., Weinberg, P., & Dittelman, J. (2012). How to use apps clinically in the treatment of aphasia. In *Seminars in Speech and Language* (Vol. 33, pp. 223–233).
- Hoover, E. L., & Carney, A. (2014). Integrating the iPad into an intensive, comprehensive aphasia program. *Seminars in Speech and Language*, *35*(1), 25–37. <https://doi.org/10.1055/s-0033-1362990>
- Howard, D., Swinburn, K., & Porter, G. (2010). Putting the CAT out: What the Comprehensive Aphasia Test has to offer. *Aphasiology*, *24*(1), 56–74.
- Hux, K., Buechter, M., Wallace, S., & Weissling, K. (2010). Using visual scene displays to create a shared communication space for a person with aphasia. *Aphasiology*, *24*(5), 643–660.
<https://doi.org/10.1080/02687030902869299>
- Hynan, A., Murray, J., & Goldbart, J. (2014). “Happy and excited”: Perceptions of using digital technology and social media by young people who use augmentative and alternative communication. *Child Language Teaching and Therapy*, *30*(2), 175–186.
<https://doi.org/10.1177/0265659013519258>
- Internet Society. (2016). Global Internet Report 2016. Retrieved from
<https://www.internetsociety.org/globalinternetreport/2016>

- Jacobs, B., Drew, R., Ogletree, B. T., & Pierce, K. (2004). Augmentative and Alternative Communication (AAC) for adults with severe aphasia: Where we stand and how we can go further. *Disability and Rehabilitation*, 26(21–22), 1231–1240.
<https://doi.org/10.1080/09638280412331280244>
- Jacobs, B., & Thompson, C. (2000). Cross-modal generalization effects of training noncanonical sentence comprehension and production in agrammatic aphasia. *Journal of Speech, Language, and Hearing Research*, 43(1), 5–20.
<https://doi.org/https://doi.org/10.1044/jslhr.4301.05>
- Jaeger, P. T. (2012). *Disability and the Internet: Confronting a digital divide*. Boulder, CO: Lynne Rienner Publishers.
- Johnson, L., Morris, J., & Menger, F. (2014). Facilitating the use of technology with people with aphasia : What are the challenges for SLTs? (poster presentation). In *British Aphasiology Society Research Update Meeting*. Newcastle upon Tyne.
- Kagan, A., Simmons-Mackie, N., Rowland, A., Huijbregts, M., Shumway, E., McEwen, S., ... Sharp, S. (2008). Counting what counts: A framework for capturing real-life outcomes of aphasia intervention. *Aphasiology*, 22(3), 258–280. <https://doi.org/10.1080/02687030701282595>
- Kane, S. K., Linam-Church, B., Althoff, K., & McCall, D. (2012). What we talk about: Designing a context-aware communication tool for people with aphasia. In *ASSETS'12*. Boulder, CO.
<https://doi.org/10.1145/2384916.2384926>
- Katz, R. C., Wertz, R. T., Davidoff, M., Shubitowski, Y. D., & West Devitt, E. (1989). A computer program to improve written confrontation naming in aphasia. *Clinical Aphasiology*, 18, 321–337.
- Kay, J., Coltheart, M., & Lesser, R. (1992). *PALPA: Psycholinguistic assessments of language processing in aphasia*. Psychology Press.

- Kelly, H., Kennedy, F., Britton, H., McGuire, G., & Law, J. (2016). Narrowing the “digital divide”—facilitating access to computer technology to enhance the lives of those with aphasia: A feasibility study. *Aphasiology*, *30*(2–3), 133–163.
<https://doi.org/10.1080/02687038.2015.1077926>
- Kerr, J., Hilari, K., & Litosseliti, L. (2010). Information needs after stroke: What to include and how to structure it on a website. A qualitative study using focus groups and card sorting. *Aphasiology*, *24*(10), 1170–1196. <https://doi.org/10.1080/02687030903383738>
- Knight, D., Adolphs, S., & Carter, R. (2014). CANELC: constructing an e-language corpus. *Corpora*, *9*(1), 29–56. <https://doi.org/10.3366/cor.2014.0050>
- Koppenol, T., Al Mahmud, A., & Martens, J.-B. (2010). When words fall short: Helping people with aphasia to express. In K. Miesenberger, J. Klaus, W. Zagler, & A. Karshmer (Eds.), *Computers helping people with special needs: 12th International Conference, ICCHP 2010, Vienna, Austria, July 2010, Proceedings, Part II* (pp. 45–48). Berlin: Springer.
https://doi.org/10.1007/978-3-642-14100-3_8
- Koss, V., Azad, S., Gurm, A., & Rosenthal, E. (2012). “This is for everyone”: The case for universal digitisation. Booz & Company. Retrieved from
<https://www.strategyand.pwc.com/reports/this-everyone-case-universal-digitisation>
- Kurland, J. (2014). iRehab in aphasia treatment. *Seminars in Speech and Language*, *35*(1), 3–4.
<https://doi.org/10.1055/s-0033-1362989>
- Leff, A., Ong, Y. H., Brown, M. M., Plant, G. T., & Husain, M. (2012). Read-Right: Free Web-based Therapy for Stroke Patients with Alexia. *Journal of Neurology, Neurosurgery & Psychiatry*, *83*(3), e1. <https://doi.org/https://doi.org/10.1136/jnnp-2011-301993.13>
- Levelt, W. J. M., Roelofs, A., & Meyer, A. S. (1999). A theory of lexical access in speech production. *Behavioral and Brain Sciences*, *22*(1), 1–38.

<https://doi.org/10.1017/S0140525X99001776>

Litt, E. (2013). Measuring users' Internet skills: A review of past assessments and a look toward the future. *New Media & Society*, *15*(4), 612–630.

<https://doi.org/10.1177/1461444813475424>

Loverso, F. L., Prescott, T. E., Selinger, M., & Riley, L. (1989). Comparison of two modes of aphasia treatment: Clinician and computer-clinician assisted. *Clinical Aphasiology*, *18*, 297–319.

Low Incomes Tax Reform Group. (2012). *Digital Exclusion*. London. Retrieved from <http://www.litrg.org.uk>

Lum, C. (2002). *Scientific thinking in speech and language therapy*. Mahwah, New Jersey: Lawrence Erlbaum Associates.

Marshall, J., Booth, T., Devane, N., Galliers, J., Greenwood, H., Hilari, K., ... Woolf, C. (2016). Evaluating the benefits of aphasia intervention delivered in virtual reality: Results of a quasi-randomised study. *PLoS ONE*, *11*(8), 1–18.

<https://doi.org/https://doi.org/10.1371/journal.pone.0160381>

Marshall, J., Roper, A., Galliers, J., Wilson, S., Cocks, N., Muscroft, S., & Pring, T. (2013). Computer delivery of gesture therapy for people with severe aphasia. *Aphasiology*, *27*(9), 27(9): 1128-1146. <https://doi.org/10.1080/02687038.2013.786803>

McGrenere, J., Davies, R., Findlater, L., Graf, P., Klawe, M., Moffat, K., ... Yang, S. (2003). Insights from the aphasia project: Designing technology for and with people who have aphasia. In *Proceedings of 2013 ACM Conference on Universal Usability (CUU)* (pp. 112–118).

Vancouver, BC, Canada: ACM. <https://doi.org/https://doi.org/10.1145/960201.957225>

McKevitt, C., Fudge, N., Redfern, J., Sheldenkar, A., Crichton, S., Rudd, A. R., ... Wolfe, C. D. A.

(2011). Self-reported long-term needs after stroke. *Stroke*, 42(5), 1398–1403.
<https://doi.org/10.1161/STROKEAHA.110.598839>

Menger, F., Morris, J., & Salis, C. (2016). Aphasia in an Internet age: Wider perspectives on digital inclusion. *Aphasiology*, 30(2–3), 112–132.
<https://doi.org/10.1080/02687038.2015.1109050>

Messamer, P., Ramsberger, G., & Atkins, A. (2016). BangaSpeak: an example of app design for aphasia clients and SLP users. *Aphasiology*, 30(2–3), 164–185.
<https://doi.org/10.1080/02687038.2015.1102856>

Moffatt, K., McGrenere, J., Purves, B., & Klawe, M. (2004). The participatory design of a sound and image enhanced daily planner for people with aphasia. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 407–414). New York.
<https://doi.org/10.1145/985692.985744>

Moffatt, K., Pourshahid, G., & Baecker, R. M. (2017). Augmentative and alternative communication devices for aphasia: the emerging role of “smart” mobile devices. *Universal Access in the Information Society*, 16(1), 115–128. <https://doi.org/10.1007/s10209-015-0428-x>

Montepare, J. M., & Lachman, M. E. (1989). “You’re only as old as you feel”: self-perceptions of age, fears of aging, and life satisfaction from adolescence to old age. *Psychology and Aging*, 4(1), 73–78. <https://doi.org/10.1037/0882-7974.4.1.73>

Mortley, J., Wade, J., Davies, A., & Enderby, P. (2003). An investigation into the feasibility of remotely monitored computer therapy for people with aphasia. *Advances in Speech Language Pathology*, 5(1), 27–36. <https://doi.org/10.1080/14417040510001669021>

Moss, B., Hilari, K., Marshall, J., & Woolf, C. (2014). Can assistive technologies compensate for writing and reading deficits and promote social participation for people with aphasia after

- stroke? (poster presentation). In *British Aphasiology Society Research Update Meeting*. Newcastle upon Tyne, UK.
- Murray, L. (1999). Attention and aphasia: theory, research and clinical implications. *Aphasiology*, *13*(2), 91–111. <https://doi.org/10.1080/026870399402226>
- Murray, L., Timberlake, A., & Eberle, R. (2007). Treatment of underlying forms in a discourse context. *Aphasiology*, *21*(2), 139–163. <https://doi.org/10.1080/02687030601026530>
- My Byline Media. (2017). Dall-Chall readability calculator. Retrieved March 20, 2017, from <http://www.readabilityformulas.com/free-dale-chall-test.php>
- Nettleton, J., & Lesser, R. (1991). Therapy for naming difficulties in aphasia: Application of a cognitive neuropsychological model. *Journal of Neurolinguistics*, *6*(2), 139–157. [https://doi.org/10.1016/0911-6044\(91\)90004-3](https://doi.org/10.1016/0911-6044(91)90004-3)
- Newcastle University. (2017). Aphasia Research User Group (ARUG). Retrieved May 20, 2017, from <http://www.ncl.ac.uk/ecls/research/speechlanguage/arug/#ourservices>
- Nicholas, M., Sinotte, M. P., & Helm-Estabrooks, N. (2005). Using a computer to communicate: Effect of executive function impairments in people with severe aphasia. *Aphasiology*, *19*(10–11), 1052–1065. <https://doi.org/10.1080/02687030544000245>
- Nickels, L. (n.d.). Nickels naming test (shortened). Unpublished.
- North East Trust for Aphasia. (2017). North East Trust for Aphasia Activities. Retrieved July 13, 2017, from <http://www.neta.org.uk/activities.html>
- Northcott, S., & Hilari, K. (2017). “I’ve got somebody there, someone cares”: What support is most valued following a stroke? *Disability and Rehabilitation Advance Online Publication*. <https://doi.org/10.1080/09638288.2017.1337242>

- Northcott, S., Moss, B., Harrison, K., & Hilari, K. (2016). A systematic review of the impact of stroke on social support and social networks: Associated factors and patterns of change. *Clinical Rehabilitation*, 30(8), 811–831. <https://doi.org/10.1177/0269215515602136>
- Noyes, J. M., & Garland, K. J. (2008). Computer- vs. paper-based tasks: Are they equivalent? *Ergonomics*, 51(9), 1352–1375. <https://doi.org/10.1080/00140130802170387>
- Nyman, A., & Isaksson, G. (2015). Togetherness in another way: Internet as a tool for togetherness in everyday occupations among older adults. *Scandinavian Journal of Occupational Therapy*, 22(5), 387–393. <https://doi.org/10.3109/11038128.2015.1020867>
- Obergfell, R. (2016). Experience: I was out at sea when a tsunami struck. *The Guardian Online*. Retrieved from <https://www.theguardian.com/>
- Ofcom. (2015). *The Communications Market Report*. Retrieved from https://www.ofcom.org.uk/__data/assets/pdf_file/0022/20668/cmr_uk_2015.pdf
- Office for National Statistics. (2016). Internet users in the UK : 2016. Retrieved from <https://www.ons.gov.uk/businessindustryandtrade/itandinternetindustry/bulletins/internetusers/2016>
- Office for National Statistics. (2017a). Internet Access - Households and Individuals. Retrieved from <https://www.ons.gov.uk/peoplepopulationandcommunity/householdcharacteristics/homeinternetandsocialmediausage/bulletins/internetaccesshouseholdsandindividuals/2017>
- Office for National Statistics. (2017b). Internet users in the UK : 2017. Retrieved from <https://www.ons.gov.uk/businessindustryandtrade/itandinternetindustry/bulletins/internetusers/2017>
- Office for National Statistics. (2017c). The Office for National Statistics. Retrieved August 14,

2017, from <https://www.ons.gov.uk>

Oh, H. J., Ozkaya, E., & LaRose, R. (2014). How does online social networking enhance life satisfaction? The relationships among online supportive interaction, affect, perceived social support, sense of community, and life satisfaction. *Computers in Human Behavior, 30*, 69–78. <https://doi.org/10.1016/j.chb.2013.07.053>

Oliver, M., & British Association of Social Workers. (1983). *Social work with disabled people*. London: Macmillan.

Oxford Internet Institute. (2014). The Oxford Internet Surveys. Retrieved from <http://oxis.oii.ox.ac.uk>

Page, R., Barton, D., Unger, J. W., & Zappavigna, M. (2014). *Researching language and social media: A student guide*. Abingdon, Oxon: Routledge.

Palmer, R., Cooper, C., Enderby, P., Brady, M., Julious, S., Bowen, A., & Latimer, N. (2015). Clinical and cost effectiveness of computer treatment for aphasia post stroke (Big CACTUS): study protocol for a randomised controlled trial. *Trials, 16*(1), 18. <https://doi.org/10.1186/s13063-014-0527-7>

Palmer, R., Enderby, P., Cooper, C., Latimer, N., Julious, S., Paterson, G., ... Hughes, H. (2012). Computer therapy compared with usual care for people with long-standing aphasia poststroke: A pilot randomized controlled trial. *Stroke, 43*(7), 1904–1911. <https://doi.org/10.1161/STROKEAHA.112.650671>

Palmer, R., Enderby, P., & Paterson, G. (2013). Using computers to enable self-management of aphasia therapy exercises for word finding: The patient and carer perspective. *International Journal of Language and Communication Disorders, 48*(5), 508–521. <https://doi.org/10.1111/1460-6984.12024>

- Parr, S. (1992). Everyday reading and writing practices of normal adults: Implications for aphasia assessment. *Aphasiology*, 6(3), 273–283. <https://doi.org/10.1080/02687039208248597>
- Parr, S. (1996). Everyday literacy in aphasia: Radical approaches to functional assessment and therapy. *Aphasiology*, 10(5), 469–479.
<https://doi.org/https://doi.org/10.1080/02687039608248426>
- Parr, S. (2007). Living with severe aphasia: Tracking social exclusion. *Aphasiology*, 21(1), 98–123.
<https://doi.org/https://doi.org/10.1080/02687030600798337>
- Pearl, G. (2014). *Engaging with people who have aphasia. A set of resources for stroke researchers*. NHS National Institute for Health Research. Retrieved from <https://www.nihr.ac.uk/nihr-in-your-area/stroke/aphasia.htm>
- Pedersen, P. M., Jørgensen, H. S., Nakayama, H., Raaschou, H. O., & Olsen, T. S. (1995). Aphasia in acute stroke: Incidence, determinants, and recovery. *Annals of Neurology*, 38(4), 659–666. <https://doi.org/10.1002/ana.410380416>
- Penfriend Ltd. (1999). Penfriend XL. Retrieved from <http://www.penfriend.biz>
- Penfriend Ltd. (2012). Getting started with Penfriend. Retrieved February 20, 2017, from <https://www.youtube.com/watch?v=wrro912Xp4g>
- Piper, A. M., Weibel, N., & Hollan, J. D. (2011). Write-N-Speak: Authoring multimodal digital-paper materials for Speech-Language Therapy. *ACM Transactions on Accessible Computing*, 4(1), 1–20. <https://doi.org/10.1145/2039339.2039341>
- Piper, A. M., Weibel, N., & Hollan, J. D. (2014). Designing audio-enhanced paper photos for older adult emotional wellbeing in communication therapy. *International Journal of Human-Computer Studies*, 72(8–9), 629–639. <https://doi.org/10.1016/j.ijhcs.2014.01.002>
- Podsakoff, P. M., MacKenzie, S. B., & Podsakoff, N. P. (2012). Sources of method bias in social

- science research and recommendations on how to control it. *Annual Review of Psychology*, 63(1), 539–569. <https://doi.org/10.1146/annurev-psych-120710-100452>
- Pricewaterhouse Coopers LLP. (2009). *Champion for digital inclusion: The economic case for digital inclusion*. Retrieved from http://parliamentandinternet.org.uk/wp-content/uploads/Final_report.pdf
- Pring, T. (2005). *Research methods in communication disorders*. London: Wiley.
- Purdy, M., & Koch, A. (2006). Prediction of strategy usage by adults with aphasia. *Aphasiology*, 20(2–4), 337–348. <https://doi.org/10.1080/02687030500475085>
- Quan-Haase, A., Martin, K., & Schreurs, K. (2016). Interviews with digital seniors: ICT use in the context of everyday life. *Information, Communication & Society*, 4(5). <https://doi.org/https://doi.org/10.1080/1369118x.2016.1140217>
- Raghavendra, P., Newman, L., Grace, E., & Wood, D. (2015). Enhancing social participation in young people with communication disabilities living in rural Australia: Outcomes of a home-based intervention for using social media. *Disability and Rehabilitation*, 37(17), 1576–1590. <https://doi.org/10.3109/09638288.2015.1052578>
- Ramsberger, G., & Messamer, P. (2014). Best practices for incorporating non-aphasia-specific apps into therapy. *Seminars in Speech and Language*, 35(1), 17–24. <https://doi.org/https://doi.org/10.1055/s-0033-1362992>
- Renvall, K., Nickels, L., & Davidson, B. (2013). Functionally relevant items in the treatment of aphasia (part I): Challenges for current practice. *Aphasiology*, 27(6), 636–650. <https://doi.org/10.1080/02687038.2013.786804>
- Ritchie, J., Lewis, J., McNaughton Nichols, C., & Ormston, R. (2003). *Qualitative research practice: A guide for social science students and researchers*. London: SAGE Publications

Ltd.

- Rocca, J. (2017). Countwordsworth. A fitting way to track your literature-related metrics. Retrieved January 27, 2017, from <http://countwordsworth.com>
- Rose, T. A., Worrall, L. E., Hickson, L. M., & Hoffmann, T. C. (2011). Aphasia friendly written health information: Content and design characteristics. *International Journal of Speech-Language Pathology, 13*(4), 335–347. <https://doi.org/10.3109/17549507.2011.560396>
- Salis, C., & Edwards, S. (2010). Treatment of written verb and written sentence production in an individual with aphasia: A clinical study. *Aphasiology, 24*(9), 1051–1063. <https://doi.org/10.1080/02687030903269648>
- Schretlen, D. (2010). *Modified Wisconsin Card Sorting Test® (M-WCST™)*. Lutz, FL: PAR.
- Shadden, B. (2005). Aphasia as identity theft: Theory and practice. *Aphasiology, 19*(March), 211–223. <https://doi.org/10.1080/02687930444000697>
- Sherbourne, C. D., & Stewart, A. L. (1991). The MOS social support survey. *Social Science and Medicine, 32*(6), 705–714. [https://doi.org/10.1016/0277-9536\(91\)90150-B](https://doi.org/10.1016/0277-9536(91)90150-B)
- Silverman, D. (2006). *Interpreting qualitative data: Methods for analyzing talk, text and interaction*. London: SAGE Publications Ltd.
- Simmons-Mackie, N., & Kagan, A. (2007). Application of the ICF in aphasia. *Seminars in Speech and Language, 28*(4), 244–253. <https://doi.org/10.1055/s-2007-986521>
- Simmons-Mackie, N., Worrall, L., Murray, L. L., Enderby, P., Rose, M. L., Paek, E. J., & Klippi, A. (2017). The top ten: best practice recommendations for aphasia. *Aphasiology, 31*(2), 131–151. <https://doi.org/10.1080/02687038.2016.1180662>
- Simpson, J. (2009). Inclusive information and communication technologies for people with

disabilities. *Disability Studies Quarterly*, 29(1).

