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Internet use in aphasia: A case study viewed through the international classification of functioning, disability, and health

ABSTRACT

Purpose: This article uses an illustrative case example to discuss a means of producing a holistic profile of Internet use for individuals with aphasia. Methods: The authors used the International Classification of Functioning, Disability, and Health as a framework to select novel and existing assessments to explore the Internet use and skills of a 74-year-old retired academic with severe aphasia.

Results: Quantitative and qualitative assessment results revealed that language impairment, nonverbal impairment, nonverbal aspects of cognition, and hemiparesis had an impact on the individual's ability to use the Internet independently for many previous professional activities; however, relevant Personal Factors showed him to have strong goals and motivation to continue to use the Internet for email and gaining information about topics such as sports. Consideration of Environmental Factors provided insight into barriers and facilitators to Internet use and into the skills of people providing support.
**Discussion/conclusions:** This approach to profiling Internet use in aphasia may be clinically useful in identifying key factors at work to guide information gathering and decision making with people with aphasia. Implications about SLP preparation and funding policies related to therapeutic priorities also are discussed.

**Key words:** accessibility, aphasia, assessment, ICF, Internet

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INTRODUCTION

People with aphasia may experience difficulties accessing and using the Internet. These difficulties relate in part to their aphasia but are also due to a variety of other factors such as age (Seshadri et al., 2006), as well as the presence of concomitant sensory, physical, or other cognitive disabilities (Adamson, Beswick, & Ebrahim, 2004). The Internet has many benefits; it enables better access to education, employment, cheaper goods and services, and, interpersonal communication (Koss, Azad, Gurm, & Rosenthal, 2012). However, there is increasing concern that those who experience difficulties accessing and using the Internet are the most vulnerable groups in society (Helsper & Reisdorf, 2016). This vulnerability could be greater in people with aphasia because language disability will lead to difficulties in relation to Internet use (Elman, 2001; Menger, Morris, & Salis, 2016; Van de Sandt-Koenderman, 2011). Examples of problems experienced by people with aphasia include reading online information, writing or typing, describing technical problems, understanding written or spoken instructions, and participation in interactions on video chat.

According to the International Classification of Functioning, Disability and Health (ICF) (World Health Organization, 2002), functioning and disability comprise a dynamic interaction between a person’s health condition and personal and environmental factors. Undoubtedly, this is a highly useful framework in aphasia (Brandenburg, Worrall, Rodriguez, & Bagraith, 2014; Kagan et al., 2008; Simmons-Mackie & Kagan, 2007; Worrall et al., 2011). In the context of Internet use, it allows scrutiny of the impact of aphasia on activity and participation online. In addition, it highlights the importance of factors within the environment and includes those which
are personal to an individual. Using this approach is helpful in considering complex and interacting factors related to successful use of the Internet. It enables a holistic understanding of the person’s strengths and weaknesses and of external factors of influence. This can then inform goal setting discussion and management.

Identifying the factors as to why some individuals do not engage with technology or why they have poor Internet skills is a focus of research communities concerned with uncovering reasons for digital exclusion (e.g., Helsper & Reisdorf, 2013; Van Deursen & Helsper, 2015). There are initiatives and recommendations aimed at promoting use of digital technologies amongst those most at risk of exclusion (e.g., Communications Consumer Panel, 2012; Forbes, Gibson, Hanson, Gregor, & Newell, 2009; Green & Rossall, 2013). Within aphasia research, there have been studies investigating promoting use of the Internet and teaching basic skills (Egan, Worrall, & Oxenham, 2004; Kelly, Kennedy, Britton, McGuire, & Law, 2016).

Research has also focused on supporting the use of Internet technologies for specific purposes, for example, e-mail (Al Mahmud, Slats, van der Veen, & Mubin, 2014; Thiel, Sage, & Conroy, 2014). Studies considering compensatory interventions include the use of speech recognition to aid writing (Caute & Woolf, 2016; Wade, Petheram, & Cain, 2001), and the use of accessible features such as font size and text to speech on e-readers to support reading (Caute et al., 2016). Researchers have also considered the accessibility of online written content (Devlin & Unthank, 2006; Ghidella, Murray, Smart, McKenna, & Worrall, 2005).

Whereas the themes explored in the studies listed above have contributed to a greater understanding of some areas related to digital technology in aphasia, limited information is available describing the experience of Internet use with aphasia. This
includes people who have never engaged with the Internet or have limited skills, and also people whose previously acquired Internet skills have been affected by their aphasia, and potentially by other stroke related impairments. The latter group (previously skilled Internet users) is the focus of this paper. The need for greater knowledge in this area is important when considering any unmet needs of people with aphasia in today’s digital society.

For researchers and clinicians, it would be of great value to be able to understand the underlying nature of any acquired difficulties people with aphasia report with using the Internet. To the authors’ knowledge there is currently no clear guidance in this area, nor are there comprehensive tools to help understand the diverse factors potentially impacting on Internet use. Increased understanding of this could guide decision-making and measurement of the outcome of interventions.

Kagan et al. (2008) discussed how the ICF can be used as a framework to guide assessment and outcome measurement in aphasia. They outlined how interventions targeted at one component within the ICF may be measured within that component or through assessment of another component. For example, treatment of word retrieval may impact the ability to interact with friends, or modifying the environment by changing the behavior of a communication partner (e.g., via communication partner training) may improve the number of successful conversations held by a person with aphasia. This highlights the importance of considering outcome across the ICF components. Profiling Internet use with aphasia using the ICF framework could enable clinicians to build a comprehensive, holistic picture of a person’s needs, strengths, priorities, and enablers, and, consequently, provide personalized interventions and assess their effectiveness.
AIMS

The aims of this article are:

1. to discuss a means of profiling Internet use for people with aphasia based on the framework provided by the ICF.
2. to illustrate development of such a profile, via a combination of novel and existing assessments used with a person with aphasia.
3. to demonstrate how using the ICF framework could facilitate decision making and goal setting around Internet use for people with aphasia.

