Adapting therapy for a new world: storytelling therapy in EVA Park

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Abstract

Background: Storytelling is fundamental to human communication yet is under-represented in aphasia therapy research and clinical practice. Access to care may be one obstacle; in the broader healthcare context, remote modes of treatment delivery can increase individuals' access to care. EVA Park is a highly novel, online platform designed with people with aphasia that has shown capacity to improve aspects of language and communication.

Aims: This study explored whether it is feasible to deliver a storytelling intervention in EVA Park and whether therapy brought about improvements in the content and organisation of their narratives. Changes in functional communication and technology use were also examined.

Methods and procedures: In a pilot feasibility study, three individuals with aphasia were recruited in the UK and Australia. Over five weeks, participants received 20 hours of therapy in EVA Park, consisting of three weekly sessions with a speech therapist and one weekly session in which the participant told the story to a volunteer who was blinded to the content of their story. A repeated-measures, case series design was used to evaluate therapy. The primary measure assessed the content of narratives elicited by novel video stimuli twice before and twice after therapy. Secondary measures investigated structural features of the video narratives and of personal narratives. Functional communication was assessed with the Communication Activities of Daily Living assessment, and technology use was probed via a Technology Screen.

Outcomes and results: Delivery of storytelling therapy via EVA Park was feasible; technology challenges arose and were resolved using multiple strategies. Following therapy, participants' storytelling improved in content, with a large effect size for the group, and in structure. Generalisation to personal narratives was not observed. Some improvements were seen in functional communication.

Conclusions: Storytelling therapy delivered via an online platform is feasible and may improve the content and organisation of participants' storytelling, with some evidence of generalisation to functional communication.

Key words: aphasia, therapy, tele-rehab, story, communication

Introduction

"Story is in everything because we put it/see it/expect it there" (p.7, Livo & Rietz, 1986)

There are psychosocial, clinical and ecological motivations to target discourse in aphasia therapy. Everyday discourse is a vehicle for displaying key aspects of identity such as attitudes and values (Armstrong & Ulatowska, 2007). One type of discourse, storytelling, plays an important role both in our interactions and in our personal experiences. We continually re-story our lives (Kenyon & Randall, 1997): shaping our experience of and reflections of an event and the weight we place on this experience (Armstrong & Ulatowska, 2007). We use storytelling to pass on our experiences (Randall, 2001), reaffirm identity and relationships (Frank, 2000), and process unexpected life events (Ochs & Capps, 2001). In periods of illness, narratives can be recuperative (Hydén, 1997). People with aphasia (PWA) engage in less storytelling than their peers (Davidson, Worrall, & Hickson, 2003). When they do produce narratives, these tend to be shorter and less complex than those produced by unimpaired speakers (Ulatowska, Weiss-Doyell, Freedman-Stern, & Macaluso-Haynes, 1983). While narrative macrostructure is relatively preserved except within individuals with severe aphasia (e.g., Olness, Matteson, & Stewart, 2010; Olness & Ulatowska, 2011), PWA present with other discourse-level difficulties: producing tangential speech and repetitions (Andreetta, Cantagallo, & Marini, 2012; Andreetta & Marini, 2015), reduced informativeness (Andreetta & Marini, 2015; Capilouto, Harris Wright, & Wagovich, 2006; Fromm et al., 2016) and errors of cohesion, local coherence and global coherence (Andreetta & Marini, 2015; Armstrong, 2000).

Discourse is a relatively neglected area in the aphasia literature, particularly with respect to therapy. Whitworth et al. (2015) make the point that, although generalisation of therapy gains to discourse is often explored, for example following semantic feature analysis (Antonucci, 2009) or other lexical treatments (Greenwood, Grassly, Hickin, & Best, 2010), discourse is rarely treated in its own right. A recent systematic review identified only 25 studies of treatment for discourse in aphasia (Dipper et al., in press). The reviewed therapies targeted different levels of language processing, such as word, sentence and macro-structure skills, although in all cases treatment attempted to transfer these skills to discourse production. The relative strengths of the different approaches were difficult to appraise, since different measures were used across studies and designs varied. The development of discourse measures has far outpaced the development of discourse treatments (Webster, Whitworth, & Morris, 2015). Reviews of the literature covering discourse analysis have identified over 500 structural measures (Bryant, Ferguson & Spencer, 2016) and 58 information measures (Pritchard, Hilari, Cocks, & Dipper, 2017). While multiple tools are available, there is no consensus on what constitutes a standardised set for assessing treatment outcomes (Dietz & Boyle, 2018).

Given the limitations of the literature, it is perhaps unsurprising that discourse is under-utilised in clinical practice both as an assessment tool and a therapeutic target. In surveys of aphasia therapists, respondents have reported infrequent assessment of discourse (n=70, Verna, Davidson, & Tanya, 2009), limited implementation of discourse-based treatment (n=188, Rose, Ferguson, Power, Togher, & Worrall, 2014) and low levels of knowledge and confidence with respect to discourse approaches (Rose et al., 2014). More recent surveys suggest that these patterns have persisted, with only 30%-40% of respondents reporting that discourse analysis is a typical (always or usually) part of their clinical practice (n=123, Bryant, Spencer, & Ferguson, 2017; n=211, Cruice et al., 2020).