<https://doi.org/https://doi.org/10.18061/dsq.v29i1.167>

Smith, M. C., & Smith, T. J. (2010). Adults' uses of computer technology: Associations with literacy tasks. *Journal of Educational Computing Research*, 42(4), 407–422.

<https://doi.org/10.2190/EC.42.4.c>

Social Inclusion Unit. (2004). *The Social Exclusion Unit*.

Speakeasy. Supporting Communication. (2017). Speakeasy.

<https://doi.org/https://doi.org/10.1080/02687030903490541>

Spencer, E., Craig, H., Ferguson, A., & Colyvas, K. (2012). Language and ageing - exploring propositional density in written language - stability over time. *Clinical Linguistics & Phonetics*, 26(9), 743–754. <https://doi.org/10.3109/02699206.2012.673046>

Steele, R. D., Weinrich, M., Wertz, R. T., Kleczewska, M. K., & Carlson, G. S. (1989). Computer-based visual communication in aphasia. *Neuropsychologia*, 27(4), 409–426.

[https://doi.org/https://doi.org/10.1016/0028-3932\(89\)90048-1](https://doi.org/https://doi.org/10.1016/0028-3932(89)90048-1)

Suleman, S., & Kim, E. (2015). Decision-making, cognition, and aphasia: developing a foundation for future discussions and inquiry. *Aphasiology*, 29(12), 1409–1425.

<https://doi.org/10.1080/02687038.2015.1049584>

Swinburn, K., & Byng, S. (2006). *The Communication Disability Profile*. London: Connect Press.

Swinburn, K., Porter, G., & Howard, D. (2004). *The Comprehensive Aphasia Test*. Hove, East Sussex: Psychology Press.

Szabo, G., & Dittelman, J. (2014). Using mobile technology with individuals with aphasia: Native iPad features and everyday apps. *Seminars in Speech and Language*, 35(1), 5–16.

<https://doi.org/10.1055/s-0033-1362993>

- Tabachnick, B. G., & Fidell, L. S. (2013). *Using Multivariate Statistics* (6th ed.). Pearson.
- Tactus Therapy. (n.d.). Language Therapy. Retrieved August 16, 2017, from <http://tactustherapy.com>
- Tate, R. L., Perdices, M., McDonald, S., Togher, L., & Rosenkoetter, U. (2014). The design, conduct and report of single-case research: Resources to improve the quality of the neurorehabilitation literature. *Neuropsychological Rehabilitation, 0*(0), 1–17. <https://doi.org/10.1080/09602011.2013.875043>
- Tech Partnership. (2017). Tech Partnership: Skills for the digital economy. Retrieved August 15, 2017, from <https://www.digitalskills.com/>
- Tee, K., Moffatt, K., Findlater, L., MacGregor, E., McGrenere, J., Purves, B., & Fels, S. S. (2005). A visual recipe book for persons with language impairments. In *Proceedings of CHI 2005 Conference on Human Factors in Computing Systems*. Portland, Oregon. <https://doi.org/10.1145/1054972.1055042>
- The Tavistock Trust for Aphasia. (n.d.). *The Aphasia Software Finder*. Retrieved from <https://www.aphasiasoftwarefinder.org>
- Thiel, L. (2015). *Applying therapies and technologies to the treatment of dysgraphia: Combining neuropsychological techniques and compensatory devices to enhance use of writing via the Internet*. University of Manchester, Manchester, UK. Retrieved from https://www.research.manchester.ac.uk/portal/files/54573284/FULL_TEXT.PDF
- Thiel, L., Sage, K., & Conroy, P. (2014). Training people with aphasia to use word prediction software for email writing. In *British Aphasiology Society Therapy Symposium*. Birmingham City University.
- Thiel, L., Sage, K., & Conroy, P. (2015). Retraining writing for functional purposes : A review of

the writing therapy literature. *Aphasiology*, 29(4), 423–441.

<https://doi.org/10.1080/02687038.2014.965059>

Thiel, L., Sage, K., & Conroy, P. (2016). Promoting linguistic complexity, greater message length and ease of engagement in email writing in people with aphasia: initial evidence from a study utilizing assistive writing software. *International Journal of Language & Communication Disorders*, 52(1), 106–124. <https://doi.org/10.1111/1460-6984.12261>

Thompson, C. K., & Shapiro, L. P. (1995). Analysis of verbs and verb-argument structure: A method for quantification of aphasic language production. *Clinical Aphasiology*, 23, 121–140.

Turner, S., & Whitworth, A. (2006). Conversational partner training programmes in aphasia: A review of key themes and participants' roles. *Aphasiology*, 20(6), 483–510.

<https://doi.org/10.1080/02687030600589991>

UK Government. (2012). Broadband roll-out moves into top gear. Retrieved December 31, 2015, from <https://www.gov.uk/government/news/broadband-roll-out-moves-into-top-gear--2>

UK Government. (2017). *Digital skills and inclusion - giving everyone access to the digital skills they need*. Retrieved from <https://www.gov.uk/government/publications/uk-digital-strategy/2-digital-skills-and-inclusion-giving-everyone-access-to-the-digital-skills-they-need>

UK Online Centres. (2008). *Digital inclusion, social impact: A research study*. Retrieved from <http://tinyurl.com/yauc2pck>

Ulmer, E., Hux, K., Brown, J., Nelms, T., & Reeder, C. (2016). Using self-captured photographs to support the expressive communication of people with aphasia. *Aphasiology Advance Online Publication*, December. <https://doi.org/10.1080/02687038.2016.1274872>

Van de Sandt-Koenderman, M. E. (2004). High-tech AAC and aphasia: Widening horizons?

Aphasiology, 18(3), 245–263. <https://doi.org/10.1080/02687030344000571>

Van de Sandt-Koenderman, M. E. (2011). Aphasia rehabilitation and the role of computer technology: Can we keep up with modern times? *International Journal of Speech-Language Pathology*, 13(1), 21–27. <https://doi.org/10.3109/17549507.2010.502973>

Van Deursen, A. J. A. M., & Helsper, E. J. (2015). A nuanced understanding of Internet use and non-use amongst the elderly. *European Journal of Communication*, 30(2), 171–187. <https://doi.org/10.1177/0267323115578059>

Van Deursen, A. J. A. M., & Van Dijk, J. A. G. M. (2010). Measuring Internet skills. *International Journal of Human-Computer Interaction*, 26(10), 891–916. <https://doi.org/10.1080/10447318.2010.496338>

Van Dijk, J. A. G. M. (2012). The evolution of the digital divide: The digital divide turns to inequality of skills and usage. *Digital Enlightenment Yearbook 2012*, 57–75. <https://doi.org/10.3233/978-1-61499-057-4-57>

Varley, R., Cowell, P. E., Dyson, L., Inglis, L., Roper, A., & Whiteside, S. P. (2016). Self-Administered Computer Therapy for Apraxia of Speech: Two-Period Randomized Control Trial with Crossover. *Stroke*, 47(3), 822–828. <https://doi.org/10.1161/STROKEAHA.115.011939>

Wade, D. T., Hewer, R. L., & David, R. M. (1986). Aphasia after stroke- natural history and associated. *Journal of Neurology, Neurosurgery & Psychiatry*, 49, 11–16.

Wade, J., Mortley, J., & Enderby, P. (2003). Talk about IT: Views of people with aphasia and their partners on receiving remotely monitored computer-based word finding therapy. *Aphasiology*, 17(11), 1031–1056. <https://doi.org/10.1080/02687030344000373>

Wade, J., Petheram, B., & Cain, R. (2001). Voice recognition and aphasia: Can computers

understand aphasic speech? *Disability and Rehabilitation*, 23(14), 604–613.

<https://doi.org/10.1080/09638280110044932>

Waller, A., Dennis, F., Brodie, J., & Cairns, A. Y. (1998). Evaluating the use of TalksBac, a predictive communication device for nonfluent adults with aphasia. *International Journal of Language and Communication Disorders*, 33(1), 45–70.

<https://doi.org/10.1080/136828298247929>

Watterson, B. (2001). *Calvin and Hobbes Sunday Pages 1985-1995*. Kansas City: Andrews McMeel Publishing.

Webster, J., Whitworth, A., & Morris, J. (2015). Is it time to stop “fishing”? A review of generalisation following aphasia intervention. *Aphasiology*, 29(11), 1240–1264.

<https://doi.org/10.1080/02687038.2015.1027169>

Wechsler, D. (1981). *Wechsler Adult Intelligence Scale—Revised*. San Antonio, TX: The Psychological Corporation.

Wechsler, D. (1987). WMS-R: Wechsler memory scale-revised.

Whitworth, A., Claessen, M., Leitão, S., & Webster, J. (2015). Beyond narrative: Is there an implicit structure to the way in which adults organise their discourse? *Clinical Linguistics & Phonetics*, 29(6), 455–481. <https://doi.org/10.3109/02699206.2015.1020450>

Whitworth, A., Leitão, S., Cartwright, J., Webster, J., Hankey, G., Zach, J., ... Wolz, V. (2015). NARNIA: a new twist to an old tale. A pilot RCT to evaluate a multilevel approach to improving discourse in aphasia. *Aphasiology*, 29(11), 1345–1382.

<https://doi.org/10.1080/02687038.2015.1081143>

Whitworth, A., Webster, J., & Howard, D. (2014). *A cognitive neuropsychological approach to assessment and intervention in aphasia: A clinician’s guide*. Hove, East Sussex: Psychology

Press.

- Wild, K. V, Mattek, N. C., Maxwell, S. A., Dodge, H. H., Jimison, H. B., & Kaye, J. A. (2012). Computer-related self-efficacy and anxiety in older adults with and without mild cognitive impairment. *Alzheimer's & Dementia*, 8(6), 544–552.
<https://doi.org/10.1016/j.jalz.2011.12.008>
- Wilson, L., & Read, J. (2016). Do particular design features assist people with aphasia to comprehend text? An exploratory study. *International Journal of Language and Communication Disorders*, 51(3), 346–354. <https://doi.org/10.1111/1460-6984.12206>
- Wilson, S., Roper, A., Marshall, J., Galliers, J., Devane, N., Booth, T., & Woolf, C. (2015). Codesign for people with aphasia through tangible design languages. *CoDesign*, 11(1), 21–34.
<https://doi.org/10.1080/15710882.2014.997744>
- Woolf, C., Caute, A., Haigh, Z., Galliers, J., Wilson, S., Kessie, A., ... Marshall, J. (2016). A comparison of remote therapy, face to face therapy and an attention control intervention for people with aphasia: A quasi-randomised controlled feasibility study. *Clinical Rehabilitation*, 30(4), 359–373. <https://doi.org/10.1177/0269215515582074>
- World Health Organization. (2002). *Towards a common language for functioning, disability and health: ICF. The international classification of functioning, disability and health*. Geneva. Retrieved from <http://www.who.int/classifications/icf/icfbeginnersguide.pdf?ua=1>
- World Health Organization. (2017). ICF Browser. Retrieved from <http://apps.who.int/classifications/icfbrowser/>
- World Wide Web Consortium. (2017). Web Accessibility Initiative. Retrieved June 9, 2017, from <https://www.w3.org/WAI/>
- Worrall, L., Sherratt, S., Rogers, P., Howe, T., Hersh, D., Ferguson, A., & Davidson, B. (2011).

What people with aphasia want: Their goals according to the ICF. *Aphasiology*, 25(3), 309–322. <https://doi.org/10.1080/02687038.2010.508530>

Zheng, C., Lynch, L., & Taylor, N. (2016). Effect of computer therapy in aphasia: A systematic review. *Aphasiology*, 30(2–3), 211–244. <https://doi.org/10.1080/02687038.2014.996521>

Appendix A: Protocol for Stage 1

Research Protocol

Inclusion in the Digital Economy for People with Aphasia – Stage 1

Background

The fast pace of change and development of online technologies has become part of our culture, with many developments aimed at improving and simplifying our lives. Communication or interaction between individuals or groups online (e.g. email, social media, webcam chats) remains the most common use of the Internet (Dutton & Blank 2011; Dutton, Helsper, & Gerber, 2009). The concept of a “digital divide”, describing a gap between those who are able to physically access online communities and services and those who cannot, has narrowed considerably over the last two decades with the majority of people having broadband access to the Internet at home. However, differences apparent in levels of skills in using the Internet are now defined as a ‘second level divide’ (Van Dijk, 2012), describing a deeper problem of groups in society being less able to enjoy the benefits of the Internet. Digital exclusion is strongly linked to social exclusion with those most likely to benefit from the Internet less likely to have access, or the skills to use it. (Helsper, 2008).

This study focuses on the risk of digital exclusion for people with aphasia, who experience acquired difficulties with language and speech following stroke. Aphasia leads to problems with the understanding or use of language. Applying this to use of the Internet, a person with aphasia may not be able to read information on a website on local support groups for people who have had stroke (e.g. Ghidella, Murray, Smart, McKenna, & Worrall, 2005), or write an email requesting information (Sohlberg, Ehlhardt, Fickas, & Sutcliffe, 2003). They might struggle to operate a mobile phone (Greig, Harper, Hirst, Howe, & Davidson, 2008) understand another person during a video or Internet phone call, or to express themselves verbally or in writing in an online context. The barriers produced by

aphasia are also likely to go beyond the basics of interaction with a computer. Without support to do so, many people with aphasia would struggle to negotiate the steps required, for example, to obtain and set up an internet connection, to operate a smartphone, to obtain telephone support or written information if services failed, or to attend a class on Internet skills.

In addition, people with aphasia are already at significant risk of marginalisation and exclusion from society. Aphasia is poorly represented in the media in comparison with other neurological disorders and public awareness is lacking (Elman, Ogar, Elman, 2000; Simmons-Mackie, Code, Armstrong, Stiegler & Elman 2002; Flynn, Cumberland & Marshall, 2009,). This could mean that designers and developers of technologies, computer sales staff, Internet service providers, or people running courses on computer skills have no awareness or knowledge of aphasia. This is likely to have a significant impact on their ability to support people with aphasia, or take their language difficulties into consideration when providing products or services. Full participation in all aspects of social life for people with aphasia is difficult and marred by their language disability (Dalemans, de Witte, Wade, & van de Heuvel 2010), and quality of life is affected (Hilari, 2011). Factors related to digital exclusion, such as being older, in poor health, or socially isolated are not unique to aphasia, although these factors in themselves are related to difficulties engaging with new technologies (Hanson, Gibson, Colman, Bobrowicz, & Mckay, 2010). Any additional barriers experienced by people with aphasia are likely to be directly related to their language difficulties. As with other excluded communities, people with aphasia are therefore least likely to benefit from the applications of technology that could help them tackle disadvantages. The benefits of Internet access are well documented and the move towards an ever more digital society is happening at a relentless pace. A study commissioned by UK online centres (UK online centres, 2009) found that Internet users in comparison with non-users were better off financially, reported an easier social life, more awareness of current affairs, better self-perceived skills of their ability to find employment, and higher self confidence. As initiatives like Go On UK (<http://www.go-on.co.uk/>) move towards encouraging excluded communities to get online, stakeholders involved in research and service provision for people with

aphasia need to ensure that those individuals are not left behind.

Value of Research

This research will be the first study to investigate how the language barrier of aphasia might impact on Internet use. The study will be valuable to people with aphasia first and foremost by highlighting the need for work towards reducing their risk of digital exclusion. A recent qualitative study (Worrall, Sherratt, Rogers, Howe, Hersh, Ferguson, & Davidson, 2011) classified the priorities of people with aphasia and found their goals were strongly related to ICF classification around activity and participation. Needs to return to life pre-stroke, to be connected to real life, to be able to obtain information, and to be social connected to others predominated. All of these identified needs can easily be linked to being able to access and use the Internet in today's society.

There will also be benefit for SLTs as there are currently no guidelines in existence for supporting people with aphasia in accessing technologies and there is a paucity of published evidence on therapeutic interventions. Demonstrating a need for people with aphasia to be supported more in this area would also raise awareness for other important stakeholders, e.g. charities providing support, designers and manufacturers of technologies, or the retail industry.

Pilot

We conducted a small pilot study of 14 people with aphasia who were attending a support centre about their use of the Internet (Menger & Morris, 2011). Of these people, 7 regarded aphasia as either the sole or major contributory barrier to being able to go online, or to improving their Internet skills. Other barriers cited included having no one to help, or lack of confidence. Their use of the Internet also appeared to be less diverse in comparison with that of the UK public. When comparing this data with the Oxford Internet Survey of 2009 (Dutton, Helsper & Gerber, 2009), it was found that 70% of the general public had

looked for health information online, compared to 33% of the people with aphasia we questioned. Half the participants required help with at least one aspect of their Internet use and 42% reported they would like to do more online, but they had no one to help them. Comparison with the UK wide population is interesting but not necessarily the most appropriate comparison for the aphasia population, who may also be older adults, experience social deprivation, or physical disability. In order to get a more accurate representation of how people with aphasia use the Internet it would be more valuable to compare their use with a population similar in all characteristics other than the acquired language impairment. This would allow for a more valid representation than a comparison with the UK population as a whole.

However, the results of the pilot did suggest that although the majority of the subjects held some interest in going online, most experienced barriers in doing so and aphasia appeared to be the most predominant barrier. This was an extremely small study, but provided some insight into use of the Internet by people with aphasia.

Objectives

We wish to expand on this data by collecting a wider and more representative sample of people with aphasia from the community to include men and women with a range of severities of aphasia, and of a variety of ages. To focus on the impact of their aphasia on Internet use, we wish to compare these individuals directly with a control group who are similar in all aspects other than language impairment.

The objectives for this initial stage of the project are:

- to understand the current level of use or non-use of the Internet by people with aphasia,
- to clearly identify whether they are at increased risk of digital exclusion,
- to understand the barriers to digital inclusion that are related to aphasia,

Research Questions

- 1 . How do people with aphasia currently use the Internet?
- 2 . Do people with aphasia use the Internet differently from a matched population of stroke participants with no aphasia?

Participants

We will recruit two groups of participants.

1. 20 people with aphasia following stroke.
2. 20 people who have had a stroke with no resulting aphasia.

The information gathered from these two groups will allow us to compare the Internet use of individuals from the same geographic area who have both suffered the significant disability of stroke and will have similar impairments (e.g. hemiplegia, hemianopia, dypraxia). One group will not have acquired language impairment. This will allow us to explore any impact of aphasia on Internet use.

Recruitment

Adult individuals with aphasia will be recruited via local speech and language therapists working in rehabilitation teams in Newcastle and Northumberland. Stroke participants (with no aphasia) will be recruited via occupational therapists and physiotherapists from the same rehabilitation teams. Participants may also be recruited by Stroke Research Nurses at review clinic appointments. In addition, local support groups for people with aphasia within the North East Region will be approached to establish whether members would be interested in taking part in the research project. If group members are

willing to accept a visit from a researcher, Fiona Menger will visit to inform them about the project, and to distribute and answer questions about information. If members of the group are interested in taking part, Fiona will then return at a later date to consent and interview interested people. It will be stressed that participants can be both users and non-users of technologies, and that all views are being sought.