The article presents methods used to collect data in relation to Internet skills of people with aphasia and goals for each component of the ICF. Case illustration is used to discuss and explore the process. By discussing data collection methods in relation to an individual with aphasia it is possible to consider the facilitating and inhibiting factors that affect Internet use.

The individual described here took part in a wider study funded by the UK Stroke Association (TSA/JRTF 2012/03) investigating Internet use in aphasia. The wider study investigated Internet and technology use by people with aphasia and investigated the effect of interventions on Internet use with a series of people who had used the Internet prior to a stroke. Each person had a different profile across the ICF framework and had different needs around interventions. In keeping with this special edition on Environmental Factors and inclusion for people with aphasia, the individual described (from this wider study) provides an example of a person for whom Environmental Factors were particularly influential within a holistic profile of Internet use with aphasia.
The UK National Health Service (NHS) research ethics committee granted ethical approval. The research was carried out in collaboration with a local NHS trust. Data collection for the wider study was carried out between October 2015 and July 2016. Data for the case illustration was collected between October-November 2015.

METHOD

Participant

The illustrative case is that of Bill\(^1\), a retired academic with severe aphasia who had previously been a competent Internet user. After the onset of aphasia, he was unable to participate in most of his previous online activities. In exploring Environmental Factors, Bill’s wife and his Speech and Language Pathologists (SLP) also took part in the study. Bill was 74 years old at time of referral. He was a PhD educated former academic prior to a left basal ganglia infarct 2 years previously, who had been active in his academic field. Bill lived with his wife “Violet” who was also retired and his primary caregiver. Bill had two adult children who lived some distance away. Other members of his family, and many of his friends lived abroad.

Bill’s right-sided hemiparesis affected his hand, arm, and leg. He was independently mobile with a cane for short distances. Post-stroke, he also suffered several episodes of sudden loss of vision but had experienced no recurrence of this for several months. He was right-handed prior to his stroke but now had no functional use of this hand. He wore glasses for reading. No difficulties with hearing were

\(^{1}\) Names have been changed for confidentiality
reported or observed. Violet reported her observation that Bill’s language abilities fluctuated from time to time. For example, on some occasions he produced words and short phrases easily but on others he appeared to struggle much more. Violet also reported that he was susceptible to fatigue and this negatively impacted his language.

Bill had recent involvement from two SLPs; SLP1 had been working with him for a large part of his inpatient and outpatient rehabilitation, and SLP2 became involved more recently, as part of a community speech and language therapy service.

**Procedures**

The data reported here were collected across eight 2-hour sessions with Bill and in two separate forty minute interviews with his wife and his SLPs (interviewed simultaneously). All sessions were audio recorded and the researcher took field notes throughout the process.

To investigate Internet use, data collection methods were used that allowed consideration of each component of the ICF framework, with the use of both qualitative and quantitative methods for assessment and information gathering, allowing for a complementarity of purpose approach (Greene, Caracelli, & Graham, 1989). Figure 1 shows the ICF framework (World Health Organization, 2002) annotated to illustrate the different means of data collection integrated throughout this research. Methods and data are presented in this paper with reference to each component of the ICF. As the research involved novel forms of data collection, methods for each area are described first and the results follow.
Assessment of language involved the Comprehensive Aphasia Test (CAT) (Swinburn, Porter, & Howard, 2004). The researchers evaluated Bill using a range of sub-tests to provide a comprehensive picture of his language abilities. The sub-tests included semantic memory, comprehension of spoken words and sentences, comprehension of written words and sentences, naming objects, spoken picture description, reading words, complex words, non-words, and writing. Other relevant cognitive abilities were also assessed. To determine the presence of perceptual visual disturbances, the researchers administered the symbol cancellation and mazes subtests of the Cognitive Linguistic Quick Test (CLQT) (Helm-Estabrooks, 2001). The Wechsler auditory and visual span subtests (Wechsler, 1987) served as measures of short-term memory (verbal, nonverbal...
respectively). The researchers used the Modified Wisconsin Card Sorting Test (WCST) (Schretlen, 2010) to assess nonverbal executive functioning.

**Activity and Participation**

For this component, it was relevant to determine how stroke and aphasia had impacted on Bill’s Internet use and his ability to carry out everyday activities online. These facets of Activity and Participation were investigated through a novel assessment of Internet skills and a supported questionnaire about Internet use.

**Assessment of Internet Skills.** The authors developed this tool based on the principles and design of an assessment developed by Van Deursen and Van Dijk (2010), and modified it for use with people with aphasia. The assessment allowed for collection of quantitative (performance scores on tasks), and qualitative data (detailed descriptions of performance and response to cues). Following Van Deursen and Van Dijk, this tool was designed to evaluate different types of Internet skills across four categories: Operational, Formal, Information, and Strategic. Definitions and examples of each of these skills are as described by van Deursen and van Dijk and are outlined in Table 1. A further category of *linguistic* skills was added as it is relevant to assessing people with aphasia. Four tasks were presented in a presumed hierarchical order of difficulty, distinguishing between different types of Internet skill. Elements of each task were pre-coded according to the type of skills required. Additional supportive materials made the tasks accessible to someone with aphasia (i.e., simple written instructions, relevant pictorial information, repetition of instructions, and task separation). Each task in the assessment and the Internet skills they targeted is provided in Appendix A.
<table>
<thead>
<tr>
<th>Type of Skill</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operational (O) basic skills in information technology</td>
<td>Opening websites by entering the URL; Navigating forward and backward; Opening various common file formats (e.g., PDF); Operating Internet-based search engines</td>
</tr>
<tr>
<td>Formal (F) navigation and orientation around the Internet</td>
<td>Using hyperlinks (e.g., menu links, textual links, image links); Maintaining a sense of location while navigating on the Internet</td>
</tr>
<tr>
<td>Information (I) actions taken to fulfil information needs online</td>
<td>Choosing a website or a search system to seek information; Defining search options of queries; Selecting information and evaluating information sources</td>
</tr>
<tr>
<td>Strategic (S) relates to use of the Internet towards reaching particular goals which benefit the user</td>
<td>Developing an orientation towards a particular goal; Taking the right action to reach this goal; Making the right decision to reach this goal</td>
</tr>
<tr>
<td>Linguistic (Lr) (Lw) Relates to language processing skills required for digital literacy</td>
<td>Understanding written information on websites (Lr); Entering information using keyboard or other text entry system (Lw)</td>
</tr>
</tbody>
</table>