Barriers to implementation of discourse analysis in clinical practice include the time-consuming nature of the task as well as clinicians' self-perception of lack of training and expertise (Bryant et al., 2017; Cruice et al., 2020; Marini, Andreetta, del Tin, & Carlomagno, 2011). This lack of confidence may reflect the complexity of discourse processing as well as variability in methodologies and

definitions of key concepts (Armstrong, 2000). The complexity of discourse production theory is outlined in the model posited by Sherratt (2007, adapted from Frederiksen, Bracewell, Breuleux, & Renaud, 1990). According to this model, discourse production involves multiple levels of processing that are interconnected and activated non-sequentially (Sherratt, 2007). For example, several processes relate to 'frame/schema generation' which involves structuring the narrative and focussing on key concepts. Others involve 'selection and topicalization of information' and 'generation, selection and chunking of propositions'. Discourse production is also influenced by external cognitive processes such as episodic memory and the speaker's online judgements of the social context (Sherratt, 2007); and production is sensitive to the discourse genre, method of elicitation and output modality (Linnik, Bastiaanse, & Höhle, 2016). Although complex, Sherratt's model offers a framework for discourse assessment. For example, Pritchard et al. (2017) mapped 58 measures of discourse information against components of Sherratt's model. A selection of these measures is used in the current study. These include key concepts (content) and story grammar, which are mapped to frame/schema generation in Sherratt's model, and predicate argument structure, which maps against linguistic formulation.

Within the discourse intervention literature, a subset of studies has focused on targeting multiple levels of language within various discourse genres. For example, NARNIA (Novel Approach to Real-life communication Narrative Intervention in Aphasia, Whitworth, 2010; Whitworth et al., 2015) targets word, sentence and discourse levels within a variety of discourse genres including recount, procedure, exposition and narrative. Secondly, LUNA (Linguistic Underpinning of Narrative in Aphasia, Dipper & Cruice, 2018) targets word, sentence and discourse features within personal storytelling. Thirdly, Interactive Storytelling Therapy (Carragher, Sage, & Conroy, 2014) targets sentence and discourse levels for the individual with aphasia and supports a familiar interlocutor to assist in the co-construction of the story. These interventions have demonstrated positive effects of therapy, albeit across a range of research designs and experimental rigour. In a two-arm randomised controlled study (n=14), participants who received the NARNIA intervention demonstrated significant increases (very large effect size) in the number of orientation elements they produced compared to a control group, that is, organising discourse with regards to the setting, key characters and what happened (Whitworth, 2010; Whitworth et al., 2015). Following LUNA intervention, a single case experimental study found the participant made improvements in word production, argument structure, local coherence and features relating to story structure (Dipper & Cruice, 2018), with generalisation to an untreated narrative (Cinderella), confidence (the Communication Confidence Rating Scale for Aphasia; Babbitt & Cherney, 2010) and mood (the Visual Analogue Self-Esteem Scale; Brumfitt & Sheeran, 1999). Following Interactive Storytelling Therapy within a case series (n=4), improvements were seen in the amount of relevant content conveyed by the participants for simple stories (n=3) and complex stories (n=2), with improvements in participants' organisation and sequencing of narrative events; interestingly, these improvements did not necessarily correspond with improvements in the amount of information correctly reported by the partner who listened to the story (Carragher et al., 2014).

One advantage of targeting therapy at this level is that discourse contextualises linguistic skills such as word retrieval and syntactic construction. All three discourse therapies (NARNIA, LUNA and Interactive Storytelling Therapy) targeted multiple linguistic behaviours as well as micro- and macro-structure. This may be important in promoting generalisation of targeted behaviours to everyday use. Often, we make assumptions that lexical or syntactic interventions will generalise into everyday language use. In fact, there is considerable evidence that such generalisation is by no means guaranteed (Best et al., 2011; Conroy, Sage, & Ralph, 2009; Thompson, Kearns, & Edmonds, 2006). While a small number of studies have demonstrated change in conversation following an

impairment-level intervention (see Carragher, Conroy, Sage, & Wilkinson, 2012), other studies suggest that PWA struggle to shift skills from a structured environment into more typical everyday communication (Purdy, Duffy, & Coelho, 1994). At the very least, individuals with aphasia benefit from additional prompting (e.g., Ballard & Thompson, 1999; Purdy et al., 1994) or training that specially targets generalisation (e.g., Clausen & Beeson, 2003; Coelho, 1990; Garrett, Beukelman, & Low-Morrow, 1989; Robson, Pring, Marshall, Morrison, & Chiat, 1998). Discourse therapy provides a vehicle for targeting discrete skills within the context of a task that is less dependent on visual stimuli, offers more choices regarding word selection and sentence construction, and includes some of the cognitive demands of everyday communication. As such, targeting language within discourse therapy could potentially reduce the challenges of achieving generalisation of therapy effects to everyday communication.

Within the broader landscape of healthcare, consideration is being given to the accessibility of intervention. Remote delivery via telehealth platforms could mitigate access issues relating to distance from the treatment centre, as well as physical or economical barriers to travelling for treatment. Healthcare costs and demands on services are rising, as the social and demographic context is changing; as such, there is an increasing need for service delivery models that include telehealth (Theodoros, 2012). The COVID-19 pandemic has highlighted the need for modes of therapy delivery that do not require face-to-face contact. One potential platform for remote delivery is EVA Park, an online virtual world which was co-designed with PWA (Wilson et al., 2015). Users create personalised avatars to represent themselves in EVA Park; therapists and participants 'meet' in the online world to interact via these personalised avatars. There is no video so participants and therapists cannot see each other; instead, they communicate via headsets so that they can hear each other in real-time. There is also an option to type written messages, which forms an important part of providing communication support during the therapy. Users can make use of pre-programmed gestures; as a result, the avatar can perform a small range of gestures to signal emotion, including waving, dancing, clapping, jumping or laughing. This online world presents opportunities to have conversations and engage in therapy in simulated everyday venues such as a café and houses. EVA Park also provides more fantastical backdrops and opportunities for interaction with stimulating features such as underwater turtles and a Tardis. Studies of intervention within EVA Park suggest this method of delivery is acceptable to participants (Amaya et al., 2018; Marshall et al., 2016; Marshall et al., 2018) and effective in improving functional communication (Marshall et al., 2016) and noun retrieval (Marshall et al., 2018).