Inclusion Criteria

Adults (over 18 with no upper age limit) with a diagnosis of aphasia resulting from single symptomatic stroke; people with a diagnosis of single stroke; at least six months post-onset of aphasia/stroke; medically stable; willing to participate and complete a questionnaire; consent to the study; absence of psychiatric conditions; absence of any other neurological condition; normal (or corrected) hearing and vision.

Exclusion Criteria

Participants will be excluded if any one of the inclusion criteria are not met.

Method

Participants will be asked to complete a questionnaire with the researcher. Basic demographic data will be collected on gender, year of birth, year of stroke, and educational level. They will then be asked whether or not they use the Internet and about their ownership and use of technologies. Users of the Internet will be asked to rate their Internet skills, about the type and frequency of their Internet use, the amount of support they require, and their use of the Internet for communication. Non-users of the Internet will be asked about the reasons for their non-use, about whether anyone uses the Internet on their behalf, and about the sources they use for information and communication. Both users and non-users will be asked to reflect on the skills they might need to access and make the most

of the Internet. Participants will have access to the questionnaire in a format designed to be accessible for people with aphasia, and as an experienced speech and language therapist, the researcher will support them to make responses either by verbal or non-verbal means. The questionnaire contains 66 questions and should take no more than 40 minutes to administer with people with aphasia. This is based on a pilot questionnaire which was administered easily within that time and contained 63 questions. Participants with aphasia will be rated by the speech and language therapist on a six point aphasia severity scale (Goodglass, Kaplan, & Baressi, 2001) based on free conversation and their language abilities during the questionnaire.

Ethical Considerations

The study will be subject to an ethical review from the National Research Ethics Service for England.

Expected Outcomes

Important stakeholders will include people with aphasia, Speech and Language Therapists, charitable support organisations, and the information technology industry. By sharing our research with these groups via publications, presentation at conferences, patient meetings, and online via social media, we expect findings will be influential by sparking debate and further research in this field. The data will be used descriptively to illustrate current use of the Internet by people with aphasia, alongside their motivation to improve their use, and the skills they have to do so. Differences between the two groups will be examined statistically, to highlight the extent of any additional barrier to Internet use provided by aphasia. This information alongside qualitative data captured via audio recording will be used to plan and design further stages of the project. In particular, barriers and facilitators to access highlighted by participants carrying out questionnaires will be used

to inform the design of semi-structured interviews with people with aphasia, their carers, and their SLTs. This next stage of the project will be aimed at examining in greater detail the nature of these barriers and facilitators, and identifying possible routes for intervention.

References for Stage 1 Protocol

Dalemans, R. J. P., De Witte, L., Wade, D., & Van den Heuvel, W. (2010). Social participation through the eyes of people with aphasia. *International Journal of Language & Communication Disorders, 45*(5), 537–550.

Dutton, W. H., Helsper, E. J., & Gerber, M. M. (2009). *The Internet in Britain 2009*. Oxford, UK. Retrieved from <http://oxis.oii.ox.ac.uk/reports/>

Elman, R. J., Ogar, J., & Elman, S. H. (2000). Aphasia : Awareness , advocacy , and activism. *Aphasiology, 14*(5-6), 455–459.

Flynn, L., Cumberland, A., & Marshall, J. (2009). Public knowledge about aphasia: A survey with comparative data. *Aphasiology, 23*(3), 393–401.

<https://doi.org/10.1080/02687030701828942>

Ghidella, C., Murray, S., Smart, M., McKenna, K., & Worrall, L. (2005). Aphasia websites: An examination of their quality and communicative accessibility. *Aphasiology, 19*(12), 1134–1146. <https://doi.org/10.1080/02687030500337871>

Goodglass, H., Kaplan, E., & Barresi, B. (1983). *Boston diagnostic aphasia examination booklet* (Third). Lea & Febiger Philadelphia, PA.

Greig, C.-A., Harper, R., Hirst, T., Howe, T., & Davidson, B. (2008). Barriers and facilitators to mobile phone use for people with aphasia. *Topics in Stroke Rehabilitation, 15*(4), 307–324.

Hanson, V. L., Gibson, L., Coleman, G., Bobrowicz, A., & McKay, A. (2010). Engaging Those Who are Disinterested: Access for Digitally Excluded Older Adults. *Chi 2010*. Retrieved from <http://kar.kent.ac.uk/27903/>

Hanson, V. L., Gibson, L., Coleman, G., Bobrowicz, A., & McKay, A. (2010). Engaging Those Who are Disinterested: Access for Digitally Excluded Older Adults. *Chi 2010*. Retrieved from <http://kar.kent.ac.uk/27903/>

Hilari, K. (2011). The impact of stroke: Are people with aphasia different to those without?

Disability and Rehabilitation, 33(3), 211–218.

<https://doi.org/10.3109/09638288.2010.508829>

Menger, F., & Morris, J. (2011). Pilot Survey of Internet Use by People with Aphasia Poster Presentation at the British Aphasiology Society Conference, University of Reading, UK

Simmons-Mackie, N., Code, C., Armstrong, E., Stiegler, L., & Elman, R. J. (2002). What is aphasia? Results of an international survey. *Aphasiology*, 16(8), 837–848.

<https://doi.org/10.1080/02687030244000185>

Moore Sohlberg, M., Ehlhardt, L. A., Fickas, S., & Sutcliffe, A. (2003). A pilot study exploring electronic (or e-mail) mail in users with acquired cognitive-linguistic impairments. *Brain Injury*, 17(7), 609-629.

UK Online Centres. (2009). *UK Online Centres Does the internet improve lives?* Retrieved from www.ukonlinecentres.com

Van Dijk, J. A. G. M. (2012). The evolution of the digital divide: The digital divide turns to inequality of skills and usage. *Digital Enlightenment Yearbook 2012*, 57–75.

<https://doi.org/10.3233/978-1-61499-057-4-57>

Van Dijk, J. A. G. M. (2012). The evolution of the digital divide: The digital divide turns to inequality of skills and usage. *Digital Enlightenment Yearbook 2012*, 57–75.

<https://doi.org/10.3233/978-1-61499-057-4-57>

Worrall, L., Sherratt, S., Rogers, P., Howe, T., Hersh, D., Ferguson, A., & Davidson, B. (2011). What people with aphasia want: Their goals according to the ICF. *Aphasiology*, 25(3), 309–322. <https://doi.org/10.1080/02687038.2010.508530>

Appendix B: Stage 1 Participant information and consent forms

Information sheets are presented in the following order:

1. Information sheet for recrtuiters
2. Information sheet for support groups
3. Stroke (no aphasia) participant information sheet
4. Aphasia participant information sheet
5. Aphasia participant information sheet (more detailed language)
6. Consent form for people with aphasia
7. Consent form for people without aphasia



IDEA Project: Inclusion in the Digital Economy for People with Aphasia.

Can you help recruit people after stroke to help in a short project looking at Internet use?

This study investigates internet use. We want to compare the experiences of people who have had strokes which affected their speech and language (aphasia) and those whose language was unaffected. We want to do this to find out whether having aphasia makes it more difficult to use the Internet.

We are recruiting 1) People with a diagnosis of aphasia resulting from single symptomatic stroke, and 2) People with a diagnosis of single stroke.

Inclusion criteria:

- at least six months post-onset of aphasia/stroke,
- medically stable
- willing to participate and complete a questionnaire,
- able to consent to the study (we can support people with aphasia)
- absence of psychiatric conditions,
- absence of any other neurological condition,
- English as a first language,
- hearing and vision sufficient to take part in a questionnaire.

Participants will be asked to complete a short questionnaire with a researcher. Only one session is required and will take no more than one hour. Participants can be visited at home or can come to Newcastle University.

Detailed patient information sheets are available including accessible versions for people with aphasia. Those interested in the research can contact the researcher directly or details can be passed on via recruiters.

If you can identify someone who is interested please contact: Fiona Menger,
Stroke Association Junior Research Fellow, Tavistock Aphasia Centre, King George
VI Building, Newcastle University, Queen Victoria Road, Newcastle, NE1 7RU

Email: fiona.menger@ncl.ac.uk, Tel: 0191 222 8550



IDEA Project: Inclusion in the Digital Economy for People with Aphasia.

Are you interested in helping with a stroke research project?

We are investigating how **people with aphasia** use the **Internet**.

We would like to talk to people with aphasia who **use the Internet**, and people who **don't use the Internet**.

Could you help? We are looking for people with aphasia

- Who have had a **single stroke** over six months ago
- Who are medically **stable**
- Who are able to complete a **questionnaire** with support
- Who have **no psychiatric** conditions
- Who have **no other neurological** conditions
- Who **speak English** as their first language
- Whose **hearing and vision** would allow them to take part

You would be asked to complete a **short questionnaire** with a researcher.

Only one session is required and would take no more than one hour.

Participants can be visited at home, or while attending their support group.

Detailed patient **information sheets** are available including **accessible versions** for people with aphasia.

If you are interested please contact: Fiona Menger, Stroke Association Junior

Research Fellow, Tavistock Aphasia Centre, King George VI Building, Newcastle

University, Queen Victoria Road, Newcastle, NE1 7RU

Email: fiona.menger@ncl.ac.uk, Tel: 0191 222 8550

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Research reference nos: 13SS0140 125221 6627

Support group information sheet v1. 15 April 2014

Inclusion in the Digital Economy for People with Aphasia

Information Sheet for Stroke Participants

Section A: Information on the study

We would like to invite you to take part in our research survey. This is a questionnaire about you and the Internet. This information sheet will tell you about the study. The researcher will go through it with you and answer any questions you have. This should take around ten minutes. Please ask us if there is anything that is not clear.

Basic information on the study

This research is funded by the Stroke Association and is being carried out as part of a PhD by the main researcher, Fiona Menger.

What is the purpose of the study?

The study is about how people who have had a stroke use the Internet. We want to compare the experiences of people who have had strokes which affected their speech and language (known as aphasia) and those whose language was unaffected. We want to do this to find out whether having aphasia makes it more difficult to use the Internet.

Why have I been invited?

You have been invited because you have had a stroke but have no difficulties with language or communication. We are interested in your responses whether you use the Internet or not.

Do I have to take part?

No. If you decide to take part, we will ask you to sign a consent form. You can change your mind at any time without giving a reason. The care you receive (or may receive in the future) will not be affected in any way.

What would I have to do?

You would need to complete a simple questionnaire on your use (or non-use) of the Internet. A researcher will visit you at home or you can visit Newcastle university. Your responses to the questionnaire would be audio recorded and we would make written notes. It would take no more than 30 minutes.

Are there any disadvantages or risks to me?

No.

Are there any benefits to me?

No.

Section B: Further Information

Further Information

Will my responses be confidential?

Yes. Your responses will be stored next to a code instead of your name. We will not store your personal details beyond how to initially contact you. Any information that could potentially identify you will be stored separately from your responses to the questionnaire.

What will happen if I decide not to continue?

You can stop at any point without giving a reason. The care you receive (or may receive in the future) will not be affected in any way.

Will my taking part in the study be kept confidential?

Yes

How will you store the information I provide?

- The information will be stored on a server at Newcastle University under a secure password.
- Only the main researchers will be able to access the information.
- Audio recordings will be stored as mp3 files. No data will be kept on the recording device.
- We will use anonymous codes to store the data so you cannot be identified.
- Paper questionnaires will be stored in a locked filing cabinet at Newcastle University.

Why are you informing my GP?

It is good practice to inform your GP if you are involved in any health related research. This is in case you want to ask them about it in future.

What will the information be used for?

Your responses will be compared to those of people with aphasia to see whether your experiences of the Internet are the same, or different.

How long will you keep the information?

The information will be kept for five years then disposed of securely.



What will happen to the results of the study? Can I see them?

The results will be used for Fiona Menger's PhD thesis. They may also be published in academic journals or presented at conferences. A summary copy of the results can be made available for you to read if you are interested.

Are you able to provide me with help and support to access the Internet?

We are not able to help you directly. However, if you wish we can provide you with details on useful resources, and on local organisations that may be able to help.

Section C: Who's who

	People involved in the study	Contact Information
 <p>Fiona Menger</p>	<p>Fiona is a Speech and Language Therapist and Stroke Association Research Fellow at Newcastle University.</p> <p>Fiona will visit you to explain the study and obtain your consent to take part.</p> <p>She will also carry out the questionnaire and make audio recordings.</p> <p>You can contact Fiona directly with any questions about the study.</p>	<p>Speech and Language Sciences</p> <p>King George VI Building</p> <p>Newcastle University</p> <p>Newcastle</p> <p>NE1 7RU</p> <p>Email: fiona.menger@ncl.ac.uk</p> <p>Tel: 0191 222 8550</p>
 <p>Dr Julie Morris</p>	<p>Julie is a Speech and Language Therapist and Senior Lecturer at Newcastle University.</p> <p>Julie will supervise Fiona's research.</p> <p>You can contact her with any questions about the study, or if you would like to make a complaint about how the study is handled.</p>	<p>Speech and Language Sciences</p> <p>King George VI Building</p> <p>Newcastle University</p> <p>Newcastle</p> <p>NE1 7RU</p> <p>Email: Julie.morris@ncl.ac.uk</p> <p>Tel: 0191 222 6841</p>

The following pages are from an A4 landscape information sheet. Images from the original have been used here for ease of formatting.

Inclusion for people with aphasia in the digital economy

Accessible Information Sheet for People with Aphasia

We would like to ask you to take part in a **research project**.

The project is a **questionnaire** about the **Internet**.

We would like to find out **if you use the internet**.

About **what you use** and **how often**.

If you **don't use the internet**, about **why not?**

This is an information sheet to tell you about **the study**. I will answer any **questions** you have.



|

+

Why are you doing this study?

We want to find out if people with **aphasia** use the Internet **less** or **differently** than others.

We want to **compare** your use to other **stroke patients**. They will have also had a stroke but **no speech problems**.

We want to find out if having **aphasia** makes it **more difficult** to use the **internet**.



Do I **have to** take part?

No. You do not have to take part.

If you say **yes**, we will ask you to sign a **consent form**.

You can **change your mind** at any time.

This will **not affect your care** now or in the future.





What will **happen** if I **take part**?

A researcher will visit you at **home** or you can come to the **university**.

You will be asked some **simple questions** about you and the **Internet**.

The researcher will **support you** to give your **answers**.

It will take around **30-40 minutes**.

We would **record your voice**.

We would rate how **severe** your difficulties are.

We would **take notes** on your answers.



Are there any **risks** involved?

There is **no risk** to you.

There is **no benefit** to you.



We will **not** store your **personal details** after we visit you.

All answers given will be **confidential**.

Answers and recordings will be stored securely in a **filing cabinet** or on **computer**.

Only the researcher will be able to see them.

We will keep them for **five years**.



Your **answers** will be **compared** to answers from other people.

Some of the other people will have **aphasia**.

Some of them will have had strokes but have **no aphasia**.



The **results** will be used for a **PhD thesis**.

They may also be published in **research journals**.

If you are interested, we can send you an **easy to**




Can you help me to **get online**?




We are **not able** to help you to use the **Internet** personally.

However, if you want, we can provide you with **information** that may help.

Who's Who?

	People involved in the study	Contact Information
 Fiona Menger	<p>Fiona is a Speech and Language Therapist and Stroke Association Research Fellow at Newcastle University.</p> <p>Fiona will visit you to explain the study and obtain your consent to take part.</p> <p>She will carry out the questionnaire and make audio recordings.</p> <p>You can contact Fiona directly with any questions about the study.</p>	<p>Speech and Language Sciences</p> <p>King George VI Building</p> <p>Newcastle University</p> <p>Newcastle</p> <p>NE1 7RU</p> <p>Email: fiona.menger@ncl.ac.uk</p>

	<p>Julie is a Speech and Language Therapist and Senior Lecturer at Newcastle University.</p> <p>Julie will supervise Fiona's research.</p> <p>You can contact her with any questions about the study, or if you would like to make a complaint about how the study is handled.</p>	<p>Speech and Language Sciences</p> <p>King George VI Building</p> <p>Newcastle University</p> <p>Newcastle</p> <p>NE1 7RU</p> <p>Email: Julie.morris@ncl.ac.uk</p> <p>Tel: 0191 222 6841</p>
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Inclusion in the Digital Economy for People with Aphasia

Information Sheet for People with Aphasia



Is reading **difficult**?



An **aphasia friendly** version of this document is available.

Section A: Information on the study

We would like to invite you to take part in our research survey. This is a questionnaire about you and the Internet. This information sheet will tell you about the study. The researcher will go through it with you and answer any questions you have. This should take around fifteen minutes. Please ask us if there is anything that is not clear.

Basic information on the study

This research is funded by the Stroke Association and is being carried out as part of a PhD by the main researcher, Fiona Menger.

What is the purpose of the study?

The study is about how people who have had a stroke use the Internet. We want to compare the experiences of people who have had strokes which affected their speech and language (known as aphasia) and those whose language was unaffected. We want to do this to find out whether having aphasia makes it more difficult to use the Internet.

Why have I been invited?

You have been invited because you have had a stroke and have aphasia. We are interested in your responses whether you use the Internet or not.

Do I have to take part?

No. It is up to you to decide whether to take part. We will describe the study to you and go through this information sheet. If you decide to take part, we will ask you to sign a consent form.

What would I have to do?

You would need to complete a simple questionnaire on your use (or non-use) of the Internet. A researcher will visit you at home or you can visit Newcastle university. We would record your voice and take notes on your answers. We would also rate how mild- severe your speech and language difficulties are on a scale. It would take around 30-40 minutes.

Are there any disadvantages or risks to me?

No.

Are there any benefits to me?

No.

Section B: Further Information

Will my responses be confidential?

Yes. We will not store your personal details beyond how to initially contact you. We will not ask for any information that could identify you. All responses will be anonymous.

What will happen if I decide not to continue?

You can stop at any point without giving a reason. This will not affect the treatment you are receiving or will receive in future.

Will my taking part in the study be kept confidential?

Yes

How will you store the information I provide?

- We will use an anonymous code instead of your name to store the responses.
- The information will be kept on a server at Newcastle University under a secure password.
- Only the main researchers will be able to access the information.
- Paper questionnaires will be stored in a locked filing cabinet at Newcastle University.
- Recording of your voice will be also be stored securely as a file on computer and will not be kept on the recording device.

Why are you informing my GP?

It is good practice to inform your GP if you are involved in any health related research. This is in case you want to ask them about it in future.

What will the information be used for?

Your responses will be compared to those of people with aphasia to see whether your experiences of the Internet are the same, or different. The information you provide will be used to design interviews with people with aphasia for the next stage of this project. Further ethical approval will be sought before the information is used.

How long will you keep the information?

The information will be kept for five years then disposed of securely.



What will happen to the results of the study? Can I see them?

The results will be used for Fiona Menger's PhD thesis. They may also be published in academic journals or presented at conferences. You can ask for an easy to read summary of the results if you are interested.

Are you able to provide me with help and support to access the Internet?

We are not able to help you directly. However, if you wish we can provide you with details on useful resources, and on local organisations that may be able to help.

Section C: Who's who

	People involved in the study	Contact Information
 <p>Fiona Menger</p>	<p>Fiona is a Speech and Language Therapist and Stroke Association Research Fellow at Newcastle University.</p> <p>Fiona will visit you to explain the study and obtain your consent to take part.</p> <p>She will also carry out the questionnaire and make audio recordings.</p> <p>You can contact Fiona directly with any questions about the study.</p>	<p>Speech and Language Sciences</p> <p>King George VI Building</p> <p>Newcastle University</p> <p>Newcastle</p> <p>NE1 7RU</p> <p>Email: fiona.menger@ncl.ac.uk</p> <p>Tel: 0191 222 8550</p>
 <p>Dr Julie Morris</p>	<p>Julie is a Speech and Language Therapist and Senior Lecturer at Newcastle University.</p> <p>Julie will supervise Fiona's research.</p> <p>You can contact her with any questions about the study, or if</p>	<p>Speech and Language Sciences</p> <p>King George VI Building</p> <p>Newcastle University</p> <p>Newcastle</p> <p>NE1 7RU</p>

	you would like to make a complaint about how the study is handled.	Email: Julie.morris@ncl.ac.uk Tel: 0191 222 6841
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Title of Project: **Inclusion in the Digital Economy for People with Aphasia**

Names of Researchers: Dr Julie Morris / Fiona Menger

Fiona Menger
Speech and Language Sciences
King George VI Building
Newcastle upon Tyne.
NE1 7RU
Tel 0191 222 8550
fiona.menger@ncl.ac.uk

CONSENT FORM

I have read and understand the information sheet .
I have had the opportunity to consider the information .
I have been able to ask questions .
I have had my questions answered .