Note: Description of Operational, Formal, Information, and Strategic skills are based on those of Van Deursen & Van Dijk (2010), pp. 898-890. The examples are taken from pp. 898-890. Linguistic skills (with examples) do not feature in Van Deursen & Van Dijk (2010) but are added for the specific purposes of assessing Internet skills in people with aphasia in this study.

*Table 1: Types of Internet skill as described by Van Deursen & Van Dijk (2010)*

Bill completed the assessment using his own computer where he typically used it.

Bill wore a head mounted camera which captured the screen and any keyboard activity while he was carrying out the tasks. If support was needed the primary
researcher first gave verbal or written prompts to direct Bill towards his goal. If this was unsuccessful, suggestions as to what to do next were given alongside verbal/written prompts or specific language prompts (e.g., provision of the initial letter of a word). Finally, if needed, the researcher gave further support (e.g., hand over hand guidance, or repeated suggestions and pointing to the desired area of the screen). If Bill was unable to complete any element of the task independently, help was offered to carry it out on his behalf and to move on to the next step.

Performance on each task was scored at the time of the assessment per completion of each element, and according to the amount of support needed. Scores were carefully analysed using notes taken within the session and then checked with reference to the video recording.

The primary researcher reviewed each task on the video recording (taken via the head mounted camera) twice, pausing and repeating sections as needed. Each Internet task was broken down into components and each component was pre-coded according to the type of skills required. Responses to the task could then be viewed with reference to these codes to provide insight into which types of Internet skill were intact and which were impaired or not evident. Qualitative observations provided additional information about how Bill worked towards completing the tasks, when he had difficulties, when support from the examiner was needed and when it was beneficial.

*Internet Use Questionnaire.* The researchers developed a supported questionnaire about Internet use, with all questions designed to be as accessible as possible for people with aphasia. Bill completed the questionnaire with support from the primary researcher, who used pictorial, auditory and written information. The questionnaire
investigated how often Bill reported carrying out a range of Internet activities (with the activities pictorially represented alongside written descriptions). This included rating how often he took part in each activity on a visual scale from 1 (never) to 5 (daily). Figure 2 gives an example of the materials used within the questionnaire.

![How Often?](image)

![Buying things online](image)

*Figure 2: Examples of supportive resources uses in the Internet questionnaire.*

Gathering this information allowed ordering of Internet activities from that Bill was involved in, from most to least frequent. His responses to individual items (point on
the scale) were recorded. The researcher made additional field notes when Bill offered any explanation for his responses or if the researcher sought clarification.

**Personal Factors**

The researchers elicited information relevant to Personal Factors through case history discussion during an initial meeting, a supported goal setting process, and via information from Violet’s interview. During a discussion of goals, a researcher and Bill identified which aspects of Internet use were most important to him. Principles of collaborative goal setting with people with aphasia were used (Hersh, Worrall, Howe, Sherratt, & Davidson, 2012). In addition, the researcher used visual supports to facilitate goal setting discussions as they were shown to be successful with people with aphasia in supporting decision making (e.g., Bornman & Murphy, 2006; Hux, Buechter, Wallace, & Weissling, 2010; Murphy & Boa, 2012). The researcher presented pictures representing aspects of Internet use one at a time with written text. Then, the researcher asked Bill to rank and place items on a visual scale according to their relative importance. This allowed for a clear visual representation of which aspects of Internet use were most important and led to a focused discussion on the aspects of Internet use he gave the highest priority. Following the session, the researcher took a photograph of the images as Bill had arranged them.

In addition, Bill completed the emotional scale of the Communication Disability Profile (Swinburn & Byng, 2006). This scale was used to obtain a measure of the impact of aphasia on emotional wellbeing, rather than as a factor influencing the disability itself.
Environmental Factors

Data collection around Environmental Factors was divided into two main areas: the digital/online environment, and the environmental support received from others.

Digital/Online Environment. The impact of the digital/online environment was investigated using the Assessment of Internet Skills described earlier. It was anticipated that some aspects of performance might be related to aspects of hardware design, or to accessibility of Web pages/online environments.

Support from Others. Environmental support from others was investigated following Antonucci and Akiyama’s (1987) approach to considering social networks. The researchers asked Bill and Violet 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 asked to indicate whether each of the names were family, friends, neighbours, or colleagues, and to quantify how often Bill saw each of them.

Interviews: Cross-Component Data

Interviews with Violet and Bill’s SLPs were used predominantly to provide information relevant to Environmental Factors, though it was anticipated that interviewees would also provide insights relevant to Body Functions and Structures, Activity and Participation, and Personal Factors. Semi-structured interviews were chosen to collect information related to experiences of those persons most likely to provide support with Internet use.
The extent to which researchers can anticipate topics to be covered in an interview depends on the previous literature on the topic, and on whether unanticipated themes may emerge. In terms of what the evidence shows, provision of support to use the Internet is a barrier for many people with aphasia (Menger, Morris, & Salis, 2014); it was therefore appropriate to probe further into the nature of possible support.