Discourse-level interventions are complex and it is not yet known whether it is feasible to administer a discourse-level intervention remotely. On the one hand, the quirky, colourful environment of EVA Park may be well suited to storytelling as this platform has been shown previously to promote a variety of conversational exchanges that are associated with markers of positive affect (Galliers et al., 2017). On the other hand, therapists and participants interact in EVA Park via their avatars; as they cannot see each other, it is not possible to exploit many aspects of multi-modal communication such as facial expression and gesture that may be useful resources to individuals with aphasia when constructing a story. Given the reduced opportunities for nonverbal communication in EVA Park, the current study employed a verbal variant of Interactive Storytelling Therapy. The intervention aimed to 1) improve participants' story planning by considering which details to include and which to exclude, 2) improve participants' story production by introducing referents and leading the listener from the beginning, middle and end of the story, and 3) enrich the content of participants' storytelling by producing verb arguments. Outcome measures were selected that reflected the aims of the intervention. The study addressed the following research questions:

- Is it feasible to deliver storytelling therapy via a virtual reality platform?
- Does storytelling therapy delivered via a virtual reality platform improve the following measures:

- the amount of relevant content produced by participants with aphasia (relating to Sherratt's 'frame/schema generation' level)
- story organisation (relating to Sherratt's 'frame/schema generation' level)
- predicate argument structure (relating to Sherratt's 'linguistic formulation' level)
- personal narrative organisation (story grammar) or predicate argument structure
- functional communication
- technology use

The current study formed part of a broader project investigating whether it is possible to deliver a range of language therapies within EVA Park. The broader project consisted of a total of five studies focusing on noun retrieval and verb retrieval (Marshall et al., 2018), sentence production, storytelling and script training; the current paper is concerned with the storytelling study.

Method

Ethics

Ethics approval was granted by City, University of London (LCS/PR/Staff/16-17/04). Approval for an externally reviewed study was granted by La Trobe University, Melbourne.

Recruitment

A recruitment call was disseminated via community groups and professional networks in Melbourne (Australia) and London (England). Individuals with aphasia who expressed interest in the study (n = 7 in Melbourne; n=2 in London) were screened on the phone against eligibility criteria. Those who were eligible were provided with written information that was designed to be accessible to PWA. Before the study commenced, written informed consent was obtained for all participants.

Participants

Three participants were recruited to this case series across two sites: La Trobe University, Melbourne (Participants 1 and 2) and City, University of London (Participant 3); see Table 1. Eligibility criteria included: over 18 years of age; chronic post-stroke aphasia (i.e., at least 4 months post-onset); sufficient hearing (i.e., as per self-report or pure tone audiometry where available); presentation of nonfluent aphasia indicated by reduced length and complexity of utterances on picture description and/or in connected speech (i.e., paucity of verbs relative to nouns, reduced utterance length and complexity, grammatical errors or omissions); with sufficient auditory comprehension to access EVA Park (clinical judgement) and comprehension text scores that were at least above chance; and lack of marked or progressive cognitive deficits (self-reported history by the participant and/or family). Participants were required to be able to access EVA Park either independently or with family support at home and have a reliable internet connection. Previous experience using technology was not an exclusion criterion. Data collection ran from October 2016 to March 2017. Assessment data were collected face-to-face in the participants' homes or at the local institute. During the study, participants continued with their usual care routines which included independent use of therapy apps (Participant 1) as well as attending social events such as an aphasia choir (Participant 1) and dance events (Participant 2). None of the participants were engaged in clinician-directed intervention.

Table 1 here

Design

A case series methodology was used to explore the effects of therapy with three participants. Baseline testing consisted of two assessments: at 5 weeks (T1) and 1-week pre-therapy (T2). No further testing was administered during the intervention period. Outcome assessments were administered at 1 week (T3) and 5 weeks (T4) post-therapy; see Figure 1.

Figure 1: Timeframe of assessments and intervention

Intervention overview

Members of the research team visited participants at home to set-up EVA Park. This included technical set-up followed by a hands-on guide for the participant. The technical set-up took approximately 1 hour and included setting up the computer, downloading and configuring software (Firestorm[1] and LogMeIn[2]), and co-creating an individual avatar with the participant using printed 2D dolls that the researcher later used to create a digital avatar. The hands-on guide for the participant took 20 minutes and included orientation to EVA Park; guidance on how to navigate around EVA Park; and learning specific functions such as making the avatar walk, fly and sit. Thereafter, all intervention consisted of the participants meeting the therapist or volunteer online.

The goals of therapy were driven by the performance during a baseline storytelling task. Baseline storytelling data were analysed by the treating therapist using a transcription-less technique to identify the participant's strengths in telling the target story, aspects where the storytelling could be strengthened, and which therapy goals were indicated as targets for therapy (Appendix 1). These strengths and weaknesses were mapped onto storytelling goals (see Appendix 2) and discussed with the participant in the first therapy session.