I understand that my participation is voluntary .
--

Research reference nos: 13SS0140 125221 6627 Consent form date of issue:	Patient Identification Number for this trial: Consent form version 2 25 July 2013
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I know I am free to withdraw at any time without giving any reason .
I know my medical care or legal rights would not be affected .
I understand you will record my voice .
I understand you will inform my GP .

I agree to take part in the above study.	YES	NO
---	-----	----

Name of Participant Date Signature

Name of person taking consent. Date Signature

Research reference nos: 13SS0140 125221 6627 Consent form date of issue:	Patient Identification Number for this trial: Consent form version 2 25 July 2013
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CONSENT FORM

Title of Project: **Inclusion in the Digital Economy
for People with Aphasia**

Names of Researchers: Dr Julie Morris / Fiona
Menger

Fiona Menger
 Speech and Language Sciences
 King George VI Building
 Newcastle upon Tyne
 NE1 7RU
 Tel 0191-222 6510
 fiona.menger@ncl.ac.uk

**Please
initial**

1. I confirm that I have read and understand the information sheet dated 25 July 2013 for the above study. I have had the opportunity to consider the information, ask questions, and have had these answered satisfactorily.	
2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my medical care or legal rights being affected.	
3. I understand you will inform my GP that I am taking part.	
4. I understand you will record my voice.	
5. I agree to take part in the above study.	

Name of Participant

Date

Signature

Name of person
taking consent.

Date

Signature

Research reference no: 13SS0140 125221 6627
Consent form date of issue:

Patient Identification Number:
 Consent form version 2 25 July 2013

Appendix C: Supported Questionnaire

All participants were asked the initial question, 'Do you use the Internet?' Those who responded 'yes' were given questionnaire A. Those who responded 'no' were given questionnaire B.

There is some duplication between the two questionnaires as some questions were relevant to all participants. Others were relevant either only to Internet users or non-users and these are indicated by shaded text. Questions are presented below in the order in which they were given with order chosen for ease of transition between questions. Alpha and alphanumerical codes seen next to the questions below relate to rationale for that aspect of the questionnaire described in Chapter two.

Questionnaire A (Internet users)

Participants were asked:

1. *Where do you use the Internet?* Options given were: home, support group, library, home of family/friend, college/university, work, Internet café, other.
2. *How do you access the Internet?* Options were: computer, mobile phone, tablet, desktop pc, laptop, games console, tv, e-reader, other.
3. *How would you rate your ability to use the Internet?* Participants were given a visual and numerical Likert scale (1=bad, 5=excellent)
4. *Would you like to be better at using the Internet? If yes - > 'What do you think prevents you from getting better at using the Internet?'* Options given were: not interested, no computer, lack of confidence, no-one to help me, costs too much, not enough time, I don't trust the Internet, computer is old/out of date, I don't need to, I'm too old, I haven't got around to it yet, health/physical problems, aphasia, something else.
5. Do you own any of the following? Do you use any of the following?

Options given were: basic mobile phone, smartphone, digital camera, Freeview/digital TV, mp3 player, satellite/cable tv, games console, webcam, laptop, tablet PC, e-reader, other.

6. *Do you use anything to help you use the Internet? E.g., equipment and/or software?* Options were: adapted mouse, adapted keyboard, voice recognition software, accessibility settings on computer, screen reader, other.

7. *If you wanted to find out information about your health, where would you go first?*

8. *If you wanted to find out information about aphasia/stroke, where would you go first?*

9. *If you wanted to find out about a trip or a holiday, where would you go first?*

Options given were: Internet, phone, ask someone to help, book, other.

10. *Do you ever look for online information on...?* Each of the following was presented as a separate question: *travel, local events, news, health, sports, finding jobs, volunteering, jokes/funnies.*

For all of the above a Yes or No response was required.

11. *How often do you use the Internet for...?* Each of the following was presented as a separate question: *sending emails, instant messaging, Facebook, Twitter, Internet phone calls, Internet video calls, blogging, downloading or streaming music, playing games, watching TV or films, religious websites, betting or gambling, buying something online, comparing products and prices, making travel reservations, online banking, information on local council, information on national government, posting pictures online.*

Participants were presented with a visual increasing scale from never - > daily.

12. After each of these if response > never, participants were asked: *Does someone help you?* Options were: friend, brother/sister, support group, librarian, colleague, children/grandchildren, partner, someone else.

13. *How do you keep in touch with others?* Options given were: Email, Social network, Visit, Write/Send a Card, Phone, Video calling, Text messaging, Other

14. *How often do you keep in touch with others?* Participants were given a visual Likert scale with 'less than monthly' at the left of the scale and 'several times a day' at the right of the scale.

Questionnaire B (Internet non-users)

1. *Have you used the Internet in the past? Do you want to use the Internet?*

2. Do you own any of the following? Do you use any of the following?

Options given were: basic mobile phone, smartphone, digital camera, Freeview/digital TV, mp3 player, satellite/cable tv, games console, webcam, laptop, tablet PC, e-reader, other.

3. *Why don't you use the Internet/Why did you stop using the Internet?* Options given were: not interested, no computer, lack of confidence, no one to help me, costs too much, not enough time, I don't trust the Internet, computer is old/out of date, I don't need to, I'm too old, I haven't got around to it yet, health/physical problems, aphasia, something else.

4. *Does someone else help you to do things on the Internet?* Options were: friend, brother/sister, support group, librarian, colleague, children/grandchildren, partner, someone else.

5. If yes: *What do they help you to do?* Options were: communication, e.g., email/keeping in touch with people, entertainment, e.g., music, games, TV, betting, money matters, e.g., banking, shopping, booking travel, government services, e.g., local or national government, social Networking, e.g., Facebook or Twitter, looking at news, something else.

6. *If you wanted to find out information about your health, where would you go first?*

7. *If you wanted to find out information about aphasia/stroke, where would you go first?*

8. *If you wanted to find out about a trip or a holiday, where would you go first?*

Options given were: Internet, phone, ask someone to help, book, other.

9. *How do you keep in touch with others?* Options given were: Email, Social network, Visit, Write/Send a Card, Phone, Video calling, Text messaging, Other

10. *How often do you keep in touch with others?* Participants were given a visual Likert scale with 'less than monthly' at the left of the scale and 'several times a day' at the right of the scale.

Appendix D: Binomial logistical regression

Chapter three, section 3.2.1. Predictors for Internet use/non-use.

Predictor Variables	B	Std.Err.	Wald	Sig.	Exp.(B)	95% CI for Exp.(B)	
						Lower	Upper
Age	.074	.037	4.003	*.045	1.076	1.002	1.157
Gender	.201	.785	.065	.798	1.223	.262	5.698
Level of Education (3 levels)			3.175	.204			
With aphasia or without aphasia	1.465	.764	3.677	.055	.231	.052	1.033

Appendix E: Protocol for stage 2

Research Protocol

Inclusion in the Digital Economy for People with Aphasia – Stage 2

Background

The Internet is a large part of the daily lives of the majority of individuals in the UK, with 76% using it every day (Office for National Statistics, 2014). The Internet complements more traditional means of communication, with users interacting using a variety of online services with a range of different devices (Dutton, Blank, & Grosej, 2013). There are many potential benefits for individuals, such as improved access to education and health services, the ability to save money on products and services, and the ability to connect with others regardless of physical distance (Koss, Azad, Gurm, & Rosenthal, 2012).

However, despite the rapid rise of the Internet in society, a 'digital divide' (van Dijk, 2012) continues to exist, with gaps between those who have the skills to access and get the most out of the Internet, and those who do not. Recent figures suggest that 21% of the UK population still do not have basic online skills. Those least likely to possess these skills include the over 65s, and those with lower socio-economic status. (BBC Marketing and Audiences, 2014) People with disabilities also face considerable barriers to Internet use (Jaeger, 2012). Reasons for Internet non-use are complex and multifactorial. However, a recent summary of digital exclusion research by Helsper & Reisdorf (2013) suggests that age, gender, and education are currently the strongest predictors of Internet use and skills.

This study focuses on the Internet skills of people with aphasia, who experience acquired difficulties with language and speech following stroke. The Internet is a language rich environment and therefore holds many potential difficulties for someone with impaired communication skills. The barriers produced by aphasia are likely to go beyond the basics of interaction with a computer. Without support to do so, many people with aphasia would struggle to negotiate the steps required, for example, to obtain and set up an internet connection, to operate a smartphone, to understand telephone support or written information if services failed, or to attend a class on Internet skills.

People with aphasia are already at significant risk of marginalisation and exclusion from society. Full participation in all aspects of social life for people with aphasia is difficult and marred by their language disability (Dalemans, de Witte, Wade, & van de Heuvel 2010), and

quality of life is affected (Hilari, 2011). Aphasia is poorly represented in the media in comparison with other neurological disorders and public awareness is limited (Elman, Ogar, Elman, 2000; Simmons-Mackie, Code, Armstrong, Stiegler & Elman 2002; Flynn, Cumberland & Marshall, 2009,). Designers and developers of technologies, computer sales staff, Internet service providers, or people running courses on computer skills may have little or no awareness or knowledge of aphasia. This is likely to have a significant impact on their ability to accommodate or support people with aphasia.

In 2014 we carried out the first stage of IDEA project. We wanted to identify how people with aphasia used the Internet in comparison with an older, disabled population without aphasia. We therefore carried out a survey of Internet use by people with aphasia post stroke in comparison with people who had had stroke but did not experience aphasia (Menger, Morris, & Salis, 2014a). We found that our group of people with aphasia were less likely to use the Internet, and that most of them considered aphasia to be a major barrier to Internet use. However, additional barriers existed, such as being older, not having support, lack of confidence, or the presence of a physical disability. In addition, a great deal of Internet use was not carried out alone, and many of our participants (both with and without aphasia) reported needing help with aspects of Internet use. (Menger et al, 2014a). The challenge for researchers and clinicians working with aphasia is to identify barriers related directly to aphasia, and to clarify how they interact with other factors such as those identified above. In this study we want to explore both the direct consequences of aphasia for Internet use, and the experiences of those providing support, so that we can discover how best to help people with aphasia either to engage with the Internet for the first time, to regain previously held skills, or to compensate for and adapt to using the internet with a language disability.

Purpose of Research

People with aphasia identify strong needs to return to life pre-stroke, to be connected to real life, to be able to obtain information, and to be social connected to others (Worrall, Sherratt, Rogers, Howe, Hersh, Ferguson, & Davidson, 2011). Worrall et al (2011) classified the priorities of people with aphasia and found their goals were strongly related to International Classification of Functioning, Disability and Health (ICF) activity and participation domains (World Health Organisation, 2001). Many types of activity and participation in today's society are dependent on being able to access and use the Internet. Although there is now an increasing body of research on technology applications for aphasia, research on accessing real life practical or social applications of technology is less common and may often be unpublished or presented only at conference (Menger, Morris, & Salis, 2014b). There are currently no published case studies systematically evaluating interventions to improve aspects of Internet use for aphasia. This study will involve a series of interventions, with a focus on rehabilitation of or compensation for previously held Internet skills.

Our series of intervention studies will use the International Classification of Functioning, Disability, and Health (World Health Organisation, 2001). We are using this framework, (as modified for aphasia by Kagan et al, (2008)), so that not only the direct consequences of aphasia on the language related aspects of Internet use are considered, but also the impact on participation in online environments, and consequences for quality of life. We will also examine the views and experiences of those providing support, investigating barriers and facilitators to Internet use in the environment of people with aphasia.

The study will provide detailed descriptions of interventions which could be replicable or modified in working with people with aphasia. It will highlight barriers experienced by SLTs and supporters/carers in providing help for people to access the Internet, providing evidence to underpin the provision of support. Demonstrating ways in which people with aphasia can be supported in this area would also be relevant for other important stakeholders, e.g. occupational therapists, charities, designers and manufacturers of technologies, or the retail industry.

As technology is constantly advancing, it is vital that intervention does not rest with particular technologies or platforms. This research is therefore not dependent on any specific technology, and will allow for dissemination of results both throughout and at the end of the project.

Objectives and Research Questions

Our previous study (IDEA Project stage 1) investigated the barriers people with aphasia experience related to acquiring or improving Internet skills. We encountered a broad spread of people, from those who had no interest in the Internet, to those who used it as a tool to manage everyday language difficulties. Our results suggested that barriers related to aphasia are significant, but that they do not stand alone. A broad spread of other factors come into play, such as age, health/physical problems, lack of confidence, or lack of support. In order to examine the impact of linguistic and cognitive aspects of stroke in greater detail, we have chosen to focus this second part of IDEA project on individuals who had Internet skills prior to their stroke, and who are now experiencing difficulties as a direct result of aphasia.

Objective 1

We want to better understand the barriers to Internet use for people with aphasia, who used the Internet prior to their stroke and aphasia.

Although we suspect aphasia is the major barrier to Internet use, we recognise that other factors are still likely to exist. For example: changes in income post-stroke, newly acquired physical disability, the type and amount of support available, or the knowledge and skills of those providing the support. Acknowledging this, we want to explore in particular the

experiences of those providing support. To address objective 1, we are asking the following research questions:

How does aphasia impact on aspects of Internet use?

How do wider cognitive changes impact on aspects of Internet use?

What barriers are experienced by speech and language therapists supporting people with aphasia to use the Internet?

What barriers are experienced by carers supporting people with aphasia to use the Internet?

Addressing these initial questions will provide information about both the impact of aphasia and any associated cognitive deficits on Internet use, and on the barriers external to aphasia which may have influenced attempts to regain previously held skills. This solid foundation will help us design interventions towards meeting the second objective.

Objective 2

We want to explore possible facilitators to Internet use by people with aphasia, by systematically evaluating a series of individual treatments/interventions.

To address objective 2, we are asking the following research questions:

Does individually-tailored intervention for Internet use result in improvement of internet skills?

What particular types of intervention can support people with aphasia to meet their goals related to Internet use?

Do linguistic and cognitive factors determine response to individually-tailored intervention from Internet use in people with aphasia?

Does individually-tailored intervention on Internet use in people with aphasia improve emotional well-being?

Does individually-tailored intervention on Internet use in people with aphasia improve social participation?

What is the impact of our interventions on supporters/carers of people with aphasia?

What is the impact of our interventions on speech and language therapists?

Participants

The study will recruit up to nine triads. These will consist of people with aphasia post-stroke, a supporter/carer involved with that individual, and the speech and language therapist providing their care. The people with aphasia will be the main focus of the project, and will all be individuals who used the internet prior to acquiring aphasia, and who have identified working on Internet skills as a goal in speech and language therapy. We aim to recruit people with a range of severities of aphasia, from as wide an age range as possible, including male and female participants. They should also have a range of previous Internet skills and types of use.

It is anticipated that we need to aim for a number of cases that is achievable within the time frame of two years (at 0.6 wte therapist time). This exploratory stage will allow us to explore current interventions over time while identifying themes relevant to future research in the field.

Recruitment

Adult individuals with aphasia and their supporters/carers will be recruited via local speech and language therapists working in NHS teams in the North East. All potential SLT recruiters will be given information on the project prior to recruitment (IDEA Project information leaflet 1¹⁶), and will have the opportunity of a meeting with Fiona Menger to discuss the details of their involvement. Speech and language therapists recruiting into the project will be given information on their potential role as participants alongside the individual with aphasia they refer into the project. Supporters/carers and speech and language therapists are not obliged to take part should the person with aphasia they are involved with consent to the project, and the person with aphasia will not be excluded should one or both other members of the triad not be willing to participate.

Inclusion Criteria

Adults (over 18 with no upper age limit) with a diagnosis of aphasia resulting from single symptomatic stroke; at least six months post-onset of aphasia/stroke; medically stable; user of the Internet prior to stroke; identified goals around Internet skills; willing to participate in the study; willing to withdraw from NHS speech and language therapy for the duration of the study¹⁷; able to consent to the study; absence of psychiatric conditions; absence of any

¹⁶ All participant information leaflets for the study are designed to be printed in A5 booklet form. If viewed on a screen please make note of page numbers to ensure pages are read in the correct order.

¹⁷ Withdrawal from NHS Speech and Language Therapy is in order to ensure no therapy intervention outside the study might contribute to change. It is anticipated that given we are recruiting individuals who are at least six months post-onset of stroke, individuals referred into the study are likely to have had a period of therapy and be either on review or having a period of less intensive treatment. Recruits to the study will have identified improving their Internet skills as a direct goal for therapy. This study would therefore represent a chance for treatment towards that goal that may be over and above NHS provision.

other neurological condition; normal (or corrected) hearing and vision; English as a dominant language¹⁸.

Exclusion Criteria

Participants will be excluded if any one of the inclusion criteria are not met.

Method

Entry into the project will be consecutive over a period of two years. Some triad participants may overlap but it is anticipated that no more than two groups will be progressing through the study timeline at any point. Each triad involved will follow the same sequence. Supporters/carers and Speech and Language Therapists will only be involved at the beginning and end of the project, taking part in a semi-structured interview. Participants with aphasia will be much more involved, and will follow a sequence of assessment, intervention, and reassessment. Assessments are designed to capture information and measure change in all domains of the ICF. Further information on each element is detailed below.

Recruitment and Consent

The recruitment and consent process will take place over a 2-3 week window for each participant. Prior to the study all potential Speech and Language Therapist (SLT) recruiters from three patient identification sites will be given information on the study (IDEA Project information leaflet 1), and the opportunity to meet with Fiona Menger to discuss the study objectives and recruitment criteria. Through this process they will also be aware of their own potential role in the project. SLTs will then identify potential participants with aphasia as meeting the recruitment criteria and having goals related to Internet use. These potential recruits will be given accessible information containing a summary of the study for themselves and their family or supporters/carers (IDEA Project information leaflet 2). If interested in the study, they will be asked to give verbal consent to the speech and language therapist to pass on their contact details to IDEA Project, and for the chief investigator to contact them in one week to establish whether they wish to find out more. Those who express further interest will be contacted by phone or letter, and if they wish, a meeting with Fiona Menger will be arranged to give more detailed information on the study (IDEA Project info leaflet 3 for people with aphasia, and IDEA Project leaflet 4 for family members

¹⁸ English as a dominant language is a prerequisite for this study due to the complex nature of interpreting language based aphasia assessments in translation. The need for translation would add additional complexity to the study which has a focus on the impact of aphasia, rather than its linguistic complexity.

and supporters/carers). The referring SLT is also welcome to attend this meeting. Further information will be provided to the Speech and Language Therapist on their potential role in the project (also IDEA Project information leaflet 4). One week later, meetings will be arranged to take consent from all interested participants.

Participants will be free to withdraw from the study at any point, without giving a reason, and without their medical care being affected. This information will be explicit in participant information leaflets.

SLT and supporter/carer interviews

Each supporter/carer and speech and language therapist participant will be interviewed at the beginning and end of the project. Each semi-structured interview will take no more than one hour. The pre-intervention interview will comprise of two sections. The first section will discuss the person's own Internet use, their feelings about the Internet, and about their own technical skills. The second section will discuss Internet use in relation to the person with aphasia, including the importance placed on Internet related goals versus other aspects of Speech and Language rehabilitation, feelings about providing support, and barriers experienced. The post-intervention interview will again cover the person's own Internet skills, with questions geared towards reflection on the outcomes and impact of intervention on the person with aphasia, and on themselves.