Johnson, Morris, and Menger (2014) identified several difficulties experienced by SLPs in supporting their clients to use technology, with the main difficulties being client’s suitability to use technology, cost, availability of trial products, and awareness of what is available. Although limited research focuses specifically on how best to support people with aphasia with Internet use, the body of literature on wider applications of technology to aphasia rehabilitation was also relevant. Examples include therapy programmes, alternative and augmentative communication, accessibility of written information, and specific software for literacy skills (Menger et al., 2016). This literature guided selection of areas for further exploration and design of interview schedules.

In the interviews with Violet and Bill's SLPs, the questioning structure followed guidelines from Arthur and Nazroo (2003) regarding ordering topics in a manner to ease participants into the interview. Interviewees were asked to discuss computers and the Internet in relation to Bill, then to discuss their experiences of providing support. The authors asked to the SLPs to consider the issue broadly, focusing first on Bill then on their experiences of Internet use by other people with aphasia. If questions elicited limited information, the interview schedule contained a range of open ended sub-questions to provide more focus. At the end, interviewees were
given an opportunity to add anything they felt had not been covered. Interviews were transcribed verbatim from audio recordings following the sessions. See Appendix B for an outline of interview questions.

Interview analysis was carried out using Nvivo software (QSR International, 2016). 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 and coded (Creswell, 2007). The ICF framework influenced initial coding, as components of the ICF were used as predetermined umbrella nodes to allow for systematic evaluation of the data in relation to the framework. Each data segment was also assigned a further code according to its content. Key themes were then identified which could be used to either validate data collected via other means, or to illuminate issues of relevance to each component of the ICF.

**RESULTS**

The results from assessment are presented in this section, profiling Bill’s Internet skills using the ICF framework components.

**Body Functions and Structures**

Bill presented with severe non-fluent aphasia with additional mild deficits in other aspects of cognition, most notably executive functioning skills and auditory and visual memory. His spoken language and writing were both severely limited. In formal assessments, Bill’s receptive language skills and ability to copy written text were less impaired than other aspects of his language. A summary of Bill’s
performance on language assessments is provided in table 2 and on other cognitive assessments in table 3.

<table>
<thead>
<tr>
<th>CAT Sub-test</th>
<th>Items correct</th>
<th>Expanded CAT Score</th>
<th>T-score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semantic memory</td>
<td>10/10</td>
<td>-</td>
<td>60</td>
</tr>
<tr>
<td>Comprehension of spoken words</td>
<td>15/15</td>
<td>29/30</td>
<td>60</td>
</tr>
<tr>
<td>Comprehension of written words</td>
<td>15/15</td>
<td>30/30</td>
<td>65</td>
</tr>
<tr>
<td>Comprehension of spoken sentences</td>
<td>15/16</td>
<td>20/32</td>
<td>52</td>
</tr>
<tr>
<td>Comprehension of written sentences</td>
<td>12/16</td>
<td>12/32</td>
<td>46</td>
</tr>
<tr>
<td>Spoken picture description</td>
<td>--</td>
<td>0</td>
<td>37</td>
</tr>
<tr>
<td>Naming Objects</td>
<td>11/24</td>
<td>19/48</td>
<td>49</td>
</tr>
<tr>
<td>Reading words</td>
<td>12/24</td>
<td>23/48</td>
<td>48</td>
</tr>
<tr>
<td>Writing: copying</td>
<td>5/5</td>
<td>27/27</td>
<td>61</td>
</tr>
<tr>
<td>Writing: picture names</td>
<td>4/5</td>
<td>16/21</td>
<td>54</td>
</tr>
<tr>
<td>Writing to dictation</td>
<td>2/5</td>
<td>11/28</td>
<td>49</td>
</tr>
<tr>
<td>Written picture description</td>
<td>--</td>
<td>1</td>
<td>52</td>
</tr>
</tbody>
</table>

Note: Expanded CAT score refers to the CAT scoring system where a second marking scheme attributing 0, 1, or 2 to each item is used. For writing sub-tests, scoring is expanded to give credit for each letter correct with deductions for errors.

*Table 2: Bill's language assessment results. * = within normal limits according to test norms*

<table>
<thead>
<tr>
<th>Test/Subtest</th>
<th>Score</th>
<th>Total Possible</th>
<th>Percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wechsler Digits Forward</td>
<td>4</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>Wechsler Digits Backward</td>
<td>1</td>
<td>12</td>
<td>&lt;2</td>
</tr>
<tr>
<td>Wechsler Visual Memory Forward</td>
<td>3</td>
<td>12</td>
<td>&lt;4</td>
</tr>
<tr>
<td>Wechsler Visual Memory Backward</td>
<td>6</td>
<td>12</td>
<td>62</td>
</tr>
<tr>
<td>CLQT Mazes</td>
<td>7*</td>
<td>8</td>
<td>--</td>
</tr>
<tr>
<td>CLQT Symbol Cancellation</td>
<td>11*</td>
<td>12</td>
<td>--</td>
</tr>
<tr>
<td>Wisconsin Card Sorting Test (Categories correct)</td>
<td>3</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Wisconsin Card Sorting Test (Executive Function Composite)</td>
<td>78</td>
<td>--</td>
<td>12</td>
</tr>
</tbody>
</table>

*Table 3: Bill's performance on cognitive assessments.*
**Activity and Participation**

The Assessment of Internet Skills highlighted some of the difficulties Bill experienced. He completed some individual elements of the assessment, although he needed multiple prompts throughout. Prompts involved repeated reminders of the task and suggestions, alongside pointing to direct him as to what he should do next. Operational skills were the most preserved. He turned on his computer, and he could click on links and copy a URL into the correct location. He had more difficulty with formal skills than operational skills. In particular, with orientation around webpages he could not find his way back to where he had been before without support, 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 British Broadcasting Corporation website), 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 Internet searches. He experienced greater difficulty with more complex tasks.