Regarding dosage and intensity, the intervention protocol was in line with the other studies in this series; that is, 20 hours of intervention delivered over five weeks. During the intervention period, participants met the speech therapist online for three therapy sessions per week, while the fourth session each week was conducted with a volunteer. Each therapy session lasted for approximately one hour. Based on the participants' locations, therapy was delivered by one of two therapists, both of whom were qualified speech therapists. For Participants 1 and 2, therapy was delivered by a speech therapist who was trained by the author MC; for Participant 3, author RT delivered therapy. Both therapists received training in the intervention protocol, based on a written therapy manual. As the Melbourne-based therapist was less experienced in aphasia therapy, she attended a 2-hour training session with MC which consisted of discussion, problem-solving and role-play.

[1] Firestorm is a 3D web browser that allows users to view 3D web content.

[2] LogMeIn (https://www.logmein.com/) enables the therapist to remotely log on to the participant's computer to provide technical assistance. The software was used on an as-needed basis and was useful for instances when the participant experienced technological difficulty that could not be revolved with verbal instruction alone, e.g., could not navigate to a specific area within EVA Park or struggled to control their volume.

Storytelling intervention

Interactive Storytelling Therapy (Carragher et al., 2014) was adapted for delivery via EVA Park. The participant practises constructing a story in response to novel video clips. The intervention draws on:

1. thinking for speaking (Marshall, 2009): the participant is supported to segment the narrative into discrete story events, and to consider which details to foreground or background
2. story grammar (Rumelhart, 1975; Stein & Glenn, 1979; Westby, Van Dongen, & Maggart, 1989): the participant is guided to plan the chronological sequence of events, and to think about when to introduce the main characters

The participant watched a funny video clip, which was projected on a screen in EVA Park, and worked with the therapist to plan the story. This consisted of conceptualising the beginning, middle and end of the story, making decisions about what information to foreground/background, building predicate argument structure, and using non-verbal output methods such as writing to support story construction. Individual lexical items or specific syntactic constructions were not targeted; rather, the therapist emphasised construction of the story, consideration of the needs of a listener who has not seen the video, and production of argument structure.

The original intervention also draws on principles of conversation coaching (Hopper, Holland, & Rewega, 2002) and part of the therapy focuses on how an everyday communication partner co-constructs the story with the individual with aphasia. In exploring whether it is possible to deliver storytelling therapy in EVA Park, a decision was made to focus the therapy solely on the participant with aphasia; conversation coaching was not used in the current study and familiar communication partners were not included in the intervention. Intervention was designed so that the last session each week required the PWA to explain the story to a volunteer who had not seen the video clip, thus creating a genuine information gap. This information gap was based on the premise that stories are designed to be told to an audience and that the interaction between storyteller and listener shapes the story (Goodwin, 1990). Thus, the information gap was conceptualised as creating a more typical interactive environment in which the storyteller (i.e., the individual with aphasia) produces the story while taking into consideration the listener's needs, working with the listener to construct the story, and responding to clarifying questions from the listener. As the volunteer was blinded to the video content, he/she could behave as a genuine communication partner in supporting the participant to produce the story. This approach has been employed elsewhere in the literature (Ramsberger & Menn, 2003; Ramsberger & Rende, 2002). In the current study, the volunteers were speech pathology students from the participating universities, recruited via an expression-of-interest process. Each volunteer was assigned to a specific participant with aphasia. The volunteers took on the role of an interested conversation partner; they listened to the PWA tell the story and provided conversation support to assist the participant's storytelling such as facilitating repair, asking clarifying questions when necessary, and verifying their understanding of the story. Volunteers did not provide cueing or modelling. At the end of the session, they watched the target video along with the participant. In this way, it was possible to maintain an element of ecological validity in the task and to help the participants with aphasia to view storytelling as a shared communicative activity rather than as a purely linguistic task. See Figure 2 for a summary of the adapted intervention. The therapy manual is available in the supplementary materials. Outside of therapy sessions, participants had access to EVA Park to explore the online world, to meet other individuals with aphasia, or to independently practice storytelling using saved notecards and retelling the story to a robot avatar.

Figure 2: Interactive storytelling therapy adapted for the current study

Measures

Assessments were administered by members of the research team who were not involved in administering the intervention but were not blind to the purpose of the assessment. All assessments were carried out face-to-face, either in the participants' home or at a University location. With the participants' consent, assessment sessions were videorecorded. Assessment data were collected for primary measures (content, story grammar and argument complexity of storytelling in response to video stimuli) and secondary measures (story grammar and argument complexity of personal narrative; functional communication; technology use). Storytelling and personal narrative data were scored by a research assistant (who later joined the authorship team); the research assistant was blind to the timepoint of the data. For the purposes of analysis, transcripts of all narratives (video stimuli and personal narratives) were de-identified, time-points removed and data presented in a random order to ensure the rater was blind to whether the data was collected pre- or post-therapy.

Feasibility of the intervention

Feasibility of the intervention was monitored via the number of sessions that participants attended and attrition during the study. Technical feasibility was monitored via daily logs, completed by the therapist after each intervention session. In the post-therapy assessment, the participant was asked to provide feedback on their experience of the intervention via an informal conversation with a member of the research team who had not delivered the intervention. Communication strategies were used to support the participants to understand the question and to convey their response, that is, written key words, written dates, drawing and checking that the assessor had correctly interpreted their response. Participants were encouraged to use gesture, drawing, writing and facial expression to convey their feedback. While only indicative, this feedback from participants offered some evidence on the acceptability of the intervention.

