"*Just Not Together*": The Experience of Videoconferencing for People with Aphasia during the Covid-19 Pandemic

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ABSTRACT

People with language impairments, such as aphasia, use a range of *total communication* strategies. These go beyond spoken language to include non-verbal utterances, props and gestures. The uptake of videoconferencing platforms necessitated by the Covid-19 pandemic means that people with aphasia now use these communication strategies online. However, no data exists on the impact of videoconferencing on communication for this population. Working with an aphasia charity that moved its conversation support sessions online, we investigated the experience of communication via a videoconferencing platform. We report a study which investigated this through: 1) observations of online conversation support sessions; 2) interviews with speech and language therapists and volunteers; and 3) interviews with people with aphasia. Our findings reveal the unique and creative ways that the charity and its members with aphasia adapted their communication to videoconferencing. We unpack specific, novel challenges relating to total communication via videoconferencing and the related impacts on social and privacy issues.

KEYWORDS

Videoconferencing, Aphasia, Covid-19 Pandemic, Total Communication, Accessibility

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1 INTRODUCTION

When communicating in-person, people frequently use gestures, sketches and props to help convey their meaning. Subtle cues in body language and facial expressions are used to augment speech and enrich expression. People with language impairments such as aphasia benefit greatly from these strategies, as they offer an alternative or complementary means for communication. This is termed '*total communication*' and is actively trained to help people with aphasia in communication [53].

The Covid-19 pandemic has meant that many of us have had to transition our social and civic communication to videoconferencing platforms [41]. The specific challenges of communicating over videoconferencing are well-known and have been studied in populations *without* language impairments and reported in the HCI literature. These include, but are not limited to, a lack of eye contact [59], turn-taking issues due to latency [26, 38] and background noise [63]. Less is known about the impact of videoconferencing on people with language impairments such as aphasia, however it seems likely that videoconferencing will not support diverse communication strategies such as total communication as effectively as in-person commmunication. In this paper, we investigate the experience of communication via videoconferencing for people with aphasia, with a particular focus on total communication. Working in collaboration with an aphasia charity who moved their services online due to the Covid-19 pandemic, we explored this via three complementary approaches:

(1) Naturalistic observations of online sessions involving people with aphasia in supported communication;
(2) Interviews with speech and language therapists and volunteers who offer conversation support sessions online;
(3) Interviews with people with aphasia who have been receiving conversation support online.

This paper contributes to the domains of HCI and accessibility by offering novel insights into the experience of people with aphasia when communicating via videoconference. We delineate the unique ways in which people with aphasia communicate via videoconferencing. We describe how total communication strategies – such as props, gesture and body language – offer challenges and opportunities for communication via videoconference, and contrast their use

to known in-person strategies. We explore the impact of known challenges with videoconferencing (e.g. latency) and their effect on informal and emotional engagement. Finally, we build upon these findings to discuss ways in which we might enable more effective and equitable communication for people with a range of language difficulties.

2 BACKGROUND

2.1 Aphasia, Accessibility and Videoconferencing

This paper explores the impact of videoconferencing on communication for people with aphasia. Aphasia is a language impairment caused by damage to the brain. It is most often caused by stroke and is experienced by approximately one-third of stroke survivors. This means that approximately 2 million people in the USA are living with aphasia [3] and this is likely to increase substantially over the coming years due to an ageing population and the increased odds of surviving a stroke. Aphasia can affect reading, writing, speech and comprehension of speech, but does not typically affect intellect. Aphasia affects each individual differently. People with aphasia may benefit from the use of total communication strategies to compensate for language difficulties [34, 53], with the support of a *communication partner* [62].

2.1.1 Accessibility Research and Aphasia. People with aphasia face challenges when using technology. Barriers arise from the highly language-based and multi-step nature of interactions with technology [27, 42]. For example, Grellmann et al. [28] and Roper et al. [55] reported that commonplace social media platforms present a range of barriers which make the creation and consumption of online content challenging.

Other research has sought to understand and design tools to support people with aphasia in language rehabilitation [50] and conversation support [37, 66]. Research has also focused on designing augmentative and alternative communication methods which circumvent the constraints of language [1, 8, 44] and provide alternative ways for individuals with aphasia to express sentiment. Recent work has also explored how people with aphasia may be best engaged in the co-design of technologies [45, 69] and how people with aphasia may be best engaged in digital creative tasks, for example, creative writing [47], media sequencing, comic creation [64] and visual art [46]. This body of work on accessibility and designing with and for people with aphasia has highlighted the specific challenges faced by this user group, but has also shown that, if the barriers are understood, technology can be designed for people with aphasia so that it is accessible and engaging.

2.1.2 Aphasia and Videoconferencing. Videoconferencing technology has been used successfully to deliver assessments of language (e.g. reading, word-finding) and telerehabilitation in aphasia. Woolf et al. [70] and Øra et al. [71] investigated the feasibility of delivering speech therapy for people with aphasia remotely using videoconferencing. They reported that it was feasible to do so and that the remote delivery was acceptable to participants.

Cruice et al. [15] reported that online supported conversation improved social participation and quality of life in some people with aphasia and Buchholz et al. [13] discuss remote communication for people with cognitive and communicative impairments – mostly focusing on text messaging, but with some consideration for videoconferencing. Since the outset of the Covid-19 pandemic, people with aphasia have – like everyone else – become reliant on videoconferencing for remote communication. Ellis and Jacobs [20] outline the '*cost of social distancing*', particularly on emotional fulfilment and social connectedness for people with aphasia. They note that although people with aphasia may experience some social contact via virtual connectedness, this is limited by the lack of diverse communication (verbal, visual, gestural) that remote communication such as videoconferencing provides.

2.2 Videoconferencing and Its Impact on Communication

Although videoconferencing tools have evolved substantially since they first emerged around 80 years ago [2], and have become standard during the pandemic, the experience of communicating via videoconferencing is still not the same as in-person. In-person, people rely on nuanced complex and context-dependent cues to communicate their meaning; this is implicit, subtle, often non-verbal communication [58]. This has been explored in studies undertaken mostly in the context of CSCW (Computer Supported Cooperative Work) – i.e. where the focus has been on productivity in remote working, with results suggesting that many of these important cues are compromised in videoconferencing.

In contrast to in-person conversation, when viewing a screen, the *viewing ratio* – the ratio between the distance of the viewer to the height of the visible screen – is vital [16]. We know that the sense of co-presence of remote participants is strongly affected by this, and that smaller displays perform poorly and are not comfortable [16]. Related to this, we know that maintaining *eye-contact* – as we do in real life conversation [4] – is challenging via videoconferencing. Work has explored how we might support this by offering individualised cameras and displays for each person in a remote conversation [59, 60] – analogous to sitting around a physical table. Gaver et al. [24] also explored the idea of using multiple camera angles in videoconferencing to provide further information in CSCW. Other work has also explored how one might configure the UI of a videoconferencing tool to suit the context [67].

There are also ergonomic challenges, such as how people position themselves and their cameras. This is highlighted in work such as that by Gan et al. [23], who describe the supporting role that grandparents of 'left behind' [1] children when communicating with their parents – e.g. positioning their camera for a better view of the co-located child. Brubaker et al. [12] document how we often use our camera feed to position ourselves in space and how it might affect our behaviour – provoking performative behaviours (c.f.[25]) due to consciousness of one's own self.

Videoconferencing, due to network latency involved in the transmission of audio and video, does not provide the same opportunities for shorter and less interrupted conversation, as there are in real-world dialogue [49]. This leads to communication challenges (c.f. [26, 38, 49]) such as a lack of inability to quickly verbally confirm

[1]Children who are 'left behind', typically in rural areas with their grandparents, as their parents go and work in cities — and are therefore reliant on videoconferencing.