Strategic skills were difficult for Bill. He 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 in using a mouse with his non-dominant hand and clicking on hyperlinks. However, with a great deal of help from the researcher he completed some aspects of all the tasks and completed the assessment.
Bill’s responses to the Internet Use Questionnaire indicated that his most frequent activities were looking at news and sports, followed by e-mailing. His other activities included looking for information on local events, general browsing, looking for information on health, jokes/funny content, and online discussions. It was unclear from his responses on this task whether he was referring to his current Internet use or his use prior to his stroke; thus, further baseline assessment of Bill’s Internet abilities was planned as an initial intervention step following profiling.

Within the interview, Violet stated that prior to his stroke and aphasia, Bill used the Internet regularly. She reported that he used computers for writing, the Internet to search for information for his research and used e-mail to correspond with friends and colleagues. Bill’s Internet skills were self-taught, and if he did not know how to do something he would work it out by looking up the information. She felt that these abilities changed a great deal following his stroke, such that Bill could not carry out his previous activities independently. Violet confirmed he had a great deal of difficulty related to his aphasia, particularly with his e-mail correspondence. She reported that trying to communicate the simplest of ideas frustrated him, and this was a contrast to his previously articulate self.

**Personal Factors**

Educated to doctoral level and having worked previously as an academic, the benefits provided by the Internet were important to Bill. As previously discussed, prior to his stroke he used e-mail to stay in touch with people around the world. He was a high achiever, motivated in his career, and although officially retired, he had continued to work and held a role with his university. Violet confirmed his ongoing drive and motivation to improve, recalling 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.

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. Figure 3 illustrates the organisation of Internet-related pictures at the end of Bill’s goal setting session. 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 3: Use of visual resources to guide goal setting.
As Bill placed increased emphasis on e-mail, news and sports, these three aspects of Internet use were determined to be main priorities for using the Internet. He was already accessing email (heavily facilitated by his wife), so his selection was interpreted as a desire either to become more independent in this area or to increase his frequency of emailing. The placement of Bill’s priorities was photographed then reviewed and confirmed with Bill in the following session.

Bill’s responses on the emotional scale of the Communication Disability Profile allowed consideration of some of his feelings related to his aphasia. Within this, a scale of 0-4 is used, with 0 representing the most positive end of the scale and 4 representing the most negative. He reported no anger or loneliness and mild feelings (rated 1) of unhappiness, worry, lack of confidence, and embarrassment. He rated his contentment, ability, and feelings of being valued at the second most positive rating on the scale (scored 1 to represent low impact of disability). Feelings of determination, frustration, and lack of control were all rated at the middle point. His strongest negative ratings were how he was feeling at the point of the assessment and about the future (rated 3).

**Environmental Factors**

Bill experienced barriers to physical access to his computer. During the Assessment of Internet Skills, Bill struggled to use his unaffected arm and hand to open his laptop and had problems discriminating between left and right click buttons on an external computer mouse. He was facilitated by the physical presence of a keyboard, and was able to match letters when copying the text of a URL. The online environment
also introduced barriers; he became distracted by 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 where he was before. He was able to return to the task with reminders of the initial instructions, and with prompting as to what to do next. 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 British Broadcasting Corporation weather website did not prompt him to click for further information, and he needed verbal prompting. Facilitators on websites were simple design features which contained single words (e.g., a menu bar at the top of the screen to help him navigate around web pages). When searching for contact information for a person, a picture and highlighted content helped him to locate the desired information.

Social network analysis

Bill completed the social network analysis with reference to a personal communication book that contained pictures of his friends and family. The completed diagram contained three names in the inner circle, that 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. In terms of frequency, Bill reported that he saw his wife every day. He saw five of the individuals fortnightly, eight monthly, and the remainder he saw rarely. This information suggests that Bill’s social support came predominantly from his wife; he had little access to any other regular support from 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 barrier, with limited access to others with the skills to use multiple means of communication.

Interviews

Data emerging from the interviews gave a thorough sense of the nature of this support, and of barriers and facilitators to Internet use in Bill’s environment. This information complemented and expanded on the social network analysis data, specifying where and from whom Bill received help with Internet use. A list of all codes and counts of themes is provided in Appendix C.

Violet's interview highlighted that she was an important environmental facilitator. She recognized that Bill was no longer able to read and write independently, so 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 using the keyboard. Violet encouraged this activity, prompting Bill to engage with e-mail messages from friends. Time was not a barrier for Violet, and she prioritised supporting Bill, viewing his needs as priority. She stated that she was willing to put Bill’s rehabilitation first over other activities, as she felt his needs were more important. Violet's interview also revealed that she and Bill had benefited from attending a communication partner training group run by local SLPs. Violet stated that this was hugely helpful to them, teaching them new ways to communicate with each other and reducing their frustrations.

However, there were potential barriers in relation to Violet’s ability to support Bill. Although she indicated that time was not a problem, she also remarked several times 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 to check for
e-mails by family and friends. Additionally, she felt many aspects of computer use were bewildering to her. She struggled to use Bill’s laptop, feeling much of it was unfamiliar and that she lacked 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.