Period of Initial Assessment and Data Collection

Each participant with aphasia will take part in periods of assessment. The initial assessment period will take place over a 1-2 week period with 4-6 individual sessions up to one hour in duration. Each participant will undertake a set of core assessments and data collection measures. If further information is needed for diagnostic or treatment purposes, some individuals will undertake further language assessments. These further assessments are chosen in order to provide more detailed information on the reading, writing, and spelling skills of participants. This is due to the high demand on literacy skills for some aspects of Internet use. They may be necessary to design interventions to meet the goals of people for whom Internet use would require increased demand on impaired literacy skills. Table 2. Lists core and additional assessment and data collection by ICF domain. Further details on assessments are listed below in sections 8.3.1 to 8.3.5.

Language Assessments

Language assessments for the pre-intervention measures are chosen to profile the language impairment of each participant. The Comprehensive Aphasia Test (Howard et al, 2004) is a comprehensive battery of assessments supported by normative data, and is used extensively for research and clinical practice. Additional assessments listed in Table 2 will allow for diagnosis of more specific aspects of language impairment not covered by the CAT. For

example, the Discourse Comprehension Test (Brookshire & Nicholas), will allow us to assess high level reading comprehension.

CAT subtests on word and non-word reading will be administered at two points in time pre- and post-intervention and will act as control measures. Ability to carry out these tasks is unlikely to change for individuals who have passed a period of spontaneous recovery.

Pre-Intervention data collection

Core Assessments		
<i>ICF domain</i>	<i>Assessment</i>	<i>Average time for participant</i>
Language and Related Impairments	Profile of aphasia using the Comprehensive Aphasia Test (Swinburn, Porter, & Howard, 2004). Subtests: Semantic memory Comprehension of spoken language (word and sentence level) Comprehension of written language (word and sentence level) Naming objects Spoken picture description Written picture names Written picture description Word and non-word reading (x2)	45mins
	Additional assessments – these may be needed to provide further details on the nature of the language impairment, and in order to guide interventions. Chosen from the following: Newcastle Reading Comprehension Assessment. (Morris et al, in preparation) Discourse Comprehension Test (Brookshire & Nicholas, 1997)	up to 90 minutes depending on assessments needed.

	Further cognitive neuropsychological assessments of reading, phonological awareness, and spelling.	
	Profile of cognition using the following assessments: Wisconsin card sorting test (Schretlen, 2010) Symbol cancellation (Helm-Estabrooks, 2001) Mazes (Helm-Estabrooks, 2001)	40mins
	Internet skills assessment	45mins
Personal Identity, Attitude and Feelings	Emotional Scale of the Communication Disability Profile (Swinburn & Byng, 2006)	10mins
	Internet use questionnaire section 1: identification of changes to Internet use emotional consequences of any changes	30mins
Participation in Life Situations	Social Network Analysis (Antonucci & Akiyama, 1987)	20mins
	Internet use questionnaire section 2 – effect of changes in Internet use to social participation	10mins

Cognition Assessments

Profiling of cognition is required to investigate aspects of cognitive function in addition to language which may impact on Internet use. The combination of assessments chosen are designed to give a basic profile of attention, problem solving, memory, and visual-spatial skills.

Internet use questionnaire

The Internet questionnaire used as part of the pre-intervention assessment process will be adapted from a questionnaire used in stage 1 of IDEA project, when participants with aphasia were asked in detail about their Internet use. For the purposes of IDEA 2, the questionnaire will be adapted slightly to elicit information on Internet use both before and after stroke. This will allow us to capture more detailed data on the impact of aphasia on Internet use for each participant.

Internet Skills Assessment

The Internet skills assessment will be a quantitative measure of Internet skills as observed during a timed and video-recorded session. Participants will be asked to attempt tasks they have identified as difficult for them, with increasing levels of complexity dependent on their level of severity. Performance will be rated based on a published framework for measuring Internet skills (van Deursen & van Dijk, 2010).

Basic medical history

Basic medical history will be collected from each participant with aphasia, to establish time post-stroke and any identify any co-occurring medical conditions (e.g. post-stroke seizures) which may be relevant during the intervention period. Details can be verified by phone if necessary via the referring SLT.

Goal Setting and Intervention

Following initial assessment and data collection, we will have determined the key barriers and facilitators to successful Internet use for each participant. Barriers may be linguistic, e.g. related to ability to read and write, cognitive, e.g. related to ability to concentrate and retain information, or environmental, e.g. related to equipment or level of support. It is likely that there will be a combination of factors. Each participant will be given the opportunity to set goals related to their internet use, using supported conversation resources as appropriate. The period of goal setting will take place over 1-2 sessions, up to one hour in duration.

Each participant will then undertake a period of intervention up consisting of 3 sessions per week up to 8 weeks in duration (intensity will vary dependent on need and ability to partake in intensive input). Given the likely complex and multifactorial nature of difficulties accessing and using the Internet post-aphasia, interventions will not be matched and instead will be flexible and designed to meet the needs of each participant. Interventions will follow a set protocol for possible direct or indirect interventions in relation to goals.

Direct Interventions

Direct interventions are likely to take the form of speech and language therapy input aimed at remediation of language deficits. For example, work directly targeted at improving reading comprehension may improve ability to read web pages, or therapy targeted at writing and spelling may improve ability to create online content such as emails or social media updates. Therapy may take a very traditional form, or may make use of software to support people with their Internet use. Examples are screen readers, speech recognition software, or screen simplification. In some cases it may be appropriate to consider

adaptation of current hardware/software, or to consider a change of hardware, e.g. moving from keyboard to touchscreen access.

Indirect Interventions

Some people with aphasia may be unable to achieve independent internet use, or there may be levels of access and use which are not achievable for them without support. Or there may be barriers in the environment which can be modified, e.g. no Internet access in their place of care, postural issues in accessing a screen, technophobia amongst supporters/carers and fear of providing poor support. In these cases it may be more appropriate to work around the environment of the person with aphasia, e.g. working with rehabilitation teams and families to provide adaptations, support, and training.

In some cases it is anticipated that there will be a combination of direct and indirect Interventions. Given the rapid pace of technology development, any new types of software or related innovations which might support people with aphasia in improving their internet use will be investigated and incorporated into therapy if appropriate.

Period of Reassessment

The period of reassessment for people with aphasia will take 1-2 weeks immediately following the intervention period, with 3-5 individual sessions of up to 1hr in duration. The selected measures are all repeated from the pre-intervention stage, and are outlined in table 3. We do not anticipate any change in language and related impairments unless interventions have specifically targeted this area (e.g. reading or writing abilities). Where we hope to see positive change is in use of the Internet to support social participation, with an increase in social networks and reports of wider Internet use. We also hope to see positive changes to direct Internet skills, as measured by our Internet questionnaire and video recorded skills assessment.

Post-intervention data collection

Repeated Core Assessments		
ICF domain	Assessment	Average time for participant
Language and Related Impairments	Repeat of CAT: Semantic memory	45mins

	Comprehension of spoken language (word and sentence level) Comprehension of written language (word and sentence level) Naming objects Spoken picture description Written picture names Written picture description Word and non-word reading (x2)	
	Internet skills assessment	45mins
Personal Identity, Attitude and Feelings	Emotional Scale of the Communication Disability Profile	10mins
	Internet use questionnaire section 1: identification of changes to Internet use emotional consequences	30mins
Participation in Life Situations	Social Network Analysis	20mins
	Internet use questionnaire section 2 – effect of changes in Internet use to social participation	10mins

Data Analyses

The data collected will allow for both quantitative and qualitative analysis as detailed below.

Outcomes of intervention studies will be considered both individually and as a case series, allowing for a detailed focus on the effectiveness of a range of interventions.

Statistical comparisons of pre and post-intervention scores in relevant measures.

Questionnaire and interview data analysed using the grounded theory method, with analysis of themes via framework analysis.

Due to choice of shared pre- and post-intervention measures for each participant, it will be possible to evaluate outcomes across the whole group, providing insight into which factors both internal and external to aphasia might predict positive or negative outcomes.

Expected Outcomes

We expect this study will have the following outcomes:

People with aphasia will have the benefit of a new branch of aphasia research investigating how best to support them in a digital age. Publication and widespread distribution of results will filter to clinical application of interventions.

Speech and Language Therapists will have the benefit of an increased evidence base in providing interventions for people with aphasia with goals related to Internet use.

Of wider implication, this research will highlight potential areas of need which might fall outside the speech and language therapy domain, for example, Occupational Therapy or wider social interventions against digital exclusion.

Organisations providing long term support to people with aphasia may also benefit from evidence on how best to support Internet use.

The information technology and software industry will have further information on difficulties faced by people with aphasia in accessing software and hardware, therefore more information with which to influence future design and development.

Dissemination

Findings from the project will be written up for Fiona Menger's PhD thesis. We also plan to disseminate findings via peer reviewed academic journals and conference presentation. Our funders the Stroke Association will receive a formal report. We also plan to share our results with patient groups, for example the Aphasia Research User Group (ARUG) based at Newcastle University.

References

Antonucci, T. C. & Akiyama, H. (1987). Social networks in adult life and a preliminary examination of the convoy model. *Journal of Gerontology*, 42(5), 519–527.

BBC Marketing & Audiences (2014). Media Literacy: Understanding Digital Capabilities follow-up. Ipsos MediaCT. Available from: <http://tinyurl.com/pwkjo9p>

Brookshire, R. H., & Nicholas, L. E. (1993). *Discourse Comprehension Test*. Tuscon, Arizona: Communication Skill Builders.

Dalemans, R. J. P., De Witte, L., Wade, D., & Van den Heuvel, W. (2010). Social participation through the eyes of people with aphasia. *International Journal of Language & Communication Disorders*, 45(5), 537–550.

Dutton, W. H., Blank, G., & Groselj, D. (2013). *Cultures of the Internet : The Internet in Britain*. Oxford, UK. Retrieved from <http://oxis.oii.ox.ac.uk/reports/>

Elman, R. J., Ogar, J., & Elman, S. H. (2000). Aphasia : Awareness , advocacy , and activism. *Aphasiology*, 14(5-6), 455–459.

Flynn, L., Cumberland, A., & Marshall, J. (2009). Public knowledge about aphasia: A survey with comparative data. *Aphasiology*, 23(3), 393–401.
<https://doi.org/10.1080/02687030701828942>

Greig, C.-A., Harper, R., Hirst, T., Howe, T., & Davidson, B. (2008). Barriers and facilitators to mobile phone use for people with aphasia. *Topics in Stroke Rehabilitation*, 15(4), 307–324.

Helm-Estabrooks, N. (2001). *Cognitive linguistic quick test*. Bloomington, MN: NCS Pearson, Inc.

Helsper, E. J., & Reisdorf, B. C. (2013). A quantitative examination of explanations for reasons for Internet nonuse. *Cyberpsychology, Behavior and Social Networking*, 16(2), 94–99. <https://doi.org/10.1089/cyber.2012.0257>

Hilari, K. (2011). The impact of stroke: Are people with aphasia different to those without? *Disability and Rehabilitation*, 33(3), 211–218.
<https://doi.org/10.3109/09638288.2010.508829>

Jaeger, P. T. (2012). *Disability and the Internet: Confronting a digital divide*. Boulder, CO: Lynne Rienner Publishers.

Kagan, A., Simmons-Mackie, N., Rowland, A., Huijbregts, M., Shumway, E., McEwen, S., ... Sharp, S. (2008). Counting what counts: A framework for capturing real-life outcomes of aphasia intervention. *Aphasiology*, 22(3), 258–280.
<https://doi.org/10.1080/02687030701282595>

Koss, V., Azad, S., Gurm, A., & Rosenthal, E. (2012). *“This is for everyone”: The case for universal digitisation*. Booz & Company. Retrieved from <https://www.strategyand.pwc.com/reports/this-everyone-case-universal-digitisation>

Menger, F, Morris, J, & Salis, C (2014a). From Facebook to Finances. How does Aphasia Impact on Internet Use? *Oral Presentation at International Aphasia Rehabilitation Conference*. 18-20 June 2014, The Hauge, The Netherlands.

Menger, F, Morris, J, & Salis, C, (2014b). From Accessibility to Inclusion. Supporting People with Aphasia to Access and Use the Internet. *Aphasiology Special Edition*. In preparation

Morris, J, Webster, J, , Howard, D Garraffa, M (in course of preparation). Language Incremental Battery for Reading. University of Newcastle upon Tyne

Office for National Statistics, (2013). Internet Access – Households and Individuals. Statistical Bulletin. 7 August 2014

Schretlen, D. (2010). *Modified Wisconsin Card Sorting Test® (M-WCST™)*. Lutz, FL: PAR.

Simmons-Mackie, N., Code, C., Armstrong, E., Stiegler, L., & Elman, R. J. (2002). What is aphasia? Results of an international survey. *Aphasiology*, 16(8), 837–848.

<https://doi.org/10.1080/02687030244000185>

Swinburn, K., Porter, G., & Howard, D. (2004). *The Comprehensive Aphasia Test*. Hove, East Sussex: Psychology Press.

Koss, V., Azad, S., Gurm, A., & Rosenthal, E. (2012). *“This is for everyone”: The case for universal digitisation*. Booz & Company. Retrieved from

<https://www.strategyand.pwc.com/reports/this-everyone-case-universal-digitisation>

Van Deursen, A. J. A. M., & Van Dijk, J. A. G. M. (2010). Measuring Internet skills. *International Journal of Human-Computer Interaction*, 26(10), 891–916.

<https://doi.org/10.1080/10447318.2010.496338>

Van Dijk, J. A. G. M. (2012). The evolution of the digital divide: The digital divide turns to inequality of skills and usage. *Digital Enlightenment Yearbook 2012*, 57–75.

<https://doi.org/10.3233/978-1-61499-057-4-57>

World Health Organization. (2002). *Towards a common language for functioning, disability and health: ICF. The international classification of functioning, disability and health*. Geneva. Retrieved from <http://www.who.int/classifications/icf/icfbeginnersguide.pdf?ua=1>

Worrall, L., Sherratt, S., Rogers, P., Howe, T., Hersh, D., Ferguson, A., & Davidson, B. (2011). What people with aphasia want: Their goals according to the ICF. *Aphasiology*, 25(3), 309–322. <https://doi.org/10.1080/02687038.2010.508530>

Appendix F: Stage 2 information leaflets and consent forms

Information sheets are presented in the following order:

1. Information leaflet for SLT recruiters
2. Summary information for people with aphasia and carers
3. Detailed information for people with aphasia
4. Information for interview participants
5. Consent form for people with aphasia
6. Consent form for interview participants

How do I refer into the project?

If you know someone who might be interested in the project, please share our leaflet entitled 'Summary Information for People with Aphasia and Supporters/ Carers'.

For those who are interested in finding out more, please ask them if you can pass on their details to Newcastle University. We will be in touch (initially by letter) to offer an appointment to discuss the project further. You would be welcome to attend this appointment.

Contact Details

If you would like to make a referral, have any questions about the study, or would like to discuss a potential participant, please contact Fiona Menger on fiona.menger@ncl.ac.uk or 0191 208 5120.

Written communication should be addressed to:

**The Tavistock Aphasia Centre, King George VI Building,
Newcastle University, Queen Victoria Road, Newcastle,
NE1 7RU**



IDEA Project

**Inclusion in the Digital
Economy for Aphasia**

Information for Speech and Language Therapy Recruiters



IDEA Project Stage 2: Info leaflet 1—version 1 23/01/2015. IRAS 156253. R&D NUTH 7423

About IDEA Project

This study is investigating interventions for people with aphasia who have goals around all aspects of Internet use. We are looking for up to nine people with aphasia to take part in therapy targeted at improving their Internet use. Each participant would be involved in the project for up to three months, and would have to withdraw from NHS Speech and Language Therapy for the duration of their involvement.

All participants would undergo a sequence of language and cognitive assessments, a period of intensive intervention, and a period of reassessment.

As part of the project we would also be looking to interview supporters/carers of the person with aphasia, and their speech and language therapist. A person with aphasia would not be excluded should their supporter/carer or SLT not wish to be involved or not be available.



Potential Participants for IDEA Project

We are looking for adults with aphasia:

- who have identified goals around Internet skills.
- who used the Internet prior to their stroke.
- who have no other neurological or psychiatric conditions.
- who are at least six months post-onset of stroke.
- who have English as a first language.
- who have normal (or corrected) hearing or vision.

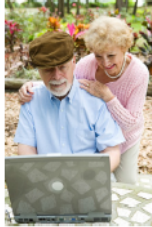


IDEA Project Stage 2: Info leaflet 1—version 1 23/01/2015. IRAS 156253. R&D NUTH 7423

Information for Supporters/Carers

Many people with aphasia find using the Internet difficult, due to the language skills needed to use things like email, social media, online shopping or banking. Although speech and language therapists often try to work with people to regain computer and Internet skills following a stroke, there is very little evidence to suggest which are the best ways to help.

This study is about finding out the best ways to support people with aphasia to regain lost skills in using the Internet. We are looking for people with aphasia who are frustrated by not being able to do things on the Internet that they could before.



What would the project mean for me?

We are also looking for the supporters/carers of people with aphasia to take part in an interview at the beginning and end of the project. There is no obligation for you to do this, and your relative would not be excluded from the research if you chose not to take part.

Researcher Details:

Fiona Menger

Stroke Association Junior
Research Fellow

Tavistock Aphasia Centre

Newcastle University

Telephone:

0191 208 5120

Email:

fiona.menger@ncl.ac.uk



IDEA Project

Inclusion in the Digital
Economy for Aphasia

Summary Information for people with aphasia and supporters/carers



IDEA Project Stage 2: Info leaflet 2—version 1 23/01/2015. IRAS 156253. R&D NUTH 7423

Information for People with Aphasia

Do you find it difficult to use the Internet?



For example:

Sending Emails

Facebook

Reading web pages

Online shopping

Research Project

Researchers at **Newcastle University** are looking for **people with aphasia** to help with a project.

We want to help people
with aphasia to **improve**
their Internet skills.



Supporters/Carers

We are also looking for **supporters/**
carers of people with aphasia.



We would like to **interview** them about the **problems you**
face using the Internet.

The Project

The project would involve:

- **Testing** of your language
- Testing of **other skills**
- **Video** recording
- A **questionnaire/interview**
- **Intensive therapy** for up to **8 weeks**
- Working towards your **goals**
- Work with your **family or carers**
- More **testing** after therapy



IDEA Project Stage 2: Info leaflet 2—version 1 23/01/2015. IRAS 156253. R&D NUTH 7423



IDEA Project

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Economy for Aphasia



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IDEA Project

Inclusion in the Digital
Economy for Aphasia

Detailed Information for People with Aphasia



IDEA Project Stage 2: Info leaflet 3—version 1 27/01/2015. IRAS 156253. R&D NUTH 7423

About IDEA Project

Thank you for your **interest** in this project.



This research is for people with **aphasia** who have difficulty using the **Internet**.

We want to find out the **best ways to help**.

We are looking for **volunteers**.

We want people who used the Internet **before their stroke**.

Why are you doing this study?

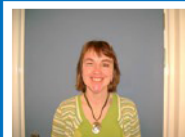
People with aphasia often **struggle** to use the **Internet**.



We want to:

- find the **best ways to help**
- see if improving Internet skills makes your **life easier**
- see if improving Internet skills helps you **interact** with **more people**
- find out more about **barriers** to using the **Internet**
- find out what **kinds of problems** make things more **difficult**

People involved in the study



Dr Julie Morris

julie.morris@ncl.ac.uk

0191 208 8550

Julie is a **Speech and Language Therapist** and **Senior Lecturer** at **Newcastle University**.

Julie will **supervise** Fiona's research.

You can contact her with any **questions** about the study, or if you would like to make a **complaint** about how the study is handled.