– "*yes*" — "*mhmm*", and challenges interjecting in conversations. Ruhleder and Jordan [57] go further, noting that these challenges are also impacted by the inability to effectively diagnose and repair conversation when miscommunication occurs. Finally, these additional communication barriers have become more prominent in the Covid-19 pandemic and have been colloquially termed 'Zoom Fatigue'. Bailenson [6] delineates the additional costs and non-natural communication approaches we adopt when videoconferencing, and how they introduce additional fatiguing qualities.

2.2.1 Previously Addressed Contexts and Concerns in Videoconferencing. Due to the aforementioned issues, previous work has documented contexts in which telecommunication introduces challenges. For instance, in context of musical performance in the Covid-19 pandemic – noting the challenges and workarounds of a folk music group maintaining 'liveness' [7]. Therapeutic contexts have also been explored. Therapeutic and medical contexts (see [22] for a review) rely on a large amount of affective communication, conveyed through eye contact, body language and tone of voice [32]. These, as reported by Faucett et al. [21], are not as effectively replicated via videoconferencing – introducing a potentially unequal exchange.

Privacy is a known challenge in videoconferencing. Separate, uncontrolled physical environments with personal space, such as a home with family members on display, has implications on privacy [10]. Much work in this area has focused on CSCW contexts (e.g. Work from Home) which have investigated ways in which we might control that which is private and that which is public to us [35]. This might range from the way we position ourselves and our devices, to specific technological solutions in the context of our private and public 'worlds', such as background blur filters [9], now integrated into most videoconferencing tools.

Finally, as people with aphasia use the 'foreign country' analogy to describe their disability, – i.e. being in a country where one does not understand the language (see "*The Word Escapes Me: Aphasia Analogies*" (pg. 81)), it is suitable to think about the experience of non-native speakers when videoconferencing. This work has been explored by He et al. [31], noting that these users often must rely more on their non-verbal communication abilities than native speakers, leading onto work which considers how more gestural support might be provided to compensate [39].

3 METHOD

We conducted a three-part study to investigate the experience of videoconferencing for people with aphasia. The study was conducted in collaboration with an aphasia charity and involved naturalistic observations of online sessions, interviews with speech and language therapists and volunteers (hereafter referred to as charity staff) and interviews with people with aphasia (hereafter referred to as charity members with aphasia). These are reported in the following subsections. Ethical approval was granted by the Research Ethics Committee at King's College London.

For the observational study, consent was gained for staff and charity members by SLTs (Speech and Language Therapists) at the charity during the online weekly sessions in line with our ethical review. We only observed sessions where all participants had given consent. Participants could additionally 'opt in' to consent to having their images included (blurred or un-blurred) in publications. Only images of participants who consented to having their identifiable images published in articles and presentations are shown in this paper. For the interviews with staff at the charity, consent was gained by a technology researcher via an approved consent form. Similarly, for the people with aphasia at the charity, consent was gained by an SLT via an accessible consent form and process. Charity costs for supporting the organisational (e.g. consenting, recruiting) and data collection aspects of this work were supported at a rate of £25 GBP per hour.

3.1 Study Context

All three parts of the study were conducted with Dyscover, a specialist aphasia charity based in the South East of England (UK). Dyscover provides specialist long-term support and opportunities for people with aphasia, with a focus on supporting people to develop strategies for communicating and maximise their abilities during stroke recovery. The charity has physical centres where, prior to the Covid-19 pandemic, regular in-person sessions took place with a range of therapeutic and conversational goals. These typically consisted of groups of between 8 and 15 people with aphasia, which would break up into smaller groups to facilitate structured conversation focused on a theme or specific objective. Groups were curated to include people with similar communication needs, and who were at a similar stage of recovery, with the aim of providing appropriate peer support and optimal benefit. Communication was generally structured and supported by at least one trained speech and language therapist who used a range of trained communication strategies to support communication. For instance, they might use writing or drawing to support asking a question. They might confirm responses to ensure communication is accurate. They might use, and support a person with aphasia in using, a range of gestures. Readers are encouraged to look at an example of Dyscover's training materials.

At the beginning of the Covid-19 pandemic (March 2020), Dyscover transitioned their services to the Zoom videoconferencing platform, having no prior experience of running online sessions. Zoom was selected as the platform of choice after exploration of a range of platforms. Online sessions were continuing at the date of writing this paper (September 2021) and appear to have been successful. Data from the charity's report [19] indicated that they had run 285 structured online group sessions for 69 people with aphasia and that 62% of those attending the online sessions would like to see online sessions continue in some form. However, when asked whether they wanted to return to face-to-face sessions in Autumn 2021, most (60%) did, 23% would prefer to continue on Zoom and 16% said they would like to do both or were unsure.

3.2 Study Part 1: Observational Study of Online Sessions

The first part of the study was observational. The aim was to explore the communication strategies of the members with aphasia when using videoconferencing. In addition, we wanted to understand the ways in which the charity staff ran the sessions and supported communication. We observed people with a range of difficulties related to aphasia participating in online supported communication in two kinds of groups: 1) '*Moving On*' groups – for people who

Members with Aphasia				Staff and Volunteers			
ID	**Gender**	**Age**	**Aphasia information**	**ID**	**Gender**	**Age**	**Role**
ObsM1	Male	50s	Severe aphasia	ObsS1	Female	50s	SLT assistant
ObsM2	Female	60s	Moderate aphasia	ObsS2	Female	—	SLT assistant
ObsM3	Male	70s	Severe aphasia	ObsS3	Female	50s	SLT
ObsM4	Male	70s	Mild aphasia	ObsS4	Female	70s	SLT
ObsM5	Female	40s	Moderate aphasia	ObsS5	Female	30s	Volunteer
ObsM6	Male	70s	Mild aphasia	ObsS6	Male	70s	Volunteer
ObsM7	Male	60s	Mild aphasia	ObsS7	Female	40s	SLT assistant
ObsM8	Male	70s	Moderate aphasia	ObsS8	Female	40s	SLT assistant
ObsM9	Male	70s	Severe aphasia	ObsS9	Female	50s	SLT
ObsM10	Male	70s	Severe aphasia	ObsS10	Female	60s	Volunteer
ObsM11	Male	70s	Moderate/Severe aphasia	ObsS11	Female	40s	SLT
ObsM12	Male	50s	Severe aphasia	ObsS12	Female	—	Volunteer
ObsM13	Male	70s	Mild aphasia				
ObsM14	Male	70s	Mild aphasia				
ObsM15	Male	70s	Moderate aphasia				
ObsM16	Female	70s	Moderate aphasia				
ObsM17	Female	70s	Mild aphasia				
ObsM18	Male	60s	Severe aphasia				
ObsM19	Male	70s	Severe aphasia				
ObsM20	Female	50s	Severe aphasia				
ObsM21	Male	60s	Moderate aphasia				
ObsM22	Female	60s	Mild aphasia				
ObsM23	Male	50s	Severe aphasia				
ObsM24	Male	70s	Moderate aphasia				
ObsM25	Female	50s	Moderate aphasia				
ObsM26	Male	50s	Severe aphasia				
ObsM27	Male	50s	Severe aphasia				
ObsM28	Male	50s	Moderate aphasia				
ObsM29	Male	50s	Moderate aphasia				
ObsM30	Female	60s	Mild aphasia				
ObsM31	Male	60s	Severe aphasia				
ObsM32	Female	50s	Mild aphasia				
ObsM33	Female	50s	Moderate aphasia				
ObsM34	Female	50s	Mild aphasia				

Table 1: Demographic information for observation participants – both members with aphasia (ObsM) and charity staff (ObsS), denoted with appended numbers. Missing or declined information is denoted with a '—'.

are recovering and successfully using a range of communication skills; and 2) – '*Learning to Live with Aphasia*' groups, for people who are adjusting to their disability (e.g. following a recent stroke). Sessions were run online via the Zoom platform. They replicated the in-person sessions, where approximately 10 people met in a group, then broke out into groups of 3 or 4 for the majority of the session, before returning to the whole group at the end. The sessions were, however, shortened for online delivery. We observed only the breakout sessions.