Despite their geographical distance, Bill’s children were also important facilitators and provided Bill and Violet with some help with technology. They had bought and set up an iPad for Bill as an alternative to his laptop. However, family support was also a potential barrier. Although the skills of their children were highly valued, and their help appreciated, Violet indicated that they found it difficult to understand what their children were doing on her and Bill’s behalf. She commented that when they were helping with Bill’s computer or the iPad they carried out tasks too quickly for her to learn. She remarked that “it doesn’t matter,” indicating that she was reluctant to offend or criticise her children regarding the support they offered.

Before retirement, both Bill and Violet accessed technical expertise from their employers. However, the assistance was no longer available. 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 working on language therapy software, and when Violet returned from a brief trip out he was distressed, and unable to explain what happened. Bill and Violet sought help with the laptop from the store where they initially purchased the laptop. The support they received was a clear facilitator as they found the service very accessible to them. Violet stated, “on
two occasions I remember their staff sat with us for about half an hour… and spoke though things and installed the Internet and all sorts of things, they were really fantastic.”

Other potential barriers emerged around the extent of provision of help from health professionals with Internet skills. Violet reported that there was no external help, and she provided any support Bill received with using computers.

The SLPs discussed how they focused on Bill’s early priorities. They suggested that although they considered goals related to Internet use, their primary focus related to Bill indicating a wish to improve his speech. Any therapy related to computers was aimed at improving his spoken production through speech and language therapy software or applications. The use of e-mail was discussed during SLP visits but not prioritized as a therapy goal.

The SLPs became involved with technology during their time working with Bill. Specifically, SLP1 provided some advice on how to install therapy apps on Bill’s iPad. The SLPs also spoke about the usefulness of Bill’s iPad as part of his therapy. The purchase of this was recommended very early in his rehabilitation, along with suggestions for which apps to use. The SLP1 commented that Bill’s ability to self-fund a tablet computer meant that financial constraints were not a barrier.

Both SLPs described their own Internet skills, and their ability to provide help in that area. SLP2 said that she developed technological skills during her academic training, and through experience over time. She felt confident in supporting others with technology. SLP1 was skeptical, discussing her knowledge of accessibility tools and commenting that she felt her knowledge in this area was limited. She also felt she would not know where to obtain the information she needed. A professional
discussion group provided her with some knowledge in this area but she acknowledged this was still limited. Both SLPs agreed that training needs around interventions to support people with aphasia to use the Internet would not be regarded as a priority by their manager over other training needs.

Furthermore, the SLPs felt that funding to provide equipment or software to help clients with aphasia to access the Internet is not easy to access. They were aware of funds to provide communication aids and therapy but not for access to the Internet, which SLP2 felt would also be beneficial. She commented that use of technology beyond communication aids or therapy software was equally important, giving the examples that people with aphasia might want to engage with activities like Internet banking or shopping.

The SLPs also discussed measuring therapy outcomes. They described possibilities for informal assessment but acknowledged a lack of formal assessment tools available to them in this area. They reported the difficulty of measuring individual’s computer skills before and after strokes. Another issue identified included how to address different types of Internet related goals for people with aphasia, with different types of activities providing different challenges. SLP1 pointed out, “some people might only want to write some e-mails, and they might have their e-mail program installed on their computer … which would be very different to somebody who wanted to go on and do shopping.”

**DISCUSSION**

The aims of this article were to discuss a means of profiling Internet use for people with aphasia. In addition, the authors sought to demonstrate through a case
illustration how a combination of novel and existing assessment measures framed around the ICF can reveal the range of factors involved in using the Internet.

Consideration of Bill’s experience showed that for him there were influential factors across ICF components. Furthermore, his aphasia (and stroke) severely impaired his ability to participate independently in the majority of his previous Internet activities. In the following text, the authors discuss the findings of the study with explicit reference to the ICF components, and highlight the clinical implications for intervention with people with aphasia.

**Body Structures and Functions**

Considering Body Structures and Functions, Bill’s aphasia and mild deficits in other cognitive skills had a substantial impact on his Internet use. Hemiparesis compounded these difficulties, making physical access to equipment cumbersome and slow. Language and cognitive assessments showed Bill had impaired verbal comprehension and memory affecting his ability to understand and retain verbal instructions. Bill benefited from repetition, written and pictorial versions of instructions, and pointing to direct his attention. These strategies would be of benefit to him if working on his Internet skills in future.

In addition, when attempting to deal with large amounts of written information on a website (e.g., the British Broadcasting Corporation homepage), he became distracted and unable to focus his attention. Bill had previously demonstrated good attention skills for other assessment tasks. His difficulty with carrying out Internet-based tasks that required a combination of verbal and nonverbal cognitive abilities could be attributed to poor executive functioning skills, with the need to switch between different facets of cognition.
The extent to which reading comprehension impairments affected his comprehension of web pages is unknown because the researchers collected data only for single word and sentence level reading comprehension. In contrast, many Web pages include paragraph-level information. He could read Web page menu items aloud, and his language assessments suggested that he understood single written words and short phrases. It would have been helpful to gather further information on his ability to retain and process longer pieces of written information, ideally within the context of reading on a screen.

Bill also demonstrated expressive language impairments. His writing was impaired such that he could not produce extensive written content independently, as would be required in e-mails. These skills were limited to copying, and, therefore, he could not successfully generate search terms or enter items into online forms. Limited spoken language resulted in his not being able to explain how and why things went wrong. This led to situations such as the incident when his laptop crashed and he could not communicate what happened.

**Activity and participation**

Bill was able to use the Internet in some ways, but he displayed only simple operational and formal skills without the need for support. Bill could recognize and click on links, open websites, and operate a search engine. The combination of impaired language and executive functioning skills, however, influenced his ability to obtain information online or to adopt a strategic approach to using the Internet. Without support, he was unable to problem solve and carry out steps requiring a range of skills toward a goal. His stroke and aphasia had a significant impact on his
previous Internet use and skills, affecting his ability to use the Internet independently, and severely restricting his online activities.