Primary measures: content, story grammar and argument complexity in storytelling in response to novel video stimuli

Primary measures reflected various levels of discourse processing according to Sherratt's model (2007). A measure of content of storytelling was mapped against the 'frame/schema generation' level, as was a measure of story grammar. Predicate argument structure was mapped against 'linguistic formulation' level.

Content: At each assessment point, participants were asked to re-tell the content of a novel video clip. Participants' storytelling was analysed regarding how well they could convey the essential information of the video clips. This 'essential information' was defined as content words that were produced by at least 50% of controls (n=8 non-impaired speakers) who watched the video stimuli and retold the narratives (see control data in Carragher et al., 2014). Control participants were not matched to the participants in the current study but represented a wide sample in terms of age (mean 42 years; range 17-64), education (mean: 16 years; range: 11-21) and gender (four females). The essential content words produced by at least 50% of control participants provided a maximum score for each story and provided an opportunity to score participants' output in relation to the total score.

The assessment video clips featured Mr Bean, a comical socially inept character who gets himself into embarrassing situations, such as being ordered off a children's' slide in a swimming pool. The participants watched the video stimuli on an iPad or laptop, with a different video clip administered at each assessment point to avoid a potential practice effect (see Appendix 3). Participants were asked to watch the video and retell the story as if to someone who had not seen the video. Participants were not restricted from using gesture, pointing, drawing or writing, although they were also not instructed to use these modalities. Story complexity was controlled, with one simple story and one complex story being assessed both pre- and post-therapy. Video stimuli collected from control participants (n=8) were used to distinguish simple narrative video material from complex narrative material. Simple narratives were relatively shorter and less complex, containing 1-2 actors, 1-2 initiating events and resolution; complex narratives included more than two actors, initiating events and resolution (Weinrich, McCall, Boser, & Virata, 2002). Baseline assessment and post-therapy data were transcribed verbatim and data were compared to identify any change in the amount of relevant content produced by participants pre- and post-therapy. A research assistant, who was blinded to the assessment timepoints, scored the data; a second blinded research assistant scored 25% of the data to check for inter-rater reliability.

Story grammar: Scoring followed the setting and episode system (Stein & Glenn, 1979; adapted by Westby et al., 1989), of which there are seven components: 1) setting (characters, time, location), and the episode system consisting of 2) the initiating event (what happened), 3) response (the character's feeling in response to what happened), 4) plan (how the character plans to deal with what happened), 5) attempt (enacting the plan), 6) consequence (the result of the plan) and 7) reaction. Scoring consisted of a binary system: one point was given to a collection of utterances that could be said to fulfil the function of one of the seven story grammar components; a score of zero was given if the utterances were not compatible with one of the story grammar components. While all components are not essential to a well-formed story, minimally, a story should consist of an initiating event, attempt and direct consequence (Coelho, 1998). Thus, a minimal threshold was applied in scoring: stories that did not include the minimal story grammar components (initiating event, attempt and direct consequence) were not scored. Story grammar scores have been found to be a psychometrically robust discourse measure (Pritchard, Hilari, Cocks, & Dipper, 2018).

Predicate argument structure (PAS): This consisted of identifying the number of predicates produced, the number of arguments produced and a mean complexity score. The complexity score was calculated by dividing the total number of arguments by the total number of main verbs produced (Pritchard et al., 2018; Webster, Franklin, & Howard, 2007). Internal and external arguments were counted (e.g., "anyway he went to a pool" = 2 arguments). Adjuncts were not included in analysis, nor were verbs that were produced in isolation.

Secondary measures: personal narrative (story grammar and PAS complexity), functional communication and technology use

Personal narrative: data were collected by asking participants to describe something that was personally meaningful (see Appendix 4). Scoring of story grammar and PAS followed the same protocol outlined above.

Functional communication: Functional communication was assessed using the Communication Activities of Daily Living-2 (CALD-2, Holland, Frattali, & Fromm, 1998). This standardised assessment presents everyday scenarios in which the individual with aphasia is required to read, write, listen and verbally produce responses. Scenarios include finding a telephone number and using a calendar. Psychometric data indicate that the CADL-2 has good inter-rater and test-retest reliability (Holland et al., 1998) and is sensitive to post-therapy change at group level (Hinckley, Patterson, & Carr, 2001).

Technology use and confidence: Technology use and confidence was screened before and after therapy using a measure developed by Roper, Marshall and Wilson (2017) to capture changes in participants' engagement with technology following an aphasia intervention delivered via computer. While not specifically developed for the current study, the screen allowed for exploration of whether taking part in a tech-delivered intervention prompted more general changes in participants' engagement with everyday technology. This was relevant given that participants would not have access to EVA Park beyond the duration of the intervention, therefore acquisition of technological skill in EVA Park might not be of interest to participants. The questionnaire consists of 18 questions in which the respondent is asked about his/her use of specific devices. The devices range from everyday items such as TV and remote control to personal devices for communication purposes such as email or online shopping. The respondent is asked if he/she has used a specific piece of technology in the last month; if the answer is 'yes', the respondent is asked to rate on a scale of 1-5 how confident they feel using the device, with 1 being not confident and 5 being very confident.