3.2.1 Procedure: Observational Study. Following the consent process, staff recorded the sessions, to allow for minimal interference and naturalistic observation of the sessions. The videos were recorded via Zoom's recording function, stored locally and then uploaded via a secure server to the researchers.

Fifteen sessions were observed via video recording, totalling 10 hours and 35 minutes of footage. The average session was approximately 42 minutes (min = 33 mins; max = 60 mins). Analysis followed Braun and Clarke [11]'s thematic analysis approach – i.e. familiarisation, coding, thematic categorisation and defining. Videos were coded for instances of behaviour relating to communication, focusing on total communication strategies and instances where communication challenges occurred. Two researchers independently viewed ~25% of the video data. They coded the data with descriptive codes and refined them accordingly to maintain a consistent coding strategy. The data was then coded for all material directly onto the videos in NVivo by one researcher. The researcher descriptive codes as NVivo nodes, making note of the relevant participant information. A second coder checked an additional ~25% of unseen videos to completion. A second pass was completed by the first coder to ensure consistency of coding across videos. Codes were explored, and an initial analysis was done in Miro by exporting each NVivo node as an individual Miro post-it. Two members of the team then grouped, reviewed and refined the themes in Miro. Individual data points (e.g. quotes) were then investigated in NVivo.

3.2.2 Participants: Observational Study. Thirty-four individuals with aphasia were included in the observed sessions along with 12 charity staff who facilitated the sessions (see Table 1). Some

ID	Age	Gender	Role	In-Person Exp	Online Exp	Videoconf.	Online Group
Ch1	34	Female	Ass. SLT	None	6 months	Extensive	Mild/Moderate
Ch2	44	Female	Ass. SLT	None	10 months	Extensive	Mild/Moderate
Ch3	42	Female	SLT	12 years	18 months	Some use	Mix
Ch4	53	Female	SLT	31 years	18 months	Some use	Mix
Ch5	47	Female	Ass. SLT	4 years	18 months	None	Mix
Ch6	67	Female	SLT	8 years	18 months	None	Mild/Moderate
Ch7	29	Female	Ass. SLT	None	10 months	Some use	Mild/Moderate
Ch8	48	Female	Vol	3 months	18 months	Extensive	Mix
Ch9	73	Male	Vol	6 years	18 months	Some use	Mix
Ch10	62	Female	Vol	6 months	18 months	None	Mix
Ch11	55	Female	SLT	30 years	18 months	Some	Mix
Ch12	51	Female	Ass. SLT	6 years	18 months	Some	Mix
Ch13	78	Female	SLT	56 years	18 months	Extensive	Mix
Ch14	70	Male	Vol	3 months	18 months	None	Mild/Moderate

Table 2: Charity staff (Ch1 – Ch14) shown by their age, gender, role, in-person and online experience of working with people with aphasia, experience of videoconferencing (before the pandemic) and the level of aphasia of their online groups.

participants appeared in more than one session, but are treated as individuals in this analysis. Participants with aphasia had a range of difficulties related to their aphasia. Charity staff had a range of experience – from fully qualified SLTs, to volunteers with experience but no formal training.

3.3 Study Part 2: Interviews with Charity Staff

To complement the data gathered in the observations, we interviewed staff at the charity with a view to exploring their experience as experts in supporting people with aphasia when videoconferencing. We also elicited their views in a proxy capacity (c.f. [17]) – that is, we asked them to consider the perspective of a person with aphasia, acting as a proxy for those who might struggle to share their views. All interviews were conducted after the observations, as to not bias behaviour.

3.3.1 Procedure: Interviews with Charity Staff. Interviews were conducted over Zoom and were semi-structured. Set questions were asked, but participants were encouraged to elaborate on their answers. After capturing demographic information, the interviews opened with broad questions – e.g. "*Could you comment on your experience of adapting to videoconferencing during the pandemic?*" — "*What are the good/bad things about running the sessions online?*". We then focused on specific topics aiming to capture the differences between online and in-person communication (including total communication), such as speaking, props, body language, etc., e.g. "*How do people in your sessions communicate via gesture online compared to in-person?*.

We aimed to interview participants in pairs [68]. Paired interviews were chosen to allow each participant to provide 'missing pieces' of information [5], and therefore provide a more complete picture of practice. To prevent one participant dominating the discussion, questions from the topic guide were alternated between interviewees, with the second person being asked for their perspective following the first answer. While we aimed to recruit in pairs, due to scheduling constraints, some interviews were individual. Interviews lasted between 35 and 69 minutes, with an average of 53 minutes and 40 seconds. Recordings were captured via Zoom. Zoom auto-generated transcripts were corrected by a researcher by referring to the original video. Transcripts were coded in NVivo following Braun and Clarke [11]'s thematic analysis approach. Data were exported, colour coded by frequency in Excel. Data were then categorised and discussed iteratively, with reference to the original data by the team in Miro, referring to the original data as needed.

3.3.2 Participants: Interviews with Charity Staff. Participants were recruited with the aim of capturing a range of experience in both working with people with aphasia (in terms of duration and severity) and videoconferencing. They were paired in a complementary manner to offer a range of experience.

Participants are shown in Table 2. Participants ages ranged from 29 to 78, with an average of 53.8 years. Twelve participants were female and two male. Five participants were fully qualified speech and language therapists and five were assistant speech and language therapists (e.g. students studying a degree in Speech and Language Therapy) and four were volunteers at the charity. In-person experience working with people with aphasia ranged from none (i.e. they began their role during the pandemic) and up to 56 years working experience (average = 11.6 years). Online experience, e.g. working at the charity on Zoom, ranged from 6 months, up to 18 months – the pandemic duration to the time of interview. Participants had a wide range of videoconferencing experience before the pandemic.

3.4 Study Part 3: Interviews with Charity Members with Aphasia

In the final part of the study, we conducted interviews with people with aphasia to capture their perspectives, including the minutiae of their experiences; contrasting their 'in-person' sessions to those they had been having via videoconference, and triangulating the data with the interviews of the charity staff.