**Personal Factors**

Exploring Personal Factors helped determine Bill’s motivations and priorities. Analysis of interviews suggested that he was driven to work on his rehabilitation and to improve his Internet skills. With support, he made these personal priorities clear. His enthusiasm for current affairs and sports, as well as his desire to communicate with colleagues and friends from around the world fueled his incentive to improve his skills.

Bill's goal's and motivations had changed following the early period after his stroke, and while he had an early focus on his speech, he was now interested in working on communication and participation using the Internet. This highlights a need for SLPs to revisit goals with their clients. As demonstrated by Bill’s case, these are likely to shift and evolve over time.

**Environmental Factors**

Bill's impairment could be viewed as the predominant factor that influenced his ability to complete the tasks within the skills assessment. Alternatively, his difficulties could be viewed in terms of Environmental Factors, as a problem of design and the consequences of inaccessible online environments that fail to take into account the needs of people with disabilities (Easton, 2013; Jaeger, 2012). The Assessment of Internet Skills, designed for this research, provided valuable insight into the use of the Internet by people with aphasia. Detailed description of performance on the
assessment tasks illustrated which Internet skills were present or absent and which aspects of design influenced performance. For example, the simple design of a menu tab with clear single word options was helpful. These findings have the potential to influence Human Computer Interaction researchers and recommendations for wider Web content accessibility guidelines (W3C, 2016).

Environmental Factors were also relevant in terms of people. Bill had family and friends who were willing to help him with his rehabilitation and his use of the Internet. His children assisted him by buying equipment and demonstrating Internet activities. However, the speed by which they demonstrated solutions meant that Bill and Violet were sometimes unable to benefit. They gave positive feedback on conversation support training for reducing frustrations between them and this approach might be of further help if offered to their children. Violet was able to prioritize her time to help Bill and took his fatigue into account. Despite her frustrations, she was interested in computers and willing to learn new skills. The nature of their relationship meant that they could comfortably work on tasks together (e.g., e-mail). However, she had limited confidence in her own Internet abilities. Most friends and family were either far away or not confident Internet users. As older adults, Bill and Violet were more likely to experience difficulties engaging with and using technology (Chang, McAllister, & McCaslin, 2015). Violet was less able than people with more confidence in their own skills when aiming to assist her husband. The SLPs were helpful in suggesting computer-based therapy and helped with the installation of therapy applications. Their input, however, had focused on Bill’s original priority of improving his spoken production; therefore, intervention related to aspects of his Internet use was not a focus.
Clinical implications

In considering the profile for an individual through the ICF, using existing and novel assessment approaches and drawing data together, it is possible to consider implications for intervention approaches. Simmons- Mackie and Kagan (2007) illustrated how interventions can be implemented across ICF components.

In relation to Bill, it is possible to identify several foci for intervention. For example, therapy targeted at the Body Functions and Structures component could aim at improving aspects of language function (e.g., the ability to produce typed written language for emailing). Intervention targeting the Activity and Participation component might involve symbol-based communication or the use of video chat as a substitute for e-mails. Intervention targeting the Environmental Factors component might include modifications to the physical environment to help Bill reach his personal goal by providing means to facilitate access (e.g., a touchscreen instead of a mouse) or by simplifying the online environment (e.g., by customizable applications personalized to display only content most relevant to his interests). Alternatively, Bill’s support environment could be adapted by training others as supportive communication partners, which may facilitate ongoing Internet use. These options are not exhaustive, but they illustrate how producing a holistic profile of Bill’s Internet use, abilities, and difficulties can inform decision making about possible interventions. Whereas Bill identified Internet use as a priority now, at an earlier stage of rehabilitation, his focus was on improving spoken production. Bill’s SLPs were aware that use of the Internet was an area of concern and identified him as a potential candidate for inclusion in this research. They were unsure how they would work in this area and where to access appropriate evidence or expert advice.
This raises issues around timing of Internet-related intervention, and how such interventions may fit within the roles of SLPs and other health professionals during the early stages of rehabilitation. Evidence of evolving goals and priorities and the role of Personal and Environmental factors as well as Body Functions and Structures strongly supports the use of the ICF framework in considering participation in aspects of the Internet for people with aphasia. Increased awareness of the model and appropriate training would enable SLPs to consider more holistic interventions in this area.

Another issue relates to the availability of guidelines and evidence. Clinical guidelines related to technology currently focus on informatics, alternative and augmentative communication, telehealth, or technology as part of rehabilitation (e.g., Royal College of Speech & Language Therapists, 2016). Less focus exists related to Internet use for communication and interaction. One may question whether interventions related to Internet use are part of an SLP’s role, but its relevance is clear when assessment is conducted within the ICF model. The knowledge and skills required to consider the many potential factors influencing Internet use could be suited to a multidisciplinary approach or an assistive technology specialty with a focus on use of the Internet for people with acquired cognitive-linguistic disabilities. For example, therapy to improve written language content and ability to use it functionally to communicate would clearly fall within an SLP’s domain, whereas interventions to improve basic Internet skills for those in the environment of people with aphasia may not.
CONCLUSIONS

Bill’s case illustrates the many factors that can influence (positively and negatively) ability and motivation to engage with the Internet. Using the ICF as a framework to consider this information shines a light on the numerous factors involved. This case illustration also demonstrates that although some factors contributing to Bill’s difficulties with the Internet were not purely linguistic in origin, his language impairment clearly had a significant impact on his Internet usage and skills. Positive and negative influences on Internet use for Bill came from difficulties in terms of Body Functions and Structures and their impact on Activity and Participation. In addition, influences were also seen within the Environmental and Personal Factor components. Clinicians and researchers can use the ICF as a framework to guide information gathering and decision making with other people with aphasia.