If you want to **complain** to someone **independent** of the study, please contact:

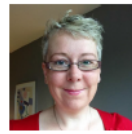
Jane Giles, Head of Speech & Language Therapy,
Newcastle Hospitals Trust

Tel: 0191 229 5848

Email: jane.giles@nuth.nhs.uk

IDEA Project Stage 2: Info leaflet 3—version 1 27/01/2015. IRAS 156253. R&D NUTH 7423

People involved in the study



Fiona Menger

Contact:

fiona.menger@ncl.ac.uk

0191 208 5120

Fiona is a **Speech and Language Therapist** and Stroke Association Research Fellow at **Newcastle University**.

Fiona will visit you to **explain the study** and obtain your **consent** to take part.

She will carry out all **assessments**.

She will be your **therapist** during the project.

You can contact Fiona directly with any **questions about the study**

What would happen if I take part?

The study would take up to **3 months**. You would **stop NHS therapy**. There would be **3 stages**.



Stage 1 (1-2 weeks)

Basic **medical history**.



Testing of your language skills. We would also test **other skills**, like **memory**.



We would do a simple **questionnaire** together.

We would **video record** you using the Internet.

You would have up to **3 sessions** of one hour **per week**.

We would also like to **interview** your **supporter/carer**, and your **speech and language therapist**. They do not have to take part.

Stage 2 (up to 8 weeks)

We would agree your **goals** related to the **Internet**.

We would **work together**. We might work with **you**, or with those who **support you**.



You would have up to **3 sessions per week**.

IDEA Project Stage 2: Info leaflet 3—version 1 27/01/2015. IRAS 156253. R&D NUTH 7423

Stage 3 (1-2 weeks)

We would **test** your **language skills** again.

We would do a **simple questionnaire** together again.

We would **video record** you using the Internet again.

We may **interview** your **supporter/carer**.

We may **interview** your **Speech and Language Therapist**.



What are the risks and benefits?

There are **no risks** to you.

You would receive a period of **therapy**, up to 3 times a week.

This **may not be available** on the NHS.

You would receive **specialist help** with your **Internet skills**.

Do I have to take part?

No. You do not have to take part.

If you say **yes**, we will ask you to sign a **consent form**.

You can **change your mind** at any time.



Your personal information

All our meetings will be **confidential**.

This includes any of your **Internet details**, like **passwords**. You do **not** have to share **passwords**.

We will store all results in a **paper file**.

Files will be in a **locked** filing cabinet.

We will transfer results to a **secure computer**. These will be **anonymous**.

Only the **researchers** can see your files. Newcastle upon Tyne Hospitals Trust may also wish to **audit** them in future.



Results

We will tell your **GP** you are involved in the research.

Your **GP and Speech Therapist** will get a **report** at the end of your part of the study.

We will send you an **easy to read** copy.

The results will be used for a **PhD thesis**.

They may be published in **journals**.

They may be presented at **conferences**.

We can share the results of the **whole project**, when we have **finished**.



IDEA Project Stage 2: Info leaflet 3—version 1 27/01/2015. IRAS 156253. R&D NUTH 7423



IDEA Project

Inclusion in the Digital Economy for Aphasia



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IDEA Project

Inclusion in the Digital Economy for Aphasia

Information for Interview Participants



IDEA Project Stage 2: Info leaflet 4—version 2 27/02/2015. IRAS 156253. R&D NUTH 7423

About the IDEA Project

This study is investigating the best ways to support people with aphasia who have goals around all aspects of Internet use.

We are recruiting people with aphasia who are struggling with the Internet to take part in a therapy study exploring ways to help.

We want to find out the barriers to people with aphasia using the Internet. These barriers may not just be about the person's language problems. We will be asking the person with aphasia to tell us about their experiences, by using a supported questionnaire. We will also video record them using the Internet.



Dr Julie Morris

Contact:

julie.morris@ncl.ac.uk

0191 208 8550



Julie is a Speech and Language Therapist and Senior Lecturer at Newcastle University.

Julie will supervise Fiona's research.

You can contact her with any questions about the study, or if you would like to make a complaint about how the study is handled.

Independent Complaints Procedure

If you want to complain to someone independent of the study, please contact:

Jane Giles, Head of Speech & Language Therapy,
Newcastle Hospitals Trust

Tel: 0191 229 5848 Email: jane.giles@nuth.nhs.uk

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Results of the study

You are welcome to have a copy of the transcription of our interview with you.

Transcriptions of interviews will be analysed and the results will be used for a PhD thesis. They may also be published in journals or presented at conferences.

When the entire project is finished, you are also welcome to have a summary of the results.

People involved in this study

Fiona Menger

Contact:

fiona.menger@ncl.ac.uk

0191 208 5120



Fiona is a Speech and Language Therapist and the chief investigator on the project. She is funded by the Stroke Association as part of a research fellowship.

Fiona will explain the study to you in detail, and obtain your consent to take part. She will conduct all interviews.

Fiona can be contacted directly with any questions about the study.



However, the experiences of those supporting people with aphasia are important to get a fuller picture of the problems involved. For example, difficulties accessing services or equipment, and differing levels of skills. So we would also like to interview 1) a supporter/carer, and 2) their speech and language therapist. We want to ask them about their experiences of providing support. We are interested in talking to people with all levels of technology skills.

What would happen if I take part?

We will arrange to interview you in a quiet location at the beginning and the end of our involvement with the person with aphasia.

We will ask you questions about supporting someone with aphasia to use the Internet. We will also ask you about your own feelings about technology.



The interview will take no more than an hour.

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Do I have to take part?

You do not have to take part, and the person with aphasia involved will not be excluded if you do not want to take part.

If you say yes, we will ask you to sign a consent form.

You can change your mind at any time.



What are the risks and benefits

There are no risks to you in taking part in this project.

There are no direct benefits to you either. The interviews are likely to help us to devise the best type of intervention for the person with aphasia involved.



Your personal information

Our interview will be confidential.

We will store the audio recordings on a password protected computer system.

We will not use your name to store the files, and will use an anonymous code instead.

When we write down the data from the interview, we will omit any information that might identify you, or the person with aphasia also involved in the project.

Only the researchers involved in the project will be able to access the information you provide.

We will keep audio recordings and transcriptions for ten years.



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Inclusion in the Digital Economy for People with Aphasia – Stage 2

Researchers: Fiona Menger/Dr Julie Morris

Information

I have **read and understand** the **information sheet**.

I have had the opportunity to consider the **information**.

I have been able to ask **questions**.

I have had my questions **answered**.

Taking part

I understand that my participation is **voluntary**.

I know I am **free to withdraw** at any time **without giving a reason**.

I know my **medical care** or **legal rights** would **not be affected**.

I understand you will make **video recordings** of me.

I understand you will **inform my GP**.

Consent

I agree to **take part** in the above study.

Name: _____ Date: _____ Signature: _____

Person taking consent: _____ Date: _____ Signature: _____

IDEA Project: aphasia participant consent form – version 1.
IRAS 156253. R&D Newcastle Hospitals 7423
28/11/2014



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**Inclusion in the Digital Economy for People with
 Aphasia – Stage 2**

Researchers: Fiona Menger/Dr Julie Morris

Please
 initial

1. I confirm that I have read and understand the information sheet dated _____ for the above study. I have had the opportunity to consider the information, ask questions, and have had these answered satisfactorily.
2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my medical care or legal rights being affected.
3. I understand you will record my voice.
4. I agree to take part in the above study.

Name: _____ Date: _____ Signature: _____
 Person Taking _____ Date: _____ Signature _____
 Consent: _____

Appendix G: Internet Assessment for Aphasia

Prior to the assessment, the following information was collected:

- Date
- Details of the device used
- Details of any hardware/software or connectivity issues
- Name and version of operating system

The assessor was provided with space to note any difficulties with motor skills or access and/or any sensory/perceptual problems. Suggestions were provided for simple adaptations to allow participants to access the assessment if any of these difficulties were present, e.g., adapted mouse, arm support, change of positioning, ensuring correct glasses were in place.

Scoring

Scoring was based on the amount of assistance given for each anticipated element of the task:

- No assistance required and independent completion of the task = 4
- Additional verbal or written prompts to direct participant towards goal = 3
- Direct pointing alongside verbal/written prompts OR need for language prompts to reach goal (e.g., initial letter, verbal cueing) = 2
- Heavily supported for all aspects of this element (e.g., need for hand over hand guidance, cues for each letter of a word, repeated cueing) = 1
- Unable despite all of above = 0

Assessment Tasks

Tasks were coded as Operational (O), Formal (F), Information (I), Strategic (S), and Linguistic (Lr – reading, Lw = writing)

Task 1:

Switch on your PC/Laptop/Tablet (O). Log-on if needed (Lw).

Task 2:

This is main page for the BBC.

Can you use the BBC to find out what the weather will be like in [LOCATION] this Saturday? Tell me or show me the answer (O, Lr, Lw).

Now please return to the BBC home page (O).

Task 3:

We are going to start at the BBC again.

Find the website for [NAME OF CHARITY] (O, F, Lw). (Ask participant if they know about [NAME OF CHARITY], and if so, if they have previously used the website).

Find out the email address for the administrator (F, Lr).

Find the current newsletter and download it (F, Lr).

Task 4:

We will start at the BBC again.

Imagine you want to go to [LOCATION] on Saturday.

You want to get there for lunch at 12:30pm.

How much is the cheapest train ticket? (O, F, I, S, Lr, Lw)

Examples of supportive materials

Task instructions:

TASK 2

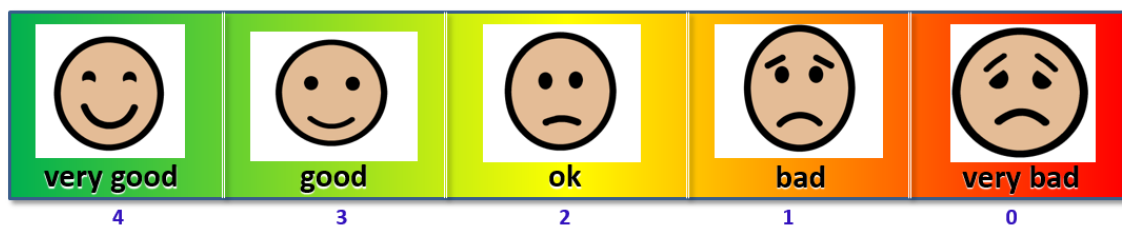
Find out what the weather will be like in Durham this Saturday



Return to the BBC home page



Rating scale:



Appendix H: Revised questionnaire

Questions were presented verbally with written and pictorial support. Options provided to support participants to respond are given below each question.

Broad Internet Use and Skills

1. *Where do you use the Internet?*

Home, Support group, Library, Home of family/friend, College/University, Work, Internet Café, Other

2. *How do you access the Internet?*

Desktop, Mobile phone, Tablet, Laptop, Games Console, TV, E reader, Other

3. *Do you have any problems with computers since your stroke?*

Each item was presented individually and participants were asked to express *yes* or *no*.

- Can't see screen well
- Screen too bright
- Can't use mouse with preferred hand
- Can't use both hands to type
- Can't use fingers to type
- Unable to sit in computer chair
- Fatigue – get tired easily
- Reading web pages
- Writing/typing information
- Entering passwords
- Remembering how to do things
- Recognising my own mistakes
- Understanding audio/spoken information
- Understanding written instructions or manuals

- Understanding spoken instructions
- Speaking to others on the computer
- Asking for help
- Problems with money/numbers
- Other

4. *Does anything else make it difficult?*

Options were:

- Lack of confidence
- No one to help me
- Helpers don't know how to help
- Helpers don't have time
- Costs too much
- Not enough time
- Can't choose the right equipment
- I'm too old
- Health/physical problems
- Other

5. *Do you use anything to help you use the Internet? E.g., equipment and/or software.*

Options were the same as in stage one

For questions 6-9, participants were asked to provide a response for 'before stroke' and 'now'.

6. How often did you/do you use the Internet for?

The frequency of use five-point scale from stage one was used with options from 'daily' to 'never'.

Types of activities probed were: email, instant messaging, Facebook, Twitter, finding info on local events, news, finding information on health, finding information on sports, looking at jokes/funny things, video calls, blogging, downloading or streaming music, playing games, watching tv or films, buying something online, comparing products and prices, making travel reservations, online banking, information about local council, information about government, posting pictures online, online discussions, browsing the Internet.

7. How did/do you keep in touch with others? (choose all that apply)

Options were the same as those used in stage one.

8. Did/does anyone help you with computers and the Internet?

If yes, participants were asked what they were helped with. Supported conversation and pictorial resources were used to help them to provide a response.

9. How often did you keep in touch with others?

The same five-point scale from stage one was used with options from 'less than monthly' to 'several times a day'.

Appendix I: Goal-Setting Materials

Pictorially represented areas of Internet use presented to participants during the goal-setting session. These were used by Bill (Chapter five), Nancy (Chapter six), and Oliver, (Chapter eight). Rose (Chapter seven) was able to prioritise goals using only written materials.

- Reading web pages
- Reading error messages on the screen
- Writing/typing information
- Entering passwords
- Listening/understanding spoken information on websites
- Understanding written instructions
- Speaking, e.g., on Skype
- Changing settings on my computer/device
- Problems with money/numbers
- Asking for help when I need it
- Choosing equipment
- Sending Email
- Instant Messaging
- Facebook
- Twitter
- Blogging
- Skype/FaceTime calls
- Downloading/streaming music
- Playing games
- Watching TV/films
- Internet shopping
- Comparing products/prices

- Booking travel
- Online banking
- Local council
- National government
- Posting pictures
- Online discussions
- Something else

Appendix J: SLT and Supporter Interviews

SLTs and supporters were each asked five main questions. For three of these, further probe areas were available to prompt discussion if the participant did not produce a detailed response. Possible areas for further probing are listed below each question. The fourth and fifth questions were left open ended. This was to reduce any interviewer bias in this area, and to allow the interviewees to reflect on topics already covered and to allow for unanticipated issues to be raised.

Interview Schedule for Speech and Language Therapists

Can you tell me about [NAME] using computers and the Internet?

Getting to know client and identification of difficulties with computer/Internet use, Impact on Activity and Participation and Identifying goals

Can you tell me about your experience of supporting [NAME] to use the Internet?

Planning and implementing therapy, use of specific software/hardware, use of external support, experience with other clients.

What influences your ability to support [NAME] to work on Internet skills?

Technical problems, training needs/support, own technological experience/skills, caseload demands, technological support, institutional support, measuring outcomes of interventions, cost/funding.

What do you think would make it easier for [NAME] and other people with aphasia to use the Internet?

Is there anything you feel we have not covered that you would like to add now?

Interview Schedule for Supporter

Can you tell me about [NAME] using computers and the Internet?

Internet use before stroke, recognition and description of problems, impact on caregiver, identifying goals.

Can you tell me about your experience of supporting [NAME] to use the Internet?

Independent provision of support, external support, family support.

What influences your ability to support [NAME] with Internet skills?

Technical problems, technical support, training needs/support, Internet skills and role to own life, time demands, cost, communication.

What do you think would make it easier for [NAME] and other people with aphasia to use the Internet?

Is there anything you feel we have not covered that you would like to add now?

Appendix K: Participants' Assessment Results

CAT subtests

Bill (Chapter five)		Raw Score		T-score	
<i>CAT subtest</i> ¹⁹	N	A ²⁰	B	A	B
Semantic memory	10	10	10	60	60
Comprehension of spoken words	15	15	15	60	60
Comprehension of written words	15	15	15	65	55
Comprehension of spoken sentences	16	15	14	52	60
Comprehension of written sentences	16	12	12	46	53
Spoken picture description	--	0	1	--	--
Naming objects	24	11	15	49	50
Reading words	24	12	11	50	48
Reading complex words	3	2	2	51	51
Reading function words	3	0	2	35	46
Reading non-words	5	0	0	40	40
Writing: copying	27	27	25	61	50
Writing: picture names	5	4	3	55	54
Writing to dictation	5	2	1	50	52
Written picture description	--	1	8	--	--

¹⁹ CAT written and spoken picture description subtests were not administered using the standardised two-minute time limit. Therefore, T-scores are not given

²⁰ A = pre-intervention, B = post-intervention

Nancy (Chapter six)		Raw Score		T-score	
<i>CAT subtest</i>	N	A	B	A	B
Semantic memory	10	10	10	60	60
Comprehension of spoken words	15	15	15	55	60
Comprehension of written words	15	15	15	65	65
Comprehension of spoken sentences	16	13	13	54	54
Comprehension of written sentences	16	12	12	59	57
Spoken picture description	--	15	14	--	--
Naming objects	24	6	21	46	52
Reading words	24	12	12	48	48
Reading complex words	3	0	0	40	40
Reading function words	3	2	2	49	49
Reading non-words	5	0	0	40	40
Writing: copying	27	27	27	61	61
Writing: picture names	5	3	2	52	50
Writing to dictation	5	1	1	48	48
Written picture description	--	6	7	--	--

Rose (Chapter seven) ²¹		Raw Score		T-Score	
<i>CAT subtest</i>	N	A	B2	A	B2
Semantic memory	10	10	10	60	60
Comprehension of spoken words	15	15	15	53	55
Comprehension of written words	15	15	15	65	65
Comprehension of spoken sentences	16	10	12	46	52
Comprehension of written sentences	16	15	15	67	60
Spoken picture description	--	36	54	--	--
Naming objects	24	18	15	51	51
Reading words	24	14	16	48	50
Reading complex words	3	0	0	40	40
Reading function words	3	2	3	49	62
Reading non-words	5	2	1	51	49
Writing: copying	27	27	27	61	61
Writing: picture names	5	5	5	67	67
Writing to dictation	5	3	3	47	52
Written picture description	--	35	34	--	--

Oliver (Chapter eight)		Raw score		T-score	
<i>CAT subtest</i>	N	A	B	A	B
Semantic memory	10	10	9	60	51
Comprehension of spoken words	15	15	14	55	58

²¹ For Rose, there were two time B periods of reassessment. At time B1, only the email narrative assessment was repeated. All core measures were repeated at time B2

Oliver (Chapter eight)		Raw score		T-score	
<i>CAT subtest</i>	N	A	B	A	B
Comprehension of written words	15	15	15	55	65
Comprehension of spoken sentences	16	16	16	65	67
Comprehension of written sentences	16	16	16	67	65
Spoken picture description ²²	--	44	51	--	--
Naming Objects	24	23	24	66	74
Reading words	24	24	24	69	69
Reading complex words	3	3	3	67	67
Reading function words	3	3	3	62	62
Reading non-words	5	3	5	54	68
Writing: copying	27	27	27	61	61
Writing: picture names	5	5	5	67	67
Writing to dictation	5	3	5	52	68
Written picture description	--	20	40	--	--

Assessment of cognition beyond linguistic processing²³

Bill (Chapter five):

Cognitive test/subtest	N	Raw	Percentile
Wechsler digits forward	12	4	6
Wechsler digits backward	12	1	<2
Wechsler visual memory forward	12	3	<4
Wechsler visual memory backward	12	6	62
CLQT mazes	8	7	--
CLQT symbol cancellation	12	11	--
M-WCST categories correct	6	3	4
M-WCST executive function composite	--	--	12

²³ Highlighted scores represent a score greater than one and a half standard deviations from the mean of standardised non-clinical samples (Wechsler and CLQT) or impaired performance as defined by the M-WCST manual. The CLQT does not provide standardised data.