3.4.1 Procedure: Interviews with Charity Members with Aphasia. Interviews were conducted over Zoom by a trained SLT and a technology researcher with experience of facilitating people with aphasia via videoconference. The same topic guide was used as in the charity staff interviews. The interviews were semi-structured,

ID	Age	Gender	Reading Challenges	Writing Challenges	Speaking Challenges	Understanding Challenges
M1	63	Male	Books, Magazines	Long text, sentences	Lots, except few words	TV OK. Telephone challenging
M2	64	Female	Books, Some Magazines	Long text, email	OK but with issues	TV OK. Telephone challenging
M3	50	Male	Books, Magazines	Long text, letter/email	OK but with issues	TV OK. Telephone OK. Challenges in groups
M4	76	Male	Books (pictures needed)	Long text, letter/email	OK but with issues	TV challenging when complex. Radio OK
M5	52	Female	Nothing, but slow	Long text, letter/email	OK but with issues	All OK, except groups hard
M6	55	Male	Nothing	Long text, letter/email	Non-verbal (supported)	All OK, except groups hard
M7	47	Female	Nothing	Long text, letter/email	OK but with issues	All OK, except groups hard
M8	75	Male	Nothing	Long text	OK but with issues	All OK
M9	41	Male	Books, Magazines	Long text, email	OK but with issues	Mostly OK, Simple convo. OK
M10	48	Male	Nothing, but effortful	Long text, email w/TTS	OK but with issues	TV and radio OK.
M11	51	Female	Nothing bar hard books	Long text, email w/errors	OK but with issues	TV and radio OK. Simple convo. OK
M12	62	Female	Some magazines	Long text	OK but with issues	TV, radio and phone hard.
M13	54	Male	Books, Some Magazines	All except single words	OK but with issues	TV and radio OK

Table 3: Members of charity with aphasia involved in the interviews. Some participants with more severe aphasia were supported in response by a co-located family member. This is noted when quoted as (supported).

and supported by slides which included visual references to support the questions, along with written versions of the questions. Interviews lasted between 31 and 71 minutes, with an average of approximately 47 minutes and 20 seconds. Recordings were captured via Zoom. The coding and analysis strategy mirrored that of the interviews with the charity members, with one difference. Instead of coding onto the transcripts, we coded directly onto the videos to account for communication challenges and to capture anything communicated via total communication. Participants were paid £25 GBP for their time and expertise.

3.4.2 Participants: Interviews with Charity Members with Aphasia. Participants were recruited from the charity and consented by a qualified speech and language therapist. All participants had been involved in the charity's online sessions, but not necessarily involved in the sessions that we observed. Participants are shown in Table 3. 13 participants were interviewed. Six were male and five were female. Their average age was 56.8 years (min = 41; max = 76). Participants had a range of communication difficulties and technology use.

Coded Instance	Staff	Member	Sum
Prop Use			
Prop for reinforcement of one's speech	36	39	75
Prop for reinforcing the speech of others	171	0	171
Prop used as a response to a question	7	61	68
Prop used to negotiate towards an answer	20	0	20
Bespoke prop use	22	48	70
All prop use	244	143	387
Gesture Use			
Pantomine or functional gestures	28	14	42
Reactions to questions (e.g. yes/no)	3	17	20
Gesturing to convey numbers	5	18	23
Call for attention (e.g hand up)	0	5	5
All gesture use	22	68	90

Table 4: Frequency of use of props and gestures in observed sessions. Note that the values of 'All prop use' and 'All gesture use' are less than the sum of individual coded instances because multiple codes were applied to some instances of communication behaviour.

4 RESULTS

Results from the three parts of the study are reported in this section. Findings from the analysis of the observational data are reported in Section 4.1. Findings from the analysis of the interviews with charity staff and members with aphasia are organised into challenges (reported in Section 4.2) and benefits (reported in Section 4.3).

4.1 Observed Strategies and Communication Challenges

We coded 816 instances of communication behaviour in the videos recorded in the observational study (part 1). After grouping, sorting, discussing and referring back to the original data, we organised the behaviours into main themes. We report four main themes that are related to communication.

4.1.1 Use of Props for Communication. The use of props was the most commonly coded total communication behaviour. There were a total of 387 instances of prop use by members with aphasia and charity staff. The majority of the prop use was by the staff members with 244 instances, as compared with 143 instances of use by members with aphasia.

Regarding the types of props, these were diverse in nature, ranging from pieces of paper with words written on them, to pictures and outfit changes. Both charity staff and members with aphasia relied on personal, nearby items in their surroundings to communicate. These items not only allowed members to support their communication, but also let the others know a little more about their passions. For example, Figure 1 shows a charity member with aphasia displaying a photo of dining on a steam train. Props were also used to support conversation about accomplishments – for example one participant held up his honorary degree to support a discussion with the group.

Interestingly, the staff at the charity – noting the challenge in communicating via videoconferencing – sent out 'kits' of props

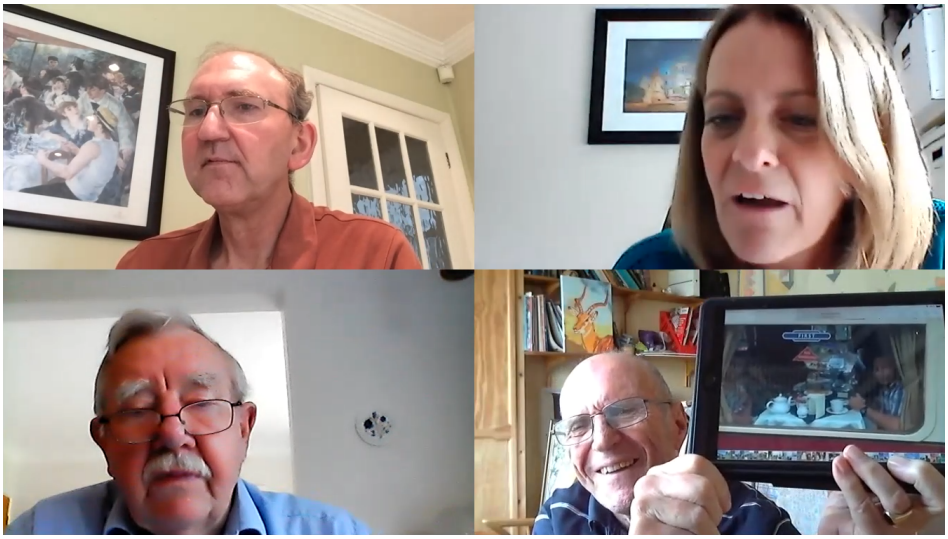

Figure 1: Figure shows bottom right participant showing a picture travelling on a steam train in First Class in a story about his passion for rail and steam trains.

specifically designed for communication (see Figure 2), including reactions (e.g. a 'thumbs up') on a stick. We term these '*stick props*'. Other charity members modified the materials and made props of their own based on these. Seventy instances of prop usage were recorded.

In terms of usage, most common prop use (171 instances) was a behaviour exhibited exclusively by the charity staff – the use of props to *reinforce the speech of others*. This was done when a member with aphasia was speaking: the staff member would use a prop to reinforce what was spoken – partly to indicate their understanding and provide feedback to the speaker, but also to support the other members in the conversation group in comprehending. These props were almost exclusively simple pieces of writing (e.g. a noun or verb) on a whiteboard. An typical example is shown in Figure 2.

Another common and related occurrence was the use of props to *reinforce the speaker's message* when communicating with others. For instance, someone talking about a given topic might highlight their point with written words, or objects demonstrating this topic. This behaviour was proportionally (compared to overall prop use) more common in the members with aphasia – 39 instances, compared to 36 (total 75). This was a mixture of hand-written and hand-drawn materials for people with aphasia. ObsM17, for instance, held up a wedding dress that she sewed to support her in telling a story. In the case of the charity staff, this was most commonly done to explain an activity – for example, ObsS5 wrote down 'SKILL' on a whiteboard to highlight the topic of the conversation.

Props were often used by the members with aphasia as *responses to questions*, in lieu of spoken words. There were 61 coded instances where a person with aphasia used a prop successfully in direct response to a question – substantially more than the charity staff (7). These were typically one word responses, for example, ObsM1 held up a piece of paper with the word 'History', as a response to the question "*What was your favourite subject at school?*". Members also used the stick props to respond in a binary nature – for example holding up the 'thumbs down' stick to indicate a negative response to a question (see Figure 2). The charity staff also used the stick props to negotiate towards an answer by iterating through options (e.g 'thumbs up', 'thumbs down') and waiting for a verbal response from the member with aphasia, or by showing multiple options (yes/no) to make a binary choice explicit within the conversation (there were 20 coded instances of this behaviour – 6 of which were via stick props).

