The use of technology to facilitate writing in aphasia

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Abstract

In an age when digital technology is becoming central to communication, writing is increasingly important, with messaging and emailing often replacing phone calls [1]. As written communication shifts to the digital modality, technology poses both challenges and opportunities to people with aphasia. The cognitive and linguistic demands of using technology present potential barriers [2], but recent research has also explored the potential of technology to facilitate writing.

This mini-review will describe the evidence base for using technology to support writing in aphasia therapy. It will describe a variety of applications, designed to remediate the impairment, facilitate functional writing skills and compensatory approaches which aim to bypass impaired writing skills. It will explore the role of the speech and language therapist in selecting the most suitable technology for an individual's needs and in training people with aphasia to use the technology. In addition, it will discuss methods of assessing people with aphasia's technology proficiency and functional writing skills, and the challenges inherent in these.

Keywords: Writing, technology, dysgraphia, therapy, assessment.

Introduction

With the rise of digital technologies, communication is increasingly happening in the written modality. Emails and text messages often replace phone calls and face-to-face conversation, while social media is used to develop and maintain social networks [1]. This shift poses opportunities and challenges to people with aphasia. For people whose aphasia is accompanied by dysgraphia, writing itself may be very challenging. In addition, technology presents cognitive as well as linguistic demands which may act as a barrier for people with aphasia.

On the other hand, for some people with aphasia, writing skills may be an area of relative strength and the written modality can allow people time to decode and compose messages without the pressure for an immediate response. Furthermore, technology presents opportunities for people with aphasia to practise impaired language skills, to support functional writing skills or to compensate for impaired writing by using speech to bypass writing.

A small but growing body of evidence is exploring the potential of these technologies to facilitate writing in aphasia. This is an important and evolving element of the work of speech and language therapists (SLTs), who are well placed to support people with aphasia in maintaining and developing their use of technology for communication. Without support, people with aphasia and dysgraphia are at risk of digital exclusion [3] in an increasingly technological world.

This article will discuss the evidence base for using technology to facilitate writing in aphasia. It will discuss the role of the SLT in selecting the most suitable therapy approach, delivering training, evaluating technological proficiency and assessing writing skills. It will discuss the challenges posed by technology for SLTs and ways that they can develop their own skills and knowledge in this area.

Technological applications to support writing

A plethora of technological tools exist which aim to support people with aphasia to address impaired language skills. Some are designed to be used independently, such as apps produced by Tactus Therapy Solutions© and Constant Therapy (https://thelearningcorp.com/constant-therapy/). Others, such as StepByStep©, are intended to be used under the guidance of a speech and language therapist, whose role is to select and set up suitable exercises, as well as monitor usage. These tools support people to develop a wide range of spoken and written language skills at home. They enable therapy to

be implemented an intensity which is recommended in the literature [4] but is rarely available in the chronic phase in countries including the UK [5] and Australia [6] due to resource restrictions. However, research studies exploring the efficacy of these apps have focused either on their impact on spoken naming skills [7], or on a range of language skills including writing, e.g. [8].

Alternatively, technology can be used to facilitate functional writing skills. A number of software programmes have been developed primarily with the aim of supporting the writing skills of people with developmental dyslexia. These offer features such as predictive text, spell-check, word banks, and text-to-speech, which can be used to listen back to and check a piece of writing. Recent research studies have explored the use of WriteOnline™ software [9] and Co-Writer® [10] to enhance writing skills in aphasia. Participants were trained to use the software and to develop associated computer skills, then therapy targeted skills such as writing emails, stories and social media posts. Results were positive, with Thiel et al [10] reporting increases in word length, accuracy and range of word classes used, while Marshall et al [9] reported improved spelling, grammar and the perceived quality of participants' writing. Both studies found that the therapy had a clear compensatory effect, with treatment gains only apparent when assisted by the technology.

Voice recognition software has been used to enable people with aphasia to use speech to bypass their impaired written language skills. This approach is suited to people whose spoken output is markedly more proficient than their writing. A small number of single-case studies have reported remarkable improvements in functional writing following a relatively brief period of intervention. For example, Caute & Woolf [11] reported the case of "Stephen", who had fluent aphasia and severe dysgraphia. Following 16 sessions of therapy, in which he learnt to use Dragon voice recognition software and Read&Write Gold© reading software, he was able to send emails and even write a letter to his local member of parliament. The therapy also had an impact on his social participation; he expanded his social network and was able to engage in voluntary work at a local hospital, a role which required him to be able to read and write comments on reports. Marshall et al's [9] recent group study investigated

the use of Dragon voice recognition as well as WriteOnline software, and reported gains in functional writing skills (see above).