What is needed to move forward in this area is an increase in the availability of assessment and outcome measurement tools and evidence to guide best practices. Aphasiologists also need to communicate their results in a manner that technology experts can use to create innovative solutions for Internet accessibility for people with aphasia and related functional limitations. Assessments of language and wider cognitive function are largely well developed. However, reliable and valid means of quantifying and describing the impact of aphasia on Internet and computer use and the influence of external factors are a clear area for development. The methods used in this research were experimental, and their reliability and validity have not been rigorously tested. However, they demonstrate how combining qualitative and quantitative methods of data collection can produce a comprehensive profile for an individual with aphasia.
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Appendix A: Internet Assessment

task instructions

Task 1

Switch on your PC/Laptop/Tablet. Log-on if needed.

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.

Now please return to the BBC home page.

Task 3

We are going to start at the BBC again.

Find the website for the [charity name]. (Ask participant if they know about the [charity name], and if so, if they have previously used the website).

Find out the email address for the administrator.

Find the current newsletter and download it.

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?
Example of supportive materials

TASK 2
Find out what the weather will be like in [location] this Saturday

Return to the BBC home page
Appendix B: SLT and Caregiver Interviews

Violet and Bill’s SLTs were asked five main questions. For three of these, further probe questions were available to prompt discussion if the participant did not produce a detailed response. 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.

Below, the main questions and the areas which were probed further (if necessary) are listed. The interviewer had questions available in these areas, if needed.

SUMMARY OF INTERVIEW SCHEDULE FOR SPEECH AND LANGUAGE THERAPISTS

1. Can you tell me about Bill using computers and the Internet?

Probe areas considered: Getting to know client and identification of difficulties with computer/Internet use, Impact on Activity and Participation and Identifying goals

2. Can you tell me about your experience of supporting Bill to use the Internet?

Probe areas considered: Planning and implementing therapy, use of specific software/hardware, use of external support, experience with other clients.
3. **What influences your ability to support Bill to work on Internet skills?**

Probe areas considered: Technical problems, training needs/support, own technological experience/skills, caseload demands, technological support, institutional support, measuring outcomes of interventions, cost/funding.

4. **What do you think would make it easier for Bill and other people with aphasia to use the Internet?**

Not probed further.

5. **Is there anything you feel we have not covered that you would like to add now?**

Not probed further.

**SUMMARY OF INTERVIEW SCHEDULE FOR CAREGIVER**

1. **Can you tell me about Bill using computers and the Internet?**

Probe areas considered: Internet use before stroke, recognition and description of problems, impact on caregiver, identifying goals.

2. **Can you tell me about your experience of supporting Bill to use the Internet?**

Probe areas considered: Independent provision of support, external support, family support.
3. *What influences your ability to support Bill with Internet skills?*

Probe areas considered: Technical problems, technical support, training needs/support, Internet skills and role to own life, time demands, cost, communication.

4. *What do you think would make it easier for Bill and other people with aphasia to use the Internet?*

Not probed further.

5. *Is there anything you feel we have not covered that you would like to add now?*

Not probed further.
Appendix C

Themes identified in interviews with Bill’s wife Violet and his two SLTs. Theme counts in brackets. Violet = V, Bill’s SLTs = SLT.

- Activity and Participation
  - Benefits of Internet use (V=4)
  - Breakdown of communication (V=2)
  - Client goals (SLT = 2)
  - Client email use (V=4, SLT=1)
  - Focus of therapy (SLT=7)
  - Independent computer use post-stroke (V=3)
  - Internet difficulties post-stroke (V=2)
  - IPad (V=1)
  - Judgement of computer skills (SLT=4)
  - Computer ability pre-stroke (V=4)
  - Participation pre-stroke (V=1)
  - Role of SLT in teaching computer skills (SLT=1)

- Body Function and Structure
  - Fatigue (V=1)
  - Fluctuation (V=2)
  - Impairment based therapy (V=1, SLT=4)
  - Mobility (V=1)
  - Reading (V=1)
  - Therapy software (V=1, SLT=3)
• Writing and typing (V=1)

• Outcome Measurement (SLT=4)

• Personal Factors
  o Age (SLT=1)
  o Person’s priorities (V=1, SLT=3)
  o Previous computer experience (V=3)

• Environmental Factors
  o Computer support for aphasia (V=3, SLT=1)
  o Connectivity (SLT=1)
  o Conversation partner training (V=2)
  o Equipment (SLT=2)
  o External agency support (V=3, SLT=1)
  o Financial (V=1)
  o Information from family (SLT=1)
  o Living alone with aphasia (SLT=1)
  o Personal purchase of equipment (SLT=5)
  o Pre-stroke support (V=4)
  o Quality of support (V=1)
  o Security and confidentiality (SLT=2)
  o SLT environment (all SLT): Access to training (2), Availability of funding (2), Complexity (1), Definition of SLT role (1), Employer support (1), Evidence base (1), Futureproofing (2), Inequality of provision (1), Recommendations from colleagues (1), Resources (2), SLTs internet skills (4), SLT’s skills on interventions for internet skills (1), SLT time commitments (1)
- Support for family or carers (SLT=1)
- Support from family members (V=2, SLT=4)
- Support from SLT (V=1)
- Support from spouse (all V): Carer frustration (2), Carer IT skills (6), Finding the time to help (1), Managing expectations (1), Motivation and encouragement (4), Perseverance (1), Proxy Internet use (2), Time for own Internet use (1)
- Support installing software (SLT=2)
- IPad for therapy (SLT=3)
- Technical problems (V=3)
- Hardware – mac vs PC (SLT=2)