The analysis also revealed a number of issues related to the use of props. One issue experienced by the members with aphasia was spelling and legibility problems – e.g. a response might be unclear due to misspelling of handwritten notes, or the clarity of images shown to the camera. An issue was framing of the props (18 recorded instances). This was exclusively the members with aphasia and included instances such as people holding up pictures or words, partially, or completely out of frame.

As the sessions were recorded from the perspective of the charity members, it is unclear how the images looked for everyone, so this is challenging to disentangle further. Another occasional issue (4 coded instances) was members with aphasia showing something to camera for a period of time which was too short for others to read. Finally, an issue relating to the stick props was that on occasion (5 coded instances) members with aphasia would hold up the wrong response – for instance producing the "Yes!" flashcard, while shaking their head from side-to-side (i.e. gesture for 'no').

4.1.2 Use of Gesture for Communication. Gestures were commonly used throughout the sessions. Ninety instances of gestures were coded. These were predominantly functional, or pantomime-like gestures (see [33]). Of these 42 such gestures, most came from staff at the charity. These were mostly used to try to establish a topic or make a point, but were also used by members with aphasia to respond without words. For instance, in a discussion ObsM20 covered their mouth to indicate that they were talking

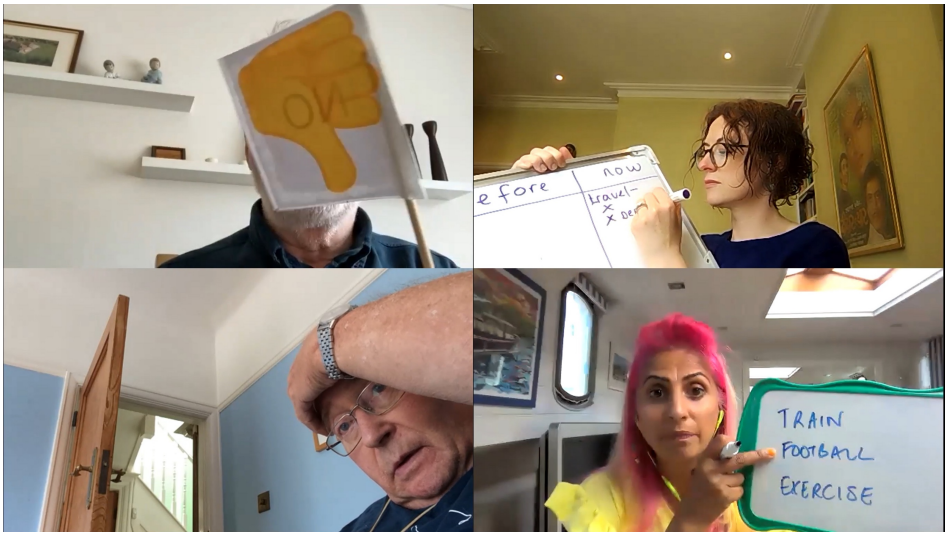

Figure 2: A range of use of total communication. Both charity staff (top and bottom on right), are using whiteboards. Charity staff in the top right is using the whiteboard to support the discussion (about things we now feel comfortable doing during the pandemic), while the charity staff member in the bottom right is using a whiteboard to tally who feels OK doing a given activity. Member with aphasia in the top left is responding with a 'No' stick prop to a question asked by charity staff member in bottom right.

about wearing a facemask when going out. Similarly, when asked "*Has anybody been doing anything since they have had their double-jab [vaccination]?*", ObsM8 responded with unclear audio, but with a drinking gesture, to which ObsS2 then understood – "*Oh you've been out drinking, then... Where did you go? [ObsM8], did you go to a pub?*". Such gestures were also used to triangulate discussions by the staff – for example, ObsS2 used gesture to describe rain in a discussion about a local cafe – "*I was going to go last Friday, but I don't know if you remembered what it did last Friday? But it poured and poured and poured with rain [gestures by flapping hand downwards each time she says poured]*".

Another common gesture by people with aphasia was to convey numbers via finger digits – 18 coded instances. This ranged from holding up two fingers to represent the number 2, to more complex sequences – e.g. ObsM10, who held up 5 fingers, and then 3 fingers to represent the number 8. This was likely not done with both hands due to hemiplegia (weakness in one side of the body, typically caused by a brain injury). Similarly frequent, was the use of gestures to respond 'yes' or 'no' in response to questions – more common in those with aphasia (17/20 coded instances).

Some issues reported related to camera mirroring For example, ObsM10 tried to convey something by writing letters in air but others saw this backwards and so did not understand. Other mirroring issues related to pointing – for example, ObsM9 pointed to an option provided on paper by charity staff, although it was inverted by the mirroring, so the staff were unclear where they were pointing. Finally, another issue related to calling for attention. An infrequent (4 coded instances) behaviour when trying to attract attention was to clearly raise a hand, but despite the staff's expertise in watching for and interpreting body language, we found two coded instances where this was not (assumed to be) not seen by the member of staff and this meant the request/interjection went unnoticed.

A common issue was the framing of the gesture. For instance, ObsM16 had framing issues when explaining a particular concept related to driving a car when she was young:

```
ObsM16: Your...um...cars...[unclear]... you got a...thing
        [makes small box gesture with fingers, mostly off
        screen]...paid... To drive around in the country.
ObsS2:  Like a chauffeur?
ObsM16: No everybody had one... If you had a car, you had
        to pay...
ObsM15: [whispering] licence...
ObsS2:  Ah -- A licence!
```

4.1.3 General (Mis)communication in Videoconferencing. In terms of visual and auditory communication, the most commonly encountered challenge was people talking over other people, likely due to the known latency and audio processing issues with videoconferencing. In total, there were 23 instances of communication breakdown. *Turn-taking challenges* were most commonly observed between the members with aphasia and the staff (14 occurrences).

Below shows an exchange between three charity members trying to answer an actor's name based on his picture. ObsM8, who had quite severe aphasia was cut off by both ObsM1 (milder aphasia) and ObsM11 (severe aphasia). His voice is cut while trying to exclaim "Indiana Jones!", as Zoom's audio cut him off, due to others speaking:

ObsS1: The next face we had, was this guy [shows a slide with Harrison Ford]. That's Harrison Ford. He is a famous actor.
ObsM1: I'm sorry...
ObsM8: [muffled, unclear] [exclaiming] In...[cut off]
ObsM1: I haven't...
ObsM11: [unclear dialogue]
ObsM1: The faintest idea.
ObsM8: [unclear]..Jooones! [completing from 4 turns ago]
ObsS1: Indiana Jones?
ObsM11: [unclear]
ObsM11 Yes! [cuts off]

Communication through visual information was mostly hindered by the aforementioned issues relating to framing for gestures and props, as well as technical issues, such as video dropout and freezing (10 coded instances). Finally, members and staff issues where they would leave the call, mostly caused by internet connection disruption (7 coded instances). This was normally disruptive and broke the flow of the planned activities for the session. For instance, ObsM10 left the session and returned approximately 1 minute later with a frozen screen, arriving to a completely different topic of conversation. Other issues relating to audio were sound being muffled by Zoom's audio processing, to the point where the conversation broke down briefly (7 coded instances).