"MakeWrite" is a novel app for iPad designed to facilitate people with aphasia to engage in creative writing (https://itunes.apple.com/us/app/makewrite/id1456271313?mt=8) [12]. It was developed with a co-design team encompassing people with aphasia, speech and language therapists and experts in human computer interaction. The consultants with aphasia were involved in all stages of the design. They identified the importance of people with aphasia being able to engage in creative rather than just functional writing processes. The app enables users to import a piece of text, erase as many words as they like, arrange the remaining words to create a novel piece of text and then share their writing with others. The app draws on the principles of constrained creativity, enabling a person with aphasia to write a poem without the need to generate words.

Challenges of using technology to support writing

Despite the myriad potentials for technology to enhance writing therapy for people with aphasia, the successful implementation of technology-enhanced approaches is not straightforward. People with aphasia may face cognitive, financial, practical and attitudinal barriers in using technology, as well as linguistic challenges. The AAC literature highlights some of the challenges of implementing alternative means of communication and of generalising these methods from therapy settings into everyday life. Fried-Oken et al [13] stress the need for further research exploring the complex interplay between people with aphasia's cognitive and linguistic abilities and external factors, such as different intervention approaches or the layout and organizational frameworks of AAC devices. Some researchers have explored factors that may facilitate or hinder the successful uptake of technology among people with aphasia, but there is as yet no consensus. For example, Nicholas et al [14] found that non-linguistic executive function skills influenced successful use of a computer-based communication system, while van de Sandt Koenderman et al [15] found that age and semantic processing influenced outcomes, but that executive functioning did not.

In addition, the pace of change may be dizzying- no sooner than someone has mastered a new skill, they may find that the technology changes. An application may become unavailable, or a simple update may require relearning of skills. For example, WriteOnline, which was used in Marshall et al's [9] study, has since been replaced with a different, albeit similar software, called DocsPlus™. Change can be particularly rapid for technological applications with a large mainstream audience, as these are produced by companies with research and development departments constantly seeking to update and improve the technology. Email providers such as Yahoo! also have frequent new versions, which can require people with aphasia to re-learn skills. This means that people with aphasia using technology need access to ongoing support, and therapists need to stay up-to-date with technological developments.

Role of the speech and language therapist

SLTs have a multi-faceted role in facilitating people with aphasia to use technology for writing. From the initial decision to use technology, through selecting the most suitable option, evaluating outcomes and offering ongoing support, the therapist's role is complex and requires continual updating of knowledge to keep pace with technological developments.

Choosing to use technology in therapy

In the UK, the Computers in Therapy Clinical Excellence Network (CIT CEN, affiliated to the Royal College of Speech and Language Therapists) has developed an online toolkit to support SLTs in this complex endeavour (https://toolkit.citcen.org) [16]. It helps SLTs to identify and overcome barriers to the use of technology, through sharing experiences of problem-solving. It includes a list of factors to consider when deciding whether to use technology or a non-technological approach to facilitating communication. It advises consideration of a client's preference, support network, cognition, language and reading ability, dexterity, vision, hearing, computer literacy, alongside the functional goals of therapy. Furthermore, it highlights practical considerations when a client is using their own device or receiving one on loan. These include the use of payment accounts, confidentiality of sensitive data, device safety and infection control.

Choosing a suitable approach and application

Once a decision has been taken to use technology, SLTs need to consider the most suitable approach and application. A challenge in this respect is the lack of evidence in the literature about characteristics of research participants that make them suitable for a particular method [10]. However, a number of authors have offered guidance to support the decision-making process. Ramsberger et al [17] describe their approach to incorporating aphasia-specific apps into therapy, a three-stage process illustrated through case-studies. They begin by assessing a client's speech and language strengths and needs, then select a functional focus for treatment. They review the evidence base before selecting the most suitable treatment approach. They consider non-linguistic capabilities including the sensory, motor and cognitive requirements of the technology and assess the client's ability to use the app. Finally, they evaluate the hardware and internet demands of the app and whether these will be accessible to the client. They recommend working with a technological consultant, whose role it is to stay abreast of technological developments and options available, as well as to monitor and test apps with the needs of users in mind. The consultant works collaboratively with a SLT to match a user to a treatment approach and suitable app.

For therapists who do not have access to a technological consultant, the Tavistock Trust for Aphasia runs a website that has up-to-date information about apps and software programmes available in the English language that are suitable for people with aphasia. (https://www.aphasiasoftwarefinder.org/) [18].

In Marshall et al's [9] project, participants used either Dragon voice recognition or WriteOnline dyslexia software, which were available on two platforms (iPad or laptop). In selecting the type of software, participant preference and linguistic factors were taken into account. Voice recognition software was not considered suitable for participants with very impaired spoken language. This was determined by the presence of severe dysarthria, dyspraxia or very impaired spoken word repetition and connected speech, as assessed by a picture description task. In contrast, participants with very impaired auditory and reading comprehension were discouraged from using WriteOnline, as they

would be unable to benefit from text-to-speech and word bank features. When selecting between an iPad and laptop, participant preference was considered, alongside the ability to use a touchscreen or keyboard and mouse. This was established by observation and discussion.