Nancy (Chapter six):

Cognitive test/subtest	N	Raw	Percentile
Wechsler digits forward	12	1	3
Wechsler digits backward	12	2	9
Wechsler visual memory forward	14	7	47
Wechsler visual memory backward	12	5	21
CLQT mazes	8	7	--
CLQT symbol cancellation	12	12	--
M-WCST Categories Correct	6	3	10
M-WCST Executive Function Composite	--	--	16

Rose (Chapter seven):

Cognitive test/subtest	N	Raw	Percentile
Wechsler digits forward	12	0	<2
Wechsler digits backward	12	2	2
Wechsler visual memory forward	14	9	90
Wechsler visual memory backward	12	6	62
CLQT mazes	8	8	--
CLQT symbol cancellation	12	11	--
M-WCST Categories Correct	6	6	69
M-WCST Executive Function Composite	--	--	82

Oliver (Chapter eight):

Cognitive test/subtest	N	Raw	Percentile
Wechsler digits forward	12	8	67
Wechsler digits backward	12	6	50
Wechsler visual memory forward	14	8	57
Wechsler visual memory backward	12	5	42
CLQT mazes	8	3	--
CLQT symbol cancellation	12	12	--
M-WCST Categories Correct	6	6	76
M-WCST Executive Function Composite	--	--	68

Social Network Analysis

	Bill		Nancy		Rose		Oliver	
	A	B	A	B	A	B2	A	B
Inner circle	3	3	10	10	6	11	20	14
Middle circle	9	3	9	6	8	20	8	7
Outer circle	9	14	2	2	16	17	7	6
TOTAL	21	20	21	18	30	48	35	27
Spouse	1	1	0	0	1	1	1	1
Family	12	10	17	14	7	7	17	--
Friend	5	5	3	4	22	40	8	--
Colleague	1	2	0	0	0	0	0	--
Other	2	0	0	0	0	0	9	--
TOTAL ²⁴	21	18	20	18	30	48	35	1

Communication Disability Profile: Emotions Scale²⁵

	Bill	Nancy	Rose	Oliver
Total score (/56)	15	30	21	11
Angry	0	0	2	0
Frustration	2	2	2	0
Determined	2	1	2	0

²⁴ The number of names labelled by category was not always equal to total number of people within each social network. For example, Oliver did not provide any information on whether people were friends, family, colleagues, etc. at time B.

²⁵ For all emotional scales ratings were 0 – 4. A score of 4 represented the most negative emotion.

	Bill	Nancy	Rose	Oliver
Unhappy	1	4	1	2
Worried	1	2	3	0
Content	1	1	3	0
Under confident	1	0	1	2
Lack of control	2	4	2	2
Able	1	4	1	3
Lonely	0	4	0	0
Embarrassed	1	4	0	0
Valued	1	0	0	0
Feelings about the future	1	2	2	1
Feelings about today	1	2	2	1

Internet Assessment Scores

	N	Bill		Nancy		Rose		Oliver	
		A	B	A	B	A	B	A	B
Switch on/operational	8	8	8	8	8	8	8	8	8
Weather/operational	20	14	11	13	15	20	19	17	17
NETA/formal	28	22	19	19	21	27	27	26	26
Train information/formal/strategic	36	14	22	19	22	35	36	23	31
TOTAL	92	58	60	59	66	90	90	74	82

Internet Assessment Timings (mins:secs)

	Bill		Nancy		Rose		Oliver	
	A	B	A	B	A	B	A	B
Switch on/operational	01:49	00:52	-- ²⁶	--	00:08	00:03	--	00:18
Weather/operational	09:27	06:54	04:18	04:16	01:04	01:11	04:33	04:47
NETA/formal	06:07	08:00	05:57	07:50	02:01	01:30	03:48	05:04
Train times/information/formal/strategic	13:09	08:46	09:11	13:51	03:18	01:41	11:57	10:19
TOTAL	30:32	24:32	19:26	25:57	06:31	04:25	20:18	20:28

²⁶ -- indicates this part of the assessment was not timed.

Appendix L: Tailored Internet Assessment

Bill's Case (Chapter five): Access to online news and sports.

See appendix G for scoring guidelines and examples of supportive materials.

Assessment Tasks

Task 1:

Here is your iPad. Can you switch it on?

Imagine you want to read about rugby.

Can you find the score for [TEAM 1] vs. [TEAM 2] in the European cup last weekend?

Task 2:

Imagine you want to read about football.

Can you find the date of the next match for [LOCAL TEAM]?

Appendix M: Additional diagnostic assessments

Rose (Chapter seven)

Discourse Comprehension Test (silent reading version):

Type of information	No. correct
Main ideas – stated	10/10
Main ideas – implied	9/10
Total main ideas	19/20
Details – stated	10/10
Details – implied	9/10
Total details	19/20
Overall (main ideas and details)	38/40

All scores fell above average performance for normal controls.

Correction of errors:

Rose was asked to read the following piece from the Guardian newspaper in silence and correct the errors. She was informed the errors were subtle and she would need to look closely. Target errors are highlighted with colour coding in this version. Rose received a copy with no mark-up.

Experience: I was out at sea when a tsunami struck

In December 2004 I **had just became** a professional photographer and was **work** on a project about communities who live on the sea, known as sea nomads. I was living with members of the Chao-Ley tribe **on small** island within the Tarutao National Marine Park in southern Thailand. I had a beach bungalow and spent a month getting to **find** the nomads. We didn't share a language, and relied on sign and body language to communicate.

I went out to sea with them regularly. The view was paradise. There was the bright blue sea, **but** dotted on the horizon were small islands that you could see clearly, even though they were 15km away.

On the morning of 26 December, I was due to **leave** out with a group **on six** Chao-Ley fishermen in a small long-tail boat. It was about 8am, and the sea looked different; sterile and tinged with a grey-silver colour. The **water totally** still. I could tell from the way the fishermen **was** behaving that something wasn't right. They **seemed discussing** whether or not we should set off, but the eldest, who operated the boat, gave the go-ahead.

About 20 minutes after our departure and a few miles out in the open sea, one of the fishermen **showed** to a small white spot far in the distance. We kept an eye on it. It **looks** like a football. It was getting bigger and bigger very quickly. We had no idea that this was a **tsunami wave speeds** through the ocean like a tornado.

With a big wave, you would **usually try as far** out as possible into the open sea. The deeper the water, the weaker the wave. **If** we weren't far enough out to be safe, nor close enough to the shore to make it back before the wave would hit the land. We were stuck.

My camera was in my rucksack. With the wave just a few hundred metres behind us, I wanted to capture the scene, **because** I couldn't. Any movement **imbalance** the boat, but I also felt paralysed by the thought of imminent death. I thought, "What's the point in **making** a picture if we are about to be washed overboard?"

Suddenly there was a huge noise and a jolt. The wave had hit the boat, but in the split second of impact, the incredibly skilled captain got it right. He managed to swerve us up and **next the wave**. We were surfing it for a few seconds. **And** the boat glided from the tip of the wave down behind it, into safe waters. Astonishingly, no water splashed into the boat, and no **one overboard**. He had saved us all.

The adrenaline **shot** through my veins made me feel completely insane. Our eyes and mouths were wide open **because** everyone let out heavy sighs. We stayed at sea for another hour or so and then made our way back to the shore. On the island we could see some damage, but nothing compared with what we later saw had happened in other parts of south-east Asia.

Surviving **giving** me a deep understanding of how short life can be. I've been **went** back to south-east Asia almost every year. The photographic project has become a homage and thank you to the people who saved my life. The picture I **wanted take** on the boat remains "the one that got away" – I **want** every photographer has one. But mine changed my life.

verb selection errors (5)

conjunctions (5)

Verb and noun agreement (8)

Prepositional phrase errors (3)

Auxiliary omission errors (6)

The Verb and Sentence Test (Action Naming):

Scoring Breakdown	Rose's Score
*Total (/40)	31
High Frequency (/19)	17
Low Frequency (/21)	14
Transitive (/29)	22
Intransitive (/11)	9
Name related (/18)	14
Not name related (/22)	17

*Aphasic mean = 22.04 (SD = 10.66, range = 37-40), Non-aphasic mean = 38.8 (SD = 1.2, range = 37-40)

Oliver (Chapter eight)

Additional assessments of spelling:

PALPA 39 – letter length spelling. TYPED		
	A	B
3-letter	6	6
4-letter	6	6
5-letter	6	6
6-letter	6	6
TOTAL	24	24

PALPA-44 – regularity and spelling (20 items). TYPED		
	A	B
Time taken (mins:secs)	22:21	14:06
Regular words (/11)	11	11
Exception words (/9)	8	8

PALPA-44 – regularity and spelling (20 items). SPOKEN		
	A	B
Time taken (mins:secs)	01:53	
Regular words (/11)	11	
Exception words (/9)	8	

PALPA-45 – nonword spelling. SPOKEN		
	A	N
All items (/24)	24	

Digit symbol substitution test:


Scoring Breakdown	Oliver's performance
Total score (/93)	16
Scaled score	6
Percentile	9*

*(-1 $\frac{1}{3}$ SD from the mean)

Appendix N: Examples of therapy materials

Bill (Chapter five): App orientation


IDEA Project: Guardian App



We are going to explore the **Guardian** app.

- First we are going to **personalise** the app.
- We will pick what is **most interesting** to you.
- We will **save** your **settings**.

- The **menu** helps you find **topics**.

- Look for the **hamburger!** 

Can you find?

- Rugby union
- Golf
- UK politics
- Lifestyle home and garden
- Football
- Travel – Europe
- Education
- Money – pensions
- Opinion Column

IDEA Project: Tennis Highlights

You are going to find the **tennis highlights**.

1. Open the **BBC Sports** app
2. Tap on the **Menu** button.



3. Select **Tennis**.
4. Scroll down to look for **videos**.
5. Videos have a **play** sign.




6. Enjoy videos!

Bill (Chapter five): Reading strategies

IDEA Project: Reading Strategies

Look at the **picture**.
What is it about?




Read the **headline**.

Read the **first paragraph**.

Read **slowly**.

Read **together**.



Nancy (Chapter six): Penfriend orientation

IDEA Project: Penfriend



We are going to **practice** using **Penfriend**

It will **predict** words as you **type**. **Select** the word you want

Today's Task

Copy these **words** onto your computer:

- Bye
- Definitely
- Please
- Fine
- Today
- Tomorrow

Nancy (Chapter six): Abbreviation expansions

Today we are going to learn how to use **abbreviations**.

This is where you type **two letters** and **something longer** appears.

So, for example:

hb = Happy Birthday!

Let's practise:

mc Merry Christmas!

hn Happy New Year!

iy I love you xx

hb Happy Birthday!

tf Thank you for being my friend.

ws I have problems with my writing and my speech.

Would you like to add any more?

Nancy (Chapter six): Penfriend training: Facebook scenarios

We are going to **practice** comments on **pictures** on **Facebook**.

1. I have a new friend! He's called Jumper.



Nancy (Chapter six): Transcript from online session (2/12/2015)

Time	Person	Message
09:56	Researcher	Good morning Nancy! Have you got Penfriend open? Send me a sticker if you are reading this.
09:58	Nancy	[STICKER]
08:58		[STICKER]
09:58	Researcher	Thank you! Now can you type 'Good Morning' using Penfriend
10:01	Nancy	good morning

Time	Person	Message
10:02	Researcher	Hurray! Well done! Did Penfriend work ok for you? Send me another sticker if it did.
10:03	Nancy	[GIF IMAGE]
10:04		You seem to be managing really well without me this morning! But don't worry, I'll be there on Friday. Your next job is to type three family names using Penfriend.
10:05	Nancy	bb
10:07	Researcher	Don't worry at all if you make mistakes. This is all good practise
10:07	Nancy	[family name] [family name]
10:07	Researcher	Excellent! Well done. Now can you type three words for the weather? Look at your sheet if you are stuck.
10:10	Nancy	Wind sun rain
10:11	Researcher	Fantastic. Well done. Next job. Three TV programmes you watch.
10:14	Nancy	This morning Emmerdale x factors
10:18	Researcher	Well done Nancy. Now three places near you.
10:18	Nancy	[local area] hospital Morrisons
10:19	Researcher	Fantastic. Now three events. I'll start this one.

Time	Person	Message
		Birthday
10:22	Nancy	Birthdays christmas easter
10:23	Researcher	Great. How are you finding this Nancy? Easy or hard?
10:24	Nancy	Easy
10:25	Researcher	I thought so! Let's make it a little bit harder. Pretend you are going to send me a message. Say hello or similar. We will now have a chat using Penfriend.
10:32	Nancy	Hello
10:32	Researcher	Hello Nancy! How are you today? (Don't forget you can also send me stickers)
10:36	Nancy	are home winds
10:37	Researcher	[SMILEY FACE] What did you have for breakfast? I had toast.
10:40	Nancy	Toast
10:41	Researcher	Nice. Now I will ask you some questions. If you can't think of the answers look on your sheet. Where do you live
10:43	Nancy	[correct location]
10:44	Researcher	Thanks.

Time	Person	Message
		When will you next see [daughter's name]?
10:46	Nancy	Today
10:46	Researcher	Great. Now final question. How are you feeling?
10:49	Nancy	How are you feeling? [THUMBS UP EMOJI]
10:50	Researcher	I'm feeling pleased with your progress! Ok Nancy, time to end the session. Thank you for working hard and enjoy the rest of your day. See you on Friday at 11:45.
10:51	Nancy	[ANIMATED GIF]

Rose (Chapter seven): Co-Writer training

IDEA Project: Co-Writer Training

What is Co-Writer

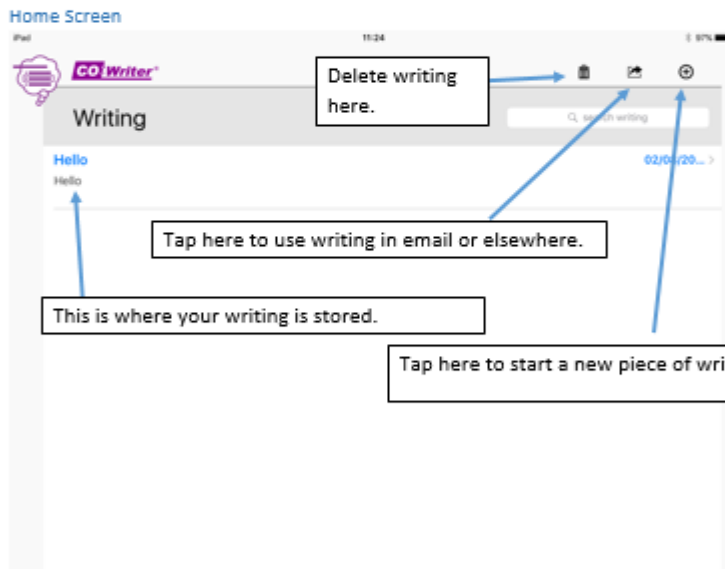
Co-writer is clever word prediction software. It detects grammatical and spelling mistakes, and predicts the next word as you are typing.

How does Co-Writer work on the iPad?

Co-writer is very simple to use. The app looks like this:



There are just a few simple things to learn.



IDEA Project: Co-Writer Training 2

More Features of Co-Writer

There are two main features of Co-Writer to learn about. One is **Topic Dictionaries**. The other is **Personal Words**.

Topic Dictionaries

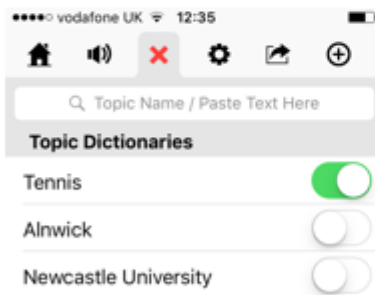
There are over 4 million topic dictionaries. They contain words related to specific topics. These words are more likely to be predicted when writing about those topics. For example, the dictionary 'Tennis' will contain words like 'racket, umpire, net, deuce, and players'. These words are more likely to be predicted if the 'Tennis' dictionary is on.

Let's try it out. Follow these instructions.

- Start a new piece of writing.
- Tap the dictionaries button – it looks like this:



- You will get a search box.
- Search for the word 'Tennis'
- Switch on the Tennis dictionary



Now write the text on the next page about tennis.



IDEA Project: Co-Writer Training 3

Co-Writer Practice

Today we are going to work on writing more text into Co-Writer. This time you will again be thinking of what to write with a little bit of help.

Exercises

1. The first exercise involves telling a story. See the Calvin and Hobbes Comic.

Imagine you are one of the characters in the story.

- o Write the story in Co-writer.
- o Remember to look at predictions as you write.
- o Email your story to Fiona.

2. This exercise involves describing directions. See the map of York.

- o Pretend you live on Jackson Street. Email your friend telling him how to get to your house from York Minster.
- o Remember to look at predictions as you write.
- o Email what you have written to Fiona.

You can do this one again giving directions from the station to the York Dungeon.

3. The final exercise involves giving your opinion. Look at the local news stories in the handout.

- Pretend you are a resident of the area and you want to write a letter to the editor of the newspaper about the story
- Remember to use predictions as you write.
- Email what you have written to Fiona.



Rose (Chapter seven): NARNIA handouts

IDEA Project: Narrative Therapy

What Next?

We are now going to move onto the **second stage** of your therapy. We will be using a type of work called '**Narrative Therapy**'.

What will we be doing?

We are going to spend the next few weeks working on your **emails**. We are expecting this will improve your ability to **plan** and **organise** what you want to write. We will be aiming to:

- increase the **range of words** you use,
- make your **sentences clearer**,
- help **organise** your emails,
- and make the **structure** more interesting.

We are going to work on **different types** of emails. They are structured in slightly different ways. The three types we are going to look at are based on the types of emails you said you want to send. They are:

- Emails to friends and family about what you have been doing.
 - We will call these **recount** emails.
- Emails making arrangements or organising things.
 - We'll call these **procedural** emails.
- Official emails. These might be like the organising emails or they might be expressing your opinion on something.
 - We'll call them **exposition** emails.

Further Assessment

We will start by assessing your ability to say the names of verbs. This won't take long (around 20 minutes).

Therapy




During each session:

- We will start with something to give us ideas to write about. You can help by finding **photos** of you and your **family and friends** from the past.
- Next we will think about the **words** you need to write about this subject.
- Then we will think about the **structure** of your piece of writing.
- We will look at the structure using a **mind map**.
- We will **plan** each email before we write it.



Rose (Chapter seven): Word level brainstorming

Word level

 <u>ACTOR</u>	 <u>ACTION</u>	 <u>WHAT</u>
---	--	--

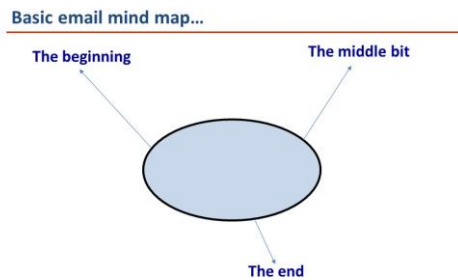
Who (nouns)	Actions (verbs)	What (subject nouns)

Description words

Rose (Chapter seven): Golden rules for writing emails

--

1. Take a blank **mind map**. Write the title of the email in the middle.



2. **Brainstorm** the words needed to write the email.

- a. Think of the **beginning**, the **middle**, and the **end**.
- b. Break down each section.
 - i. Is there anything you need to reply to?
 - ii. What are the parts of each section?

3. **Highlight** all the **verbs**, then all the **nouns**. Underline the **descriptive** words.

4. **Do you have enough** of each type of word to make your email interesting?

- a. Can you think of **more**?
- b. Look at the words you have and try to think of more words **around** them.

5. Write **full sentences** into co-writer using the words you have written.

6. **Link** your sentences.

7. **Rate** your own work using the feedback sheet (see other side). Do you want to **change** anything?

Oliver (Chapter eight): Accessibility handout

Accessibility Settings

In session one we looked at the following options on your iPad:

Larger text

- Settings > General > Accessibility > Larger text
 - You can change the size of text to your preferred reading size

Bold text

- Settings > General > Accessibility > Bold Text
 - You can make text stand out more in bold

Button shapes

- Settings > General > Accessibility > Button shapes
 - Makes buttons stand out by putting a shape around them

Reduce transparency

- Settings > General > Accessibility > Increase contrast > reduce transparency
 - Makes text easier to read on your screen. See below.