4.1.4 Third-Party Involvement. A clear difference between the videoconferencing sessions and the 'in person' sessions previously run at the charity, was that the members were in their homes, with their families nearby. The impact of this was clear from our observational data. Two patterns emerged. One was simply that being in one's own home environment can introduce background distractions. We found 15 coded instances of this happening. Visual background distractions involved people walking past or 'lurking' in the background to access parts of the home. These were most frequent and not particularly intrusive.

There were also instances of co-located family members speaking off-camera (likely not realising that the session could hear them), of a charity member's phone ringing, and of an (off-topic) cat distracting the members by walking in front of one member's camera (Figure 3).

The second common theme (17 coded instances) was the active involvement (e.g. beyond 'tech support' (4 coded instances)) of another co-located person within the discussions – typically a family member. Commonly this involved speaking on behalf of the member and answering questions and talking about topics posed to them, and also handing the person supporting pieces of paper with notes and props (e.g. the stick props). An example where an off-camera 3rd party speaks in the background on behalf of their co-located family member:

ObsS2: ObsM10, have you ever been to Wimbledon [UK tennis tournament]
ObsM10: Yes [thumbs up]
ObsS2: Good. That is really excellent. Did you get a good match?
ObsM10: [off camera person speaking] Years ago...
ObsM10: Yeaah.
ObsS2: Years ago?
ObsM10: [off camera person speaking] Many years ago!
ObsS2: Did you go to a final?
ObsM10: [off camera person speaking] No.
ObsS2: But you went...
ObsM10: No.

4.2 Perspectives on Communication Challenges when Videoconferencing

This section reports the communication challenges identified from both sets of interviews (i.e. charity staff and members with aphasia) when videoconferencing, in contrast with 'in person' communication.

4.2.1 Loss of Communication through Body Language and Gesture. In the interviews, charity staff who were trained as SLTs noted how their years of training in understanding body language to determine whether someone is feeling OK, were somewhat lost when on Zoom: "*It's not just facial...It's just non-verbal communication in the round. The way somebody comes into a room. The way somebody greets somebody. The way somebody sits down, where they look. How they look.*"(Ch6). These nuanced, full-body, assessments were also seen as important for understanding when someone is distressed.

Charity staff were concerned about members with aphasia becoming distressed in online sessions, as one is unable to use the innate human ways of comforting and reassuring. The most commonly discussed approaches were taking someone aside: "*Maybe somebody was having 'feelings' when you when we're doing groups. If there's a coffee break [...] you could take somebody aside and say "Are you Okay?". You could you can enable a private conversation much more easily in a face to face setting*" (Ch13). On Zoom this was considered a much more 'formalised' process. Finally, the lack of physical contact afforded by Zoom was seen as a major challenge when supporting members who were distressed – "*It's obviously harder to have a separate conversation with them [a distressed member], and to reassure them, and you know, by touch... I mean this is a natural thing we do*" (Ch11).

The members with aphasia mostly expressed that they much preferred an in-person environment for communication as they could 'read' people better – "*In person you pick up people's... [gestures around face]... [moderator: face?]...Signals. Body language.*" (M5). M11 stated that they felt they were sometimes getting the 'wrong impression' – "*I think, online, you can get the wrong impression. Because you can only see the face, it is difficult to read the whole body language*". Finally, members with aphasia also noted how it was a challenge to see others as Zoom puts everyone in small 'tiles' – making it challenging to read their expressions and understand "*harder to see expression*" (M13).

People with aphasia also surfaced the challenges around the framing of props identified in the observations. This was something M1 found a particular challenge, due to having only one working

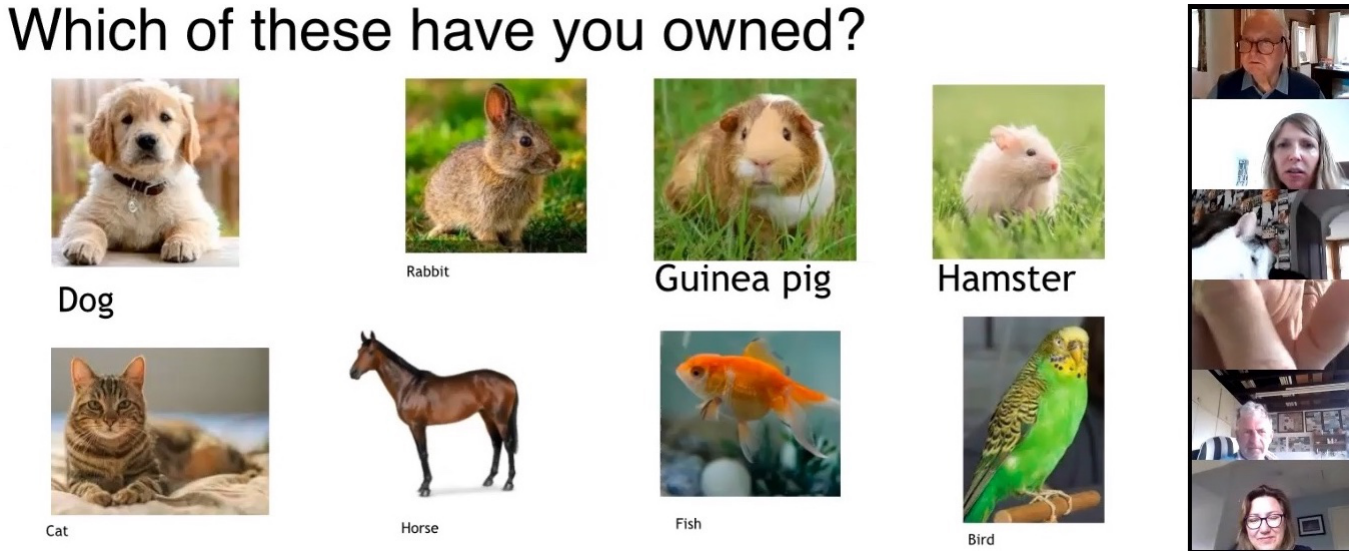

Figure 3: Camera being blocked in two ways as a charity member shares their screen. One participant's face (third from top) is blocking his screen by interacting with the UI on his tablet, and another's (4th from top) face is occluded by a cat.

hand. M4 also described the issues of showing objects to camera, ensuring others can see it, while also being able to see the screen themselves. He notes his preference for a shared physical space – "*When I pick up, say, this [picks up an A4 piece of paper] it is quite fiddly... You have to find where it is on the... [points at the camera]... So you can see it. If it was in my office... I could just point at it and say "look – HERE!"*".

4.2.2 Increased Structure and Challenges in Turn-Taking. In the interviews with charity staff, they praised the members with aphasia in their ability to adapt their communication to the platform. However, several challenges were surfaced. The sessions were perceived as substantially more structured than the 'in person' sessions. This was a structure which was enforced mostly by the charity staff, to overcome the narrowing of communication bandwidth associated with the online platform, and the challenges in turn-taking that the latency of videoconferencing introduces. This meant, practically, cuing each person to talk explicitly more than in the in-person sessions – "*We have to wait, we have to take turns and we might not get as much chance to speak is normal*" (Ch12).

The charity staff noted how this completely changed the communication dynamic, which is a particular issue for people with language impairments who are re-acquiring language – "*I think conversation is less spontaneous. It tends to be more formal.*" (Ch13). This mediation of conversation implied an additional cost for the charity staff, making the sessions more cognitively demanding and tiring – "*[in person] You feel much more able to adapt and change and do something different, whereas if you're on Zoom you like..."right we're talking about the sport and that's all I've got here today, and my brain can't think of anything else*"". (Ch12). In addition, the charity staff touched not only on the issues of framing ones-self for communication turns, but also their challenges in reading body language to determine when someone is going to take a conversation turn – "*I think I probably know this because I'm a speech therapist but recognising when somebody has something to say in a conversation, and moves forward, and responding to the body actions in terms of whether they're wanting to be in the conversation*" (Ch13).