Missing data

There are some anomalies in the assessment data for Participant 3. The technology screen was administered only once at T1; therefore, it was not possible to monitor potential change in Participant 3's use/confidence using technology after therapy. In the post-therapy assessment of storytelling, an administrative error was made in the order of stimuli: immediately post-therapy (T3), Participants 1 and 2 completed simple storytelling, while Participant 3 completed complex storytelling; five weeks post-therapy (T4), Participants 1 and 2 completed complex storytelling while Participant 3 completed simple and complex storytelling. Thus, Participant 3 completed post-therapy storytelling in the wrong order and also completed two retellings of the post-therapy complex story. This second telling of the complex story was excluded from analysis, as this represented the only data where the participant was asked to tell the same story for a second time.

Interrater reliability

Twenty-five percent of the novel video storytelling data were double scored for narrative content, story grammar and predicate argument structure. Interrater reliability was investigated using intra-class correlation (ICC); this measure was selected as a subset of data was checked by two raters and the remainder of data were rated by a single rater (Hallgre, 2012). Interrater reliability was calculated using IBM SPSS Statistics for Windows, version 26 (IBM Corp, 2019) using a 2-way mixed, consistency, single measures ICC model (McGraw & Wong, 1996) with two raters across a 20% data subset. Interrater reliability was interpreted using Cicchetti's (1994) cut-offs of poor (ICC values <.40), fair (.40 to .59), good (.60 to .74) and excellent (.75 to 1.0). For the personal narrative data, story grammar was coded by the two raters together, due to the higher incidence of data not conforming to the minimal definition of a story.

Results

Interrater reliability

For narrative content in the storytelling data, the resulting ICC was moderate, ICC = 0.731, indicating acceptable IRR for scoring relevant content produced by the participants (95% confidence interval -0.341-1.00). Interrater reliability for story grammar and PAS complexity indicated zero variance.

1. Is it feasible to deliver a storytelling therapy via a virtual reliability platform?

Participant 1 attended 100% of sessions; Participants 2 and 3 attended 95% of sessions, missing one due to ill health. There was no attrition during the study. Technical challenges arose during the intervention and required a range of solutions; see Table 2. These solutions included the therapist talking the participant through a solution on the telephone, a family member providing assistance, or the therapist logging into the computer via LogMeIn. The most common technical challenges related to sound issues (such as low volume or no volume for one user, switching on the microphone) and visual display issues (such as the participant accidently minimising a window, changing the view in EVA Park), sound (i.e., switching on the microphone). While LogMeIn was a useful resource for the therapist to resolve a technology challenge on the participant's behalf, at times this was itself a source of challenge when the therapist had difficulty logging into the account. Technology problems were more likely in the first weeks of the intervention; by the third week of intervention, technology problems were rare.

Table 2 here

Reflecting on the experience of intervention, Participant 1 reported finding the final weeks difficult, particularly given her busy social life. Nonetheless, she reported experiencing a sense of achievement in completing the intervention. She would have liked to explore more of EVA Park during the sessions and make use of opportunities within the environment to practice communication; she had tried to explore EVA Park on her own (outside of the therapy sessions) but ran into technical difficulties such as her avatar flying further than she had intended. Participant 2 reported a different experience: although she found it challenging to focus on storytelling and that it required high levels of concentration, she reported it felt "liberating". She found the repeated opportunities to tell the story helpful, with a sense of mastery developing after the third session each week. She would have liked 10 weeks of intervention in total, rather than five weeks as per the study protocol. Participant 3 also would have liked longer in EVA Park. She reported no difficulty with access or navigation, and valued being able to go into EVA Park independently to re-watch the videos and practice storytelling to the robot avatar. However, Participant 3 would have liked more opportunity to interact with other users in EVA Park outside of sessions.

2. In storytelling of novel video stimuli, is there a change in the amount of relevant content produced by participants?

Using control data for each story, scores are reported for participants' production of content in terms of the number and percentage of essential words produced (Table 3 and Figure 3). All participants improved in producing essential content required in the stories; this improvement was particularly marked in the simple storytelling where all participants doubled their production of essential content after therapy. For complex storytelling, improvements were also seen: Participants

1 and 2 again doubled their production of essential content after therapy. Participant 3, who presented with the severe aphasia at baseline, demonstrated a more modest improvement in the complex story after therapy.

A comparison between the mean pre-therapy score (5.33, standard deviation 1.03) and the mean post- therapy score (12.5, standard deviation 4.8) indicates a large effect size for the group (Cohen's d = 2.06).

Table 3 here

Figure 3 here

3. In storytelling of novel video stimuli, are there changes in story grammar?

Table 4 (and see Appendix 5) reports the pre- and post-therapy story grammar scores. Following therapy, all stories demonstrated completeness, or included the minimal required elements of an initiating event, attempt and direct consequence. This was a clear change from pre-therapy, where only two simple stories, produced by Participants 1 and 2, demonstrated completeness. In almost all cases the improvement in completeness was accompanied by an increased number of story elements. Thus, most stories after therapy were not only more complete, but also contained more elaborating features, such as details about the setting, the character's internal plan and/or their attempts to execute the plan. In one instance the number of elements reduced after therapy, but completeness was improved (Participant 3, complex story). This suggested a greater focus on the essential features of the story and a possible increase in efficiency of storytelling.

Table 4 here

4. In storytelling of novel video stimuli, are there changes in PAS complexity?

For the simple story, all participants at least doubled their production of predicates and arguments (see Table 5). Furthermore, Participants 1 and 2 showed a slight increase in their PAS complexity. For the complex story, Participants 1 and 2 showed more modest improvements and no change in PAS complexity. Participant 3 did not show change in argument structure within the complex story.