Evaluating the usability of different technologies

Human computer interaction researchers specialise in evaluating the usability of different technologies. Recent innovative collaborations with SLTs have explored how usability can be optimized for people with aphasia. For example, Grellman et al [19] explored the usability of mobile applications. They conducted an audit with four people with aphasia who were asked to perform a number of tasks using four widely-used social media apps. Observations were conducted to identify usability issues, which either prevented a task being completed or caused a delay in doing so. The authors concluded that the general usability guidance produced by the World Wide Web Consortium's Web Accessibility Guidelines (https://www.w3.org/WAI/standards-guidelines/wcag/) did not always meet the needs of people with aphasia. Their key recommendations for aphasia-friendly design were to keep text short and simple, minimise distractions, let users control the pace of interaction, limit the number of steps and that icons should be accompanied by a text label. SLTs can use these guidelines when considering whether an app would be suitable for a client with aphasia and for comparing the usability of apps that fulfil similar functions.

Assessment and evaluating outcomes

Assessment poses further challenges for SLTs considering the use of technology to facilitate writing in aphasia. There are no established, widely used measures either of functional writing or of technology use, meaning that it can be difficult to establish a pre-therapy baseline or to measure outcomes after therapy.

Recent studies exploring technology-enhanced writing therapy [9,10,11} used novel assessments of email writing as their primary outcome measures. These had a number of similarities; they all asked participants to write three emails under time-constrained conditions, in both handwritten and technology-assisted form. For example, participants in Marshall et al's [9] study were asked to write a

semi-structured email inviting a friend or family member to meet them. In addition, two unstructured tasks required participants to write about what they would do if they won the lottery and to share a piece of news.

The studies differed in the methods used to evaluate the quality of writing. Marshall et al used three measures to evaluate the quality of writing; lexical and grammatical quotient scores and a social validity score. The lexical quotient score aimed to capture the quantity, variety and accuracy of words used. For the grammatical quotient score, emails were rated according to the range of syntactic structures used and how well-formed sentences were. Social validity scores were derived from ratings of how effective emails were in conveying the message, how informative and grammatically correct they were, and how comfortable they felt to read (adapted from Jacobs et al [20]). Thiel et al also used three measures to evaluate the quality of writing; number of correctly spelt words, number of correct and informative units and the psycholinguistic characteristics of the words used (i.e. frequency, imageability, length and word class).

Although these assessments have not been subjected to extensive psychometric tests, Marshall et al [9] reported excellent inter-rater agreement for lexical quotient scores and moderate agreement for grammatical quotient and social validity scores. Meanwhile, test-retest reliability yielded excellent agreement across all domains.

A variety of approaches has been used to evaluate technology skills. A novel technology questionnaire evaluates the extent and ease of participants' use of technology and is accessible for people with severe aphasia [21]. Respondents are asked whether they have used different technologies over the last month and to rate how easy of difficult they found it to use each type. It includes activities that involve writing, such as using social media, giving a picture of functional use of technology.

Two therapy studies included both objective and subjective outcome measures in order to assess computer skills. Egan et al [22] developed a therapy programme targeting internet skills for people with aphasia and used an internet skills assessment before and after therapy. Participants were observed carrying out 12 tasks, such as sending an email and surfing the internet and their

independence was rated on a 5-point scale. Thiel et al's [10] emailing skills assessment was adapted from Egan et al's [22] and evaluated competence in computing skills required for emailing. Participants were rated on their ability to independently perform tasks, such as entering an email address. In addition, a keyboard skills assessment probed participants' accuracy and speed in copying text. Thiel et al reported that very few participants showed change on these assessments despite their improved writing skills. However, Egan et al reported positive change, perhaps reflecting the increased focus on internet skills in Egan's study, whereas Thiel et al's therapy focused more on writing skills.

As a subjective measure, Thiel et al administered the writing subtest of the Comprehensive Aphasia Test Disability Questionnaire [23] and reported positive change across the group. Egan et al administered a questionnaire before and after intervention probing participants' previous and current internet usage, access to the internet and attitudes to learning. They reported favourable outcomes, although the results were not analysed statistically.

Discussion

Using technology to facilitate writing in aphasia opens up a range of new avenues and possibilities. These include opportunities for intensive impairment-based practice, developing compensatory strategies which bypass the impairment and engaging in creative writing. It calls upon SLTs to adopt new roles, by keeping up to date with technological developments, evaluating the suitability of different technologies for particular clients and providing technology training and support. Cross-disciplinary collaborations are key in addressing the multi-faceted challenges of using technology for people with aphasia. The potential benefits are interventions that can lead to remarkable functional gains after a short period of therapy and facilitating people with aphasia to remain connected with 21st century digital communications.

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