Similarly to the charity staff, members with aphasia noted that they found it more challenging to interject when videoconferencing, leading to stilted conversation "*you have to hold back for other people to have a turn. It's not as easy as a conversation face-to-face. You aren't aware of people online wanting to speak so much*" (M11). Further, they reported that speaking on Zoom – and speaking to everyone in that Zoom call – made them 'at the centre' of the discussion. Charity staff, who were often enforcing turn taking to counter people speaking over each other due to latency, introduced an additional pressure on the members with aphasia to speak in a given time when communicating, as member with aphasia M5 notes: "*you are very aware of the time [when speaking]*" (M5). This likely further introduced fatigue associated with speaking. In addition to turn-taking challenges, determining the current speaker was not always possible, meaning that parts of the conversation got lost. This resulted in additional cognitive and language demands to 'catch-up' with the conversation. Similarly, some participants with aphasia also expressed it was challenging when multiple people spoke at once and therefore cut each other off "*I can't talk with four people together. It's too many. If they are talking together, it is difficult.*" (M12)

A common point raised by the charity staff was how the members with aphasia were not able to have the focused, one-to-one discussions that were typical at the physical centre. In Zoom, when one person speaks in a group, they speak to everyone. However, in person, people use the physical environment to break into informal gatherings, especially in the coffee breaks. Due to this, and the more turn-based nature of videoconferencing, the staff indicated that some members with aphasia might feel more left out as they were unable to express in alternate ways – "*Where one person is a*

bit bored by another person, or a bit fed up with the fact that they're struggling [...] I might look as if I'm giving them [the other person] more attention..." (Ch13). Charity staff raised the concern that more dominant (in terms of language) members took over conversation more so on Zoom. For instance, when comparing online and in-person sessions, Ch11 found it more challenging to interject in this form of dominant behaviour: "*They would dominate – start talking, and then they wouldn't stop. Because they've got their turn and they're going to go for it. I find find it harder to stop them [on Zoom]*" (Ch11).

4.2.3 Informality, Social and Emotional Aspects. The charity staff suggested that the requirement for turn-taking, and the one-to-many communication challenges of videoconferencing made informality challenging for the members with aphasia, as each turn seemed pressured, or prescribed. Formality was noted as a major downside of running sessions online by virtually all charity staff. As Ch10 noted: "*I'm looking forward to face to face. It's the informal banter that happens in the break [...] obviously, that is something you can't do on zoom. I think that's really, really valuable*". Charity staff reflected on how they had essentially removed, or curtailed the informal parts of the sessions due to this – "*45 minutes of cups of tea in the face to face, which is important and vital for that social communication connection, but we obviously don't have the need for that on Zoom...*". Some expressed the importance of the in-person tea breaks in particular, as an important social bonding activity for supporting communication through empathy – "*You're just not together... Sharing food, even just a coffee break, is quite an important social phenomenon and I guess I've learned a lot more about individuals in the coffee breaks [than in the formal parts of the sessions].*"(Ch14).

For the participants with aphasia, turn-taking was seen as a major barrier to informality – noting that any informal conversation between two individuals is heard by the whole group – "*If you wanted an informal chat with one person [gestures by showing one finger] - everyone is listening! [laughs] – If you are in a big group. If you are 'in person' you may say "Did you enjoy such and such?""*" (Ch5). Even when specific time was allocated by the charity for informal chats, it was still viewed as a challenge and something which was not as good online – "*At the same time... Ya can't do face-to-face [if remote]. I like that chat – know what I mean? It's really important to me.*" (M10). This noted, many of the participants still expressed the view that the online sessions were a major 'lifeline' for them – to communicate, and to maintain the friendships they had made at the groups. Privacy challenges related to the fact that it was harder to have an aside with someone if a private discussion was needed, in that it involved setting up a 'formal' meeting in a breakout room, rather than walking up to them. However, it was also noted as a positive, as breakout rooms are completely separate. At the physical charity centre, it may be the case that other people can overhear private conversations.

4.2.4 Environmental Control and Third Parties. Typically, in the charity's centres, the charity staff are able to control and closely monitor the environment in which the sessions are run. Before sessions, staff pay close attention to the way they organise the room – its chairs, tables, dividers and props available – to support communication. However, in the homes of the members with aphasia, this level of control is missing. "*When they come to us face-to-face, we have managed that environment for them [...]. We can't do that on Zoom*" (Ch3). Charity staff noted that they tried to make their home surroundings as supportive as possible to reduce the cognitive burden on communication – e.g. by reducing background clutter, as Ch1 notes: "*I didn't want to have too much behind me [...] I didn't want people to to kind of think "Oh, what's she got on the wall?" [...] it's very much focusing on [points to self]*".

People with aphasia in their interviews often commented on the convenience of being in their own physical space. Some participants, however, missed the 'structure' of being around a physical table – "*I like the structure, as it was... of, people in a room and we're sitting around a table and doing exercises or chatting – I like that better.*" (M5). Participants noted that they missed the ability to just 'walk up' to someone they like and begin a conversation "*Say...Dyscover... me and... <member of staff>... Go away [...] have a little chat. [interviewer confirms – this is more difficult in zoom?] – Yes.*" (M2).

The most challenging aspect of being in the home environment, surfaced by the charity staff, was the *interference of third parties*. In the 'real world' sessions at the centres, family members generally did not attend. However, in the Zoom sessions, as it was in their home, they had no choice but to. This introduced challenges, especially for people with more severe aphasia. While it was a given that some partners must be around to (as Ch6 puts it) "*help them to get on to the Zoom and and press the right buttons*", it was clear that the charity staff found their presence challenging at times. This was mostly due to a lack of independence due to their presence: "*We've encouraged the partner to leave quite explicitly, not because we want to talk about something which we don't want them to hear, but in order to allow the person [with aphasia] to be more independent*" (Ch10). Staff reported that partners often help out of frustration and are therefore talking on their behalf. "*Plenty of them would just do the talking for them. Y'know poor 'Dave' would just sit back and listen to his wife talking [...] Which was completely disabling for them – they didn't have the conversation, the independence*" (Ch12).

Co-located third-parties also introduced privacy concerns in sessions. Several charity staff expressed that they were sometimes unclear whether the partner was in the room or not "*because when you are zoom you have no idea of who is sitting just here [points off camera, to side]...*" (Ch11). Sensitive background noise, when not on mute, was also flagged as a concern: "*there are things going on in the background [...] When the lady was called by her hospital... she came back on and she said, oh I'm sorry I thought I muted myself.*" (Ch1).

4.2.5 Challenges with Videoconferencing and Variation in User Interfaces. In their interviews, members with aphasia generally described their experience with the videoconferencing platform as a learning experience. Perceived competency varied. Several people expressed that their technology competency, or lack thereof, affected their experience of communicating via videoconferencing. Several reported that the features of Zoom were useful, but only when used by others – e.g. annotation "*difficult, but helpful when done by others*" (M1 (in supported conversation)).