Table 5 here

5. In personal narrative, are there changes in story grammar or PAS complexity?

Story grammar changes were less evident in the participants' personal narratives (Table 6). At several timepoints, two participants (2 and 3) produced output that did not satisfy the criteria to be defined as a story. Only Participant showed positive changed in the number of story elements produced and story completeness; however, it is not possible to attribute the positive changes to therapy, given that Participant 1 demonstrated improvement from her second baseline.

Table 6 here

There was considerable variability for number of predicates and arguments produced across all time points, including baseline assessment (see Table 7). On average, Participant 1 produced fewer predicates and arguments after therapy, but no change in PAS complexity. For Participant 2, her average number of predicates and arguments increased after therapy. For Participant 3, no change was seen in production of predicates, arguments or PAS complexity.

Table 7 here

6. What, if any, are the effects of therapy on untreated but related behaviours of functional communication and technology use?

All three participants showed positive change on the measure of functional communication (CADL-2; Table 7). Participant 1 demonstrated greatest change, with post-therapy improvements in her ability to explain information, interpret humour (from a picture stimulus), utilizing context to arrive at a conclusion, and reading. The smaller changes seen for Participants 2 and 3 are likely due to ceiling effects in the baseline data.

Table 8 here

For technology use, participants indicated which devices they had used in the previous month and subsequently rated their confidence in using these devices on a scale of 1-5. As the number of devices used differed across time, confidence ratings were converted to percentages to allow for comparison; a higher percentage indicates higher confidence in using a specific device (Table 8). Participant 1 showed little change in terms of number of devices used but reported improved ease of use following therapy. Participant 2 reported using fewer devices after therapy but improved ease of use. Post-therapy data is not available for Participant 3.

Discussion

Growing evidence supports the feasibility of delivering traditional face-to-face therapy interventions via a telehealth platform (e.g., Hall, Boisvert, & Steele, 2013; Pitt, Hill, Theodoros, & Russell, 2018; Pitt, Theodoros, Hill, & Russell, 2019). In the current study, a storytelling therapy delivered via the online platform, EVA Park, appeared to be feasible and resulted in improvements of direct measures of therapy including story content, story grammar and argument structure. Following intervention, participants showed improvements in story content, producing content more similar to that of neurologically healthy control speakers. These improvements were more marked in the simple story (all participants improved by at least 30%), suggesting an unsurprising effect of the complexity of the stimuli. Greater change was demonstrated by those participants with higher baseline scores and mild-moderate severities (Participants 1 and 2). These improvements in story content echo those seen in the face-to-face variant of interactive storytelling therapy (Carragher et al., 2014), suggesting

that individuals with varying levels of aphasia severity can benefit from online storytelling intervention in EVA Park.

Participants also showed improvement in story grammar, producing more complete stories including an initiating event, attempt and direct consequence. Participants 1 and 2 produced richer stories, with inclusion of more non-essential story structure components such as the setting, internal plan and internal response. Participant 3 demonstrated smaller improvements in the simple story and actually produced fewer story components in the post-therapy complex story. Despite this, she did produce all the essential story components in both the simple and complex story following therapy, suggesting a more complete but compact story organisation following therapy. Similar improvements to story organisation have been seen following other forms of narrative therapy, for example, in a pilot randomised control trial, Whitworth et al. (Whitworth et al., 2015) found a significant difference in the number of orientation elements produced by participants who had received the narrative treatment compared to those who had receive usual care treatment. Story grammar measures have been found to correlate with listeners' judgements of discourse impairments for Cantonese speakers with aphasia (Kong & Wong, 2018), suggesting this is a valid target for intervention and outcome measurement. In the current study, participants also showed improvements with regards to argument structure, particularly in the simpler story where all participants doubled their production of predicates and arguments. Increased production of predicate argument structures have been seen elsewhere in the literature following multi-level narrative intervention (Dipper & Cruice, 2018; Whitworth et al., 2015).

Secondary measures included assessment of personal narratives (story grammar and PAS complexity), functional communication and frequency/confidence using technology. Within personal narratives, variability was seen across baseline assessment regarding story grammar and the number of predicates and arguments produced. One reason for this variability likely relates to how the personal narrative data were sampled: participants were free to choose which personal narratives to share. The instructions were sufficiently broad so that participants were not explicitly instructed to select something they would consider to be a story. Therefore, participants' personal narratives ranged from autobiographic-type information (Participant 1), describing a hobby (Participant 2) and commentary on health and wellbeing (Participant 3). For Participants 2 and 3, their personal narratives often did not fulfil the criteria of a story, which led to not being able to score these data. Participants also differed in their choice of stories over time; that is, Participants 2 and 3 retold similar personal stories throughout each assessment, while Participant 1 demonstrated variability in the topic she selected, including recalling times of heightened negative emotion. Storytelling is influenced by our reasons for telling the story in the first place, the audience to whom it is being told, and the story itself. Participant 1's selection of stories that conveyed a negative emotional experience for her most likely served a different purpose to the topics selected by Participants 2 and 3. Within the personal narratives, variability was also seen in participants' production of argument structure. While PAS complexity remained relatively stable across time for all participants, production of predicates and arguments fluctuated. Variability in discourse at an individual level has been reported elsewhere in the literature (Cameron, Wambaugh, & Mauszycki, 2010). This suggests the need for multiple baselines in order to establish stability within individual participants before employing this outcome measure in post-therapy personal narrative data.