Assistive touch

- Settings > Accessibility > Assistive Touch
 - Makes your iPad easier to operate with only one hand.
 - We changed your iPad assistive touch settings to operate:
 - Screenshot
 - Volume up
 - Volume down
 - Siri
 - Home button

Oliver (Chapter eight): Finding and deleting errors²⁷

There are ten places in this text where the letters XOXO have been added. Can you find them and delete them?

Sir Bradley Wiggins has said XOXOthat Chris Froome can emulate his 2012 Tour De France and Olympic time-trial double but thinks XOXOit may be more difficult for his Team GB team-mate and former Sky lieutenant because the Games XOXO are being held in Rio. Wiggins followed up his 2012 Tour success with victory against the clock around the streets of London, a raceXOXO of truth in which Froome took bronze.

With Wiggins concentrating on the track in Rio, Froome's best hopes of a gold rest in the time trial, where his chief rival, the Dutchman Tom Dumoulin, is now a serious injury doubt with a fractured wrist sustained XOXO during the Tour. "I think XOXO it's probably harder for him this time," said Wiggins. "He has to travel out to a completely different continent whereas we came back home, and that is probably more of a challenge for Chris."

Chris Froome said after his third Tour de France win that XOXOhe has been thinking about the Olympic time trial 'for six months' and has matured as a rider over the past year

Speaking of hXOXOis own victory in the final time trial of the 2012 Tour, Wiggins said it left him buoyed with confidence that he would also prevail in its Olympic equivalent. Froome, he believes, has every right XOXOto feel equally bullish.

"The power I averaged that day, I knew nothing XOXOwas going to change in 10 days," he said. "If I just did it again, I'd be all right. There wasn't too many challenges XOXO for me to overcome other than I couldn't get down my lane [to my house] for a couple of days. He can do it, definitely. The way he won the Tour, that's not going to go anywhere for two weeks. If anyone can do it, he can do it."

²⁷ Original text from: <https://www.theguardian.com/sport/2016/jul/25/sir-bradley-wiggins-chris-froome-tour-de-france-olympic-games-time-trial>

Appendix O: Nancy's vocabulary choices

In conversation: *Ah, Bye, Yea, You're Welcome, Yes, Please, Let me know, Oh, Ok, Thanks, That's fine, Perhaps, Definitely, Probably, Somewhere, Not sure, Together*

Starting conversations: *How are you?, Did you enjoy..?, Hello, What do you think?, What's up?, Are you ok?*

Time: *At the moment, Last night, Last week, Today, Tomorrow, Tonight, Next week, Now, This morning, This week, Yesterday*

The weather: *Cold, Fog, Freezing, Rain, Sleet, Snow, Hot, Wind, Ice, Lightening, Thunder*

Events: *Christmas, Birthday, Easter, Party, New Year, Bank Holiday, Summer holiday*

People/places: *18 family names, 9 local places, Station, Hospital, Spain*

Commenting on pictures and status updates: *Terrible, Tired, Beautiful, Wonderful, Sweet, Young, Wrong, Serious, Gorgeous, Different, Perfect, Pretty, Drunk, Oh dear!, Funny, Good, Cute, Special, Dead, Old, Handsome, Hot, Nice, Normal, Mad, Lovely, Lucky, Interesting, Fair, Great*

Health/illness: *Aphasia, Cold, Flu, Feel better, Virus, Stomach, Leg, Pain, Stroke*

Travel: *Walk, Bus, Car, Drive, Taxi, Plane*

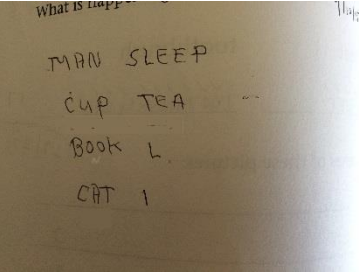
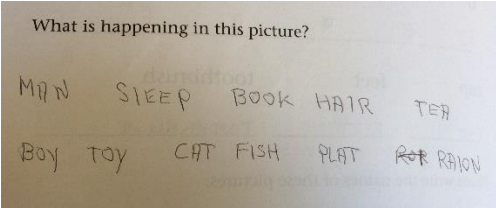
Emotions: *Fine, Worried, Happy, Lonely, Lucky, Tired*

Food/eating: *Breakfast, Lunch, Dinner, Tea, Snack, Eating, Drinking*

TV: *BBC, Soaps, This Morning, Coronation Street, Watching, X Factor, Hollyoaks, Eastenders, Emmerdale, ITV, Strictly*

Appendix P: Written language samples and analysis

Nancy (Chapter six): CAT written picture description at times A and B

A	B	B (+Penfriend)
		<i>man sleep cup tea book cat fish boy and toys radio plants</i>
MAN SLEEP CUP TEA BOOK L CAT I	MAN SLEEP BOOK HAIR TEA BOY TOY CAT FISH PLAT [CROSSED OUT] RAION	

Rose (Chapter seven): Email Narratives

Rose's formatting is retained including her use of the return key to create a new line of text. Identifying details such as names of people and places have been changed or obscured from her original text.

Recount Emails

TIME A:

Hello Fiona,

I'm tried to writing about my last holiday and let you know what we were doing.

First the weather was good. Then the hotel was inclusive with drinks and food.

We haven't that before and we will not anymore. I love to explore new places but there wasn't much to do or sit around the pool. Boring around the hotel and pool.

TIME B1:

A day out

On Saturday I went with 2 friends to (place). Marjorie, my friend has a car but didn't like to drive not far so asked Jill to drive there and she was very happy do go. When we were there we met the wine club group. They had lunch and we could taste 5 wines. Some were good and other ones not so good. The afternoon was to explore the house and gardens. The house is high up and have a super view over the hills. In was cold in the garden but when we were in the lounge was a huge log fire burning for us to sit

around. We had pages to look at quizzes about the house and garden and hope we would win after dinner. Dinner in the evening everybody dressed up and meet asked about answers and questions. More wine tasting with the dinner and more questions about the wine and where we thought they were from. Sorry to say we didn't win the quiz about the house and garden nor win the wine tasting.

TIME B2:

Dear Fiona,

This last week James and I went to Majorca, Palma to staying at C'an Pastilla in Palma Stay Hotel. Also our

son Simon joined us for some of the days. We were happy when saw the hotel and didn't expect it to be

new but although the rooms were small. The hotel had 2 outside pools and inside a spa and pool. One

excellent point was that no children allowed. The weather was sun sometimes and other times cold and

heavy rain but mainly about 23 temperature which meant we could walk easily and enjoy ourselves.

We went to Palma twice on the bus and we have been several times and love to walked from a plaza at

the top and walk down to the cathedral near the sea. It is an interesting city and much to see. Daniel

haven't been before and he was amazed and now going to again with some friends.

Last week at C'an Pastilla in the hotel there was Champion Training Cycling. The cyclists were Germans

and are fit and young. They were in large groups and having fun and also we saw many bruises and

broken limbs after tumbles from their bikes.

Fortunately that is a long cycle path along the promenade from C'an Pastilla to Palma and we could walk

easily.

Simon went search to find us a bar when we went first there and he was happy to meet Spanish and

other people to talk. We have friends from Whitley Bay who live in Palma now and it was lovely to see

them. One evening Gavin came to drive us to a hotel in Palma for some jazz. There were young

fashionable people who live in Palma and the modern jazz music was not our taste but interesting.

Another afternoon we went Gavin and Gaye in Palma and had a meal near the cathedral.

Saturday night after Simon had gone we walked on next the beach we heard music and dancing and

when we went into a restaurant. There was a party of Spanish people dressing in costumes in colourful

dresses. They had come from Barcelona for a birthday and invited us to be there.

Our holiday has been lovely and then coming home we hope the house would be alright with the twins

and okay it was great.

I hope you can sense all my rambling

Rose

Procedural Emails

TIME A:

Hello Jean,

Can you meet in xx at Monday, 14th February for lunch. I thought to meet at Olive and Bean next the xx Market at 1.0pm. James can't go because he goes for jazz on a Mondays.

Love Rose

TIME B1:

Easter

We love you and William come to our house at Easter for the weekend. It is James' 80th so we are having a party and a jazz band. He didn't know about this so please don't tell him. I'm making a large cake and a buffet. I'm going to send him to another friend he can stay out off the away. Please come on Saturday afternoon and the party starts at 3.00 and finished at 7.00. I hope you can come.

TIME B2:

Dear Susan,

I hope you can come to Odeon next week to see the film Eddie The Eagle. Tuesday 17th May, at 5.30pm is a good time for me so I hope you also can. It is a different film for us and an easy, funny simple story but was true. I thought we could meet for a coffee before at Costa and chatter because we haven't spoken for ages. I will get the tickets before I booked them on the Internet.

After we can talk about the film and we think it.

I hope you can so text me soon.

Love Rose

Exposition emails

TIME A:

Dear Sir,

Last week I went to your restaurant with some friends. Another friend has recommend your restaurant because you have some super menus.

We liked the restaurant when we went in and the decor and seating was good. We were placed in a table corner

and looked at the menus and thought the food is going to be good but suddenly the door opened and in came three trumpeters and a drummer. When they started the play we couldn't hear and ran out of the place.

Your sincerely

TIME B1

Hotel

Last month I stayed at your hotel with some friends. I booked a single room and wanted peace for the weekend. I hoped the room would be ready when I went into it but it wasn't. The first then I saw was the untidy bed. The sheets and covers on the top and not been changed. The pillows thrown on the floor. The bin full and the curtains not opened. The ensuite had not been cleaned so the cleaners not been since others stayed.

I talked to the operator and she said that all the cleaners had gone. I want my money back.

TIME B2

Dear Sir

Last week I bought a AEG new washing machine from Fenwicks. I ordered this model before because it has very good for years. I was delighted to changed a new one and the man from Fenwick's plumbed it in. Yesterday I tried it in the morning and my washing was fine but then this morning after the washing the spinning stopped and the washing was wet.

I'm very disappointed and I have a large family with dirty clothes, so if you come at once now to mended or change the machine I will have to go to the laundry and charge you.

Please send someone to fixed my brand machine.

Sincerely R Bloggs

Rose (Chapter seven): CAT Written Picture Description

TIME A:

Grandad is babysitting with the little boy who has a toy car. Grandad is asleep in the chair when the cat on the shelf is trying to get the fish in a bowl. The little boy tries to point to Grandad so that the cat get the fish but the books fall off the shelf and will awaken Grandad.

TIME B:

Mum has gone out and asked Grandad to watch the little baby but Grandad fell asleep and at the same time the cat went to get the fish on the shelf. The little boy shouted to Grandad because the books on the shelf are falling onto his head and also the cat will catch the fish. What a mess!

**Rose (Chapter seven): Curtin University Discourse Protocol: Analysis of
Rose's email narratives**

RECOUNT	A	B1	B2	PROCEDURAL	A	B1	B2	EXPOSITION	A	B1	B2
[start] - greeting	1	0	1	[start]	1	0	1	[start] – greeting	1	0	1
[TITLE] - email title	1	1	1	[TITLE] - email title	1	1	1	[TITLE] - email title	1	1	1
[RSQ] - repeating stimulus questions	2	0	0	[IE] - initiating event	0	2	0	[Th] - thesis or issue	1	1	1
[OT] - orientation time	0	0	2	[G] - Aim/Goal	2	1	2	[OT] - orientation time	0	1	0
[OC] - orientation character	0	2	2	[EC] - evaluative comment	0	1	4	[OC] - orientation character	0	1	0
[OL] - orientation location	0	1	2	[M] - Methods/steps	3	4	6	[OL] - orientation location	0	1	0
[IE] - initiating event	0	1	1	[S] - Statement	2	3	2	[S] - statement elaborating position	7	6	6
[E] – Event	2	10	18	[Conc] - concluding statement	0	1	0	[Ex] – example	0	6	2
[EC] Evaluative comments	3	4	17	[end] - email sign off	1	0	1	[EC] - evaluative comment	3	1	3
[OO] Orientation Other	1	0	0					[Conc] – conclusion	0	1	3
[C] concluding statement	0	2	1					[end] - sign off	1	0	1
[end] email sign off	1	0	1								

Oliver (Chapter eight): Email narratives with researcher notes

Oliver's formatting is retained, but names have been changed for confidentiality.

TIME A:

Hello ¹Fiona^{2,3},

How are you?

I have⁴ just come back from⁵ [COUNTRY].

I ,rather,we had a super time.The food,wine,and weather⁶ ,were⁷ all excellent⁸.

I hope to hear from you soon.

Oliver⁹

No. of words = 31. Time taken = 26 mins 45 secs

1. 'Fiona' was typed as 'Fe' then corrected.
2. Oliver returned to the first line to put in a comma after 'Fiona'. He then asked for a reminder of the task instructions.
3. Oliver double tapped the return key after his first comma in error. He then deleted the extra return.
4. Oliver typed 'have' as 'hahe' and then then corrected his error.
5. 'Oliver typed 'from' as 'for' then deleted and corrected his error.
6. The iPad suggested 'wear' as replacement for what Oliver initially typed here. Oliver put his head in hands and sighed heavily. He deleted back to 'we' and typed 'weather'.
7. Oliver typed 'were' as 'wrere' then corrected his error.

8. Oliver typed 'excellent' as 'exexx'. The iPad suggested and autocorrected to 'executive. Oliver deleted to 'exec' and typed 'excellent'. There was a very long pause between typing of the final two letters. Oliver commented, '*that's still not right.*'. He put his head in his hands, closed his eyes, and sat back in his chair. Following this pause he then deleted and retyped the error as 'excellent'.
9. Oliver commented, 'There's one more comma in there than there should be I think'.

TIME B:

Hello Fiona,

Since I last saw you I have been to [CITY].

We had a marvellous time.

There was no particular standout time, just that the holiday was marvellous¹ end to end².

The prime reason for the journey saw³ visit to see my cousin.

⁴We had previously⁵ arranged to visit the setting⁶ for the painting that my father completed in 1957⁷.

We completed the journey. It was nostalgic.

It brought back many memories.

One of the highlights⁸ of the visit was the trip to [NAME]⁹ Art¹⁰ Galleries¹¹. It is a favourite of mine. I try to go there every time I'm in [CITY].

On the Saturday evening¹², Pauline and I, along with Betty¹³ and Sam went for a meal¹⁴ with Dan and Alison.

We had a lovely time.

Dan and Alison are very good company.

On the Sunday we went for a walk in the park.¹⁵

The weather was good but a little colder than I had expected.

That can happen in [COUNTRY].

No. of words: 192. Time taken: 26 mins 54 secs

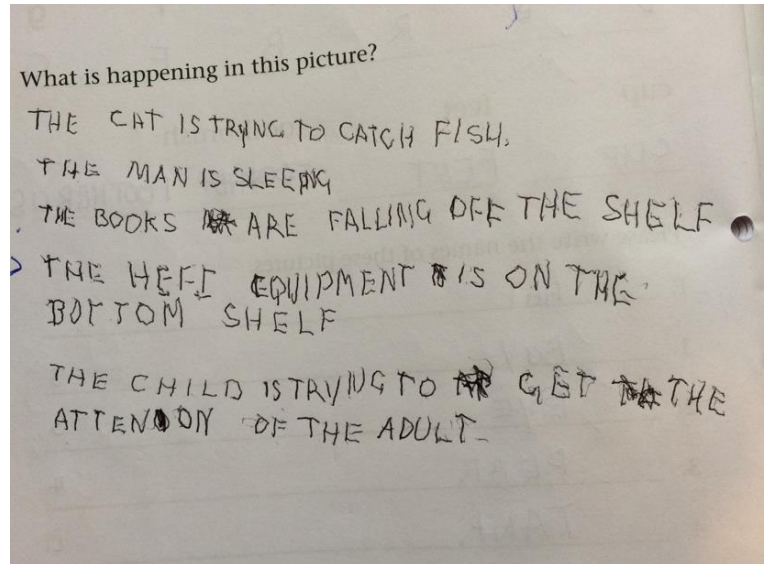
1. Oliver commented, "I've said marvellous twice".
2. Three words were wrongly dictated due to dysfluency in Oliver's speech. He spotted and deleted these.
3. The word 'was' was detected by the iPad as 'wasn't'. Oliver attempted to correct this with cursor and keyboard but replaced 'wasn't' with 'saw'
4. Oliver used the paste button by mistake. He deleted all the extra text manually.
5. Dictation of the word 'particularly' appeared as 'I will take Lulu wanted to'. Oliver deleted this and changed to 'We had previously arranged'.
6. The phrase 'The Location' was edited to read 'the setting' including changing upper to lower case.
7. Oliver began talking without pressing dictate button. He realised at the end of his sentence and started again.
8. 'One of the highlights' was deleted then re-added by dictation.
9. The name of the art gallery was originally dictated incorrectly but with the correct suffix. Oliver edited and used word prediction to enter the correct name then deleted the additional suffix.
10. 'Art' was dictated as 'l'l'. Oliver then deleted and manually typed in 'Art'.
11. Oliver changed a lower-case letter to an upper-case letter. He initially entered the wrong upper-case letter.
12. After 'Saturday evening', Oliver again forgot to press dictate. He realised at the end

of the sentence and started again.

13. Three names were not recognised, and Oliver corrected this by typing them.
14. The phrase, 'went for a meal' was dictated as 'with her for a meal'. Oliver corrected this using iPad prediction.
15. Dictation of "full stop" was recognised as 'after'. Oliver corrected this with typing.

Oliver (Chapter eight): CAT written picture description

TIME A:



The cat is trying to catch fish.

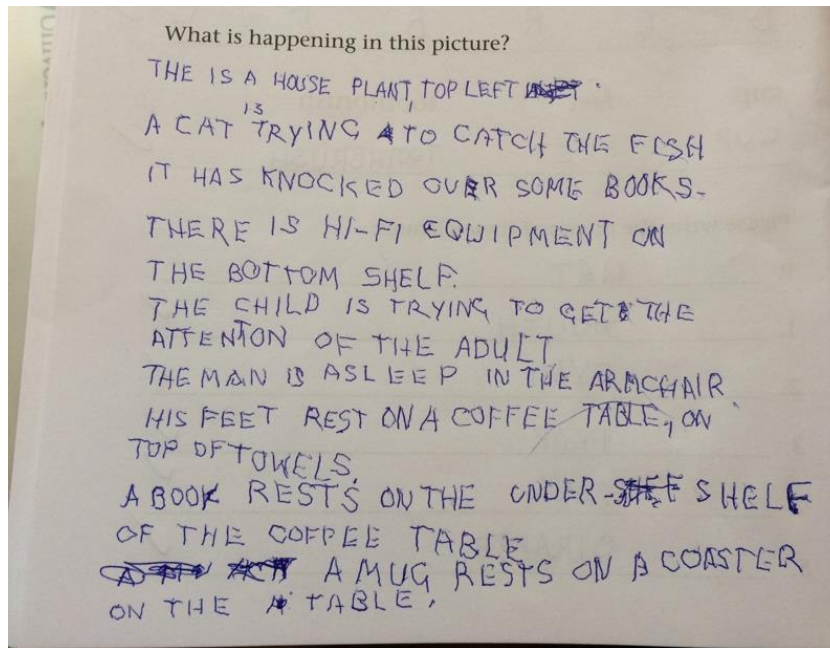
The man is sleeping

The books [SCORED OUT] are falling off the shelf

The hifi equipment [SCORED OUT] is on the bottom shelf

The child is trying to [SCORED OUT] get [SCORED OUT] the atten[SCORED OUT]on of
the adult.

TIME B:



The is a house plant, top left [SCORED OUT]

A cat is trying [SCORED OUT] to catch the fish

It has knocked over some books.

There is hi-fi equipment on the bottom shelf.

The child is trying to get [SCORED OUT] the attention of the adult

The man is asleep in the armchair.

His feet rest on a coffee table, on top of towels.

A book rests on the under-[SCORED OUT] shelf of the coffee table

[SCORED OUT X 2] A mug rests on a coaster on the [SCORED OUT] table.