Functional communication (measured by the CADL-2) was stable across baseline assessments and all participants showed improvements on this measure. Improvements in communication were seen in skills that were practiced in therapy including specific speech acts of informing and interpreting humour. During therapy, written output was used by the therapists to structure the story and flesh

out the details, and by the participants; this may explain the positive changes in participants' reading. Technology use remained unchanged (Participant 1) or decreased slightly (Participant 2), but both participants reported improved confidence using technology following the intervention.

Delivering an intervention via the platform of EVA Park had implications for both for administration of the intervention as well as the intervention design. In terms of administration, all three participants experienced technology challenges, particularly in the initial weeks of intervention. The most common difficulty related to sound or visual display issues. Unsurprisingly, daily logs kept by the therapists indicate a level of participant frustration in these sessions. With time and increased familiarity, these technology challenges became less frequent, and became rare after week 3 of intervention. Interestingly, these initial teething problems did not lead to participant attrition. This may be a factor of the technology challenges quickly becoming less frequent, the support offered by the therapist or participant-specific characteristics of the study cohort such as their capacity to cope with problems and their motivation to complete the study. Findings of the current study underscore the importance of firstly, managing the expectations of both therapists and participants that technology challenges will arise but can be overcome, and secondly, the need to have a number of solutions in place to increase the likelihood of success. Such solutions may include the therapist providing instructions on the telephone, a family member being nearby to provide assistance as needed, and the option of LogMeIn for the therapist to directly resolve the issue.

Online administration also altered the intervention design. Interactive Storytelling Therapy was originally developed for face-to-face delivery involving both an individual with aphasia and their close other. As the platform of EVA Park imposes some restrictions on non-verbal communication, it was necessary to adapt the intervention so that it was suitable for online delivery. As a result, multimodal communication was restricted; that is, it was not possible for therapists, participants or volunteers to make use of gesture, pointing, facial expression or drawing. It is difficult to say what impact this had on the intervention as the study did not compare face-to-face and online versions of the therapy. Other telehealth-delivered aphasia interventions have made use of multimodal communication supports to enable individuals with severe aphasia to participate in online intervention groups (e.g., Pitt et al., 2018). Yet the lack of face-to-face communication in EVA Park has not proved to be problematic; for example, a participant with moderate/severe non-fluent aphasia made significant improvements in naming treated nouns in EVA Park despite both the cues and the participant's responses focusing on the spoken modality (Marshall et al., 2018). In the current study, all participants showed some improvements on direct measures; it remains unknown as to whether individuals with specific patholinguistic aphasia profiles would benefit even more from the availability of multimodal communication support within the EVA Park platform. One of the benefits of delivering intervention in EVA Park compared to other telehealth platforms relates to the fantastic nature of the environment; previous studies have indicated that individuals with aphasia enjoy the novelty of engaging in therapy in EVA Park (Marshall et al., 2016; Marshall et al., 2018). For the duration of the intervention, participants with aphasia can access EVA Park independently to explore the environment or to practice storytelling with a robot avatar. These elements of EVA Park were appreciated by participants in the current study, with two participants reporting they would have liked more opportunities to interact with elements of EVA Park (such as making use of the café or hairdressers for conversational practice) as well as with other avatars outside of therapy sessions. One participant reported technical difficulties relating to navigating through EVA Park, echoing some of the challenges of tele-delivered intervention reported elsewhere in the literature (Hall et al., 2013).

Limitations

The current study is a small pilot study without a control arm; therefore, findings must be interpreted with caution. Previous research of Interactive Storytelling Therapy has suggested it is possible to improve narrative content and structure in the stories of PWA (Carragher et al., 2014); that finding is replicated in the current study with a variant of the intervention. As we did not assess the effect of therapy on participants' dialogues, caution is needed in extrapolating these findings to dyadic interactions. Future studies using an experimental design would offer rigorous evidence of treatment efficacy.

Discourse-level tasks may be more vulnerable to natural variability as behaviours are free to vary, such as selection of lexical and syntactic items, the perspective taken by the speaker, as well as decisions on which details to highlight and which to minimise or omit. There are also demands on participants' working memory and attention, which may be vulnerable to fatigue. This variability is particularly evident within the participants' personal narratives in the current study. Discourse elicited using video stimuli may be more stable and more sensitive to showing change following therapy. It is currently unclear what the preferences of individuals with aphasia are with regards to discourse tasks and meaningful outcome measures. Future studies may wish to investigate stability of measures of interest over time within a range of discourse tasks, as well as the assessment preferences of individuals with aphasia.

Finally, it should be noted that an initial investment of time was necessary to set-up the participants' avatars and to help them become sufficiently familiar to navigate through EVA Park; this was done via face-to-face sessions in the participant's home. Nonetheless, all participants reported positive experiences of engaging in therapy in EVA Park, with some suggestions for future improvements including increasing the dosage and opportunities to interact with others within EVA Park.

Conclusion

A feasibility study of multi-level storytelling therapy delivered remotely via EVA Park to individuals across a range of aphasia severities resulted in improvements in behaviours targeted in therapy, that is, story content, story grammar and argument structure. Improvements were greater in response to less complex story stimuli and for participants with mild-moderate severities. There was no generalisation to the untreated discourse genre of personal narratives. Assessment of storytelling in response to a funny video clip appears to be a stable and sensitive context for outcome measurement.

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