The main issue surfaced by the charity staff was that were challenges relating to inconsistent UIs between devices – e.g. the iPad not having the same Gallery view as desktop so that members sometimes faced challenges with seeing who is speaking. They also

mentioned that this was a major issue for the remote debugging of problems on member's devices – "*the functionality is different [...] the annotate function, which is really straightforward on a laptop, but on an iPad it's different, and if you don't have an iPad, you don't know which icon [to tell them] to click on*". (Ch2)

4.3 Perspectives on Communication Benefits when Videoconferencing

This section reports the communication benefits identified in both sets of interviews (i.e. charity staff and members with aphasia).

4.3.1 Enhancing Communication through Props and Physicality. Charity staff noted that the members with aphasia being in their own environment had unexpected benefits. Due to members being in their own homes rather than the charity centre, they were able to more precisely control their *presentation of self* (in the Goffman sense [25]). This was viewed as empowering by the charity staff, as captured by Ch10 (speaking 'as a member with aphasia'): "*I'm not the person with aphasia. I'm actually the person with the garden that looks like this. The kitchen that looks like this...*".

The spaces behind members when on camera – such as pictures or objects – provoked conversations in ways that they could not at a physical centre. The spontaneous grabbing of props in people's homes was seen to be of substantial benefit by many of the charity staff – "*People's homes are rich in resources that they can use to help them communicate. Whereas, previously, I have met 'Raj' in a room at Dyscover, and perhaps I did not know much about him, now I can say "you've got a lovely picture behind you". Or "is that your cat?"*". Use of these props was actively encouraged within the sessions as a result of their success: "*I think that's what's nice about them [members with aphasia] being at home. They've got their hands on things at their fingertips*" (Ch3). Similarly, it was also noted by charity staff that the ability of the members with aphasia to arrange their own spaces for communication was somewhat empowering – "*They [the members] sit at their desks on chairs, with their computers, and they approach it very much like a project that they've been working on [...] there's possibly something around that the environment that they've created.* (Ch7)

The aforementioned *stick props* were promoted by the charity staff as a way of encouraging explicit answers to questions. This was done in lieu of using the reactions inbuilt to Zoom which staff felt would be challenging for some. Initially these were 'Yes' and 'No' sticks, but members with aphasia quickly innovated to encompass other sentiments: "*We've also introduced 'yes or no' sticks in one of the groups that I do [...] Then [members were] scrambling around to create their own 'maybes' as well*" (Ch3).

In the interviews with members with aphasia, they reported that they felt able to use props in Zoom, generally agreeing that it was possible and useful to support their communication by drawing, writing and finding nearby objects. They alluded to the benefits of being in one's own home with personal objects to hand. M11 noted: "*I often show pictures, objects. I don't tend to do writing...*", also describing a benefit of presenting a prop via their camera was that *they* were in control of its presentation – rather than it being 'passed around' during the session - "*that is easier [to show it to the camera] than passing the phone around, because you talk about the picture while you are holding it up for people to see*". Interestingly, members with aphasia also noted that they were able to more easily take advantage of 'off-camera' props – for example, M13, who rested a 'cheat-sheet' with some phrases written by him or a family member on his knee when on Zoom.

4.3.2 Self-Monitoring as an Affordance for Clear Communication. Participants with aphasia noted were generally positive towards using gestures when videoconferencing and felt they were very useful as a means of communication when online. Only four noted gesturing to be more challenging compared to 'in person'.

Members with aphasia noted that one benefit of communicating via videoconferencing was that they could monitor themselves to see how they were communicating – "*you can see yourself, and what you are trying to do*" (M5). M4 noted how gesturing occluded his face when speaking – "*I would be using my hands [puts hands in front of camera while gesturing] – you can't see me speak, can you?*".

The act of self-monitoring was also reported by the charity staff. While some noted that being on Zoom made them self-aware, others saw this as an opportunity to monitor their own communication – to ensure they were communicating as effectively as possible – "*You're much more aware of yourself on zoom because of course you're looking at yourself [...] You are much more aware, so if I'm writing keywords or doing a gesture yeah I would be super aware of that*" (Ch5).

4.3.3 Practicalities and Geography. When describing the positives, charity staff mentioned that they were glad that they had been able to transition their previous physical sessions to an online delivery. Simply put, videoconferencing has allowed people to *remain connected during the pandemic*, as described by Ch12: "*It brought people together. It was continuity. Maintaining friendships and the regular weekly Dyscover slots in people's lives [...] whilst all this crazy pandemic was going on*". It was also mentioned frequently that members with aphasia and the charity staff found the online sessions to be very convenient. Travelling can be tiring, given that some people with aphasia often face struggles with travel due to their language impairment, and other (generally physical) impairments acquired as a result of their stroke. As Ch6 noted: "*people aren't having to schlep across town [...]*". It was also expressed that it was useful to be able to group sessions not by the geography of the charity centres, but the abilities, needs and interests of the participants, as noted by Ch4: "*we've been able to bring together people that have got a lot in common, who would have never been able to meet*".

5 DISCUSSION AND FUTURE DIRECTIONS

5.1 Physicality and Presence as a Communication Strategy

The observational part of this study revealed that props and gestures are important for people with aphasia when videoconferencing, just as they are for in-person communication. In our observations, an interesting range of planned (e.g. the stick props) and impromptu props (e.g. nearby objects) were used. Props were of particular importance for the people with aphasia. Further, being able to present one's self through possessions or accomplishments was empowering and allowed people to present themselves in a new light. This is of particular importance for people with aphasia, who may face challenges in negotiating their post-stroke identity, in the context of their pre-stroke life and accomplishments [61]. While these

communication behaviours were mostly successful, members with aphasia were disproportionately unsuccessful. Issues highlighted in the findings concerned problems with the framing of props and communication challenges due to mirroring and occlusion. These are essentially breakdowns in the understanding of one's presentation on camera, compared to actual physical presence. We found in the interviews that people explicitly monitored themselves for reasons beyond those reported in the literature (e.g. vanity, self consciousness [14, 18]). In this case, it was often to actively monitor one's own communication – ensuring good framing and effective communication.

Future design of videoconferencing platforms should consider how to support these forms of self-monitoring behaviour, which in turn support total communication, more effectively. With this in mind, we should also be wary of the cognitive burden that self-monitoring introduces (as discussed by Bailenson [6]). To improve issues around framing, we might also consider approaches for easily capturing images so that the user may re-refer to them, thus addressing problems that arise from the short duration that the user can hold something up to the camera. We might seek inspiration from mixed-reality contexts for video communication, e.g. the work of Miller et al. [43] who explore semi-transparent overlays on video, or from the domain of telepresence research which considers feedback to the user [52]. For gestural approaches, we might consider how to provide feedback on gestures [39]. For props, we might consider embodying them tangibly in conversation (c.f [30]) or offering multiple views of physical space [24] to present them (e.g. on our desk). Previous work has shown that people with aphasia can be supported in complex interactions through the use of tangibles [48, 51].

Another challenge was *missed communication* – e.g. an unseen raised hand, or a lack of clarity in visual information. This was in part due to too many elements crowding the UI, or the viewing ratio of the video feeds being too small. Many participants in the calls made it challenging to see clearly for effective communication, or be easily noticed when wanting to speak. Bailenson [6] notes how videoconferencing, and the size of the video feeds, violates the norms of interpersonal distance which are typical in face-to-face communication. This means that we can rely less on the communication norms associated with the 'real world'. People with aphasia, who might rely on these norms to fill in the gaps when they experience difficulties in verbal communication or auditory comprehension, are likely disproportionately affected in their communication. Further, this loss of non-verbal communication might result in us expending more energy resulting in Zoom fatigue [6]. Such fatigue likely impacts people with aphasia disproportionately. As noted by Riley [54], 80% of people with aphasia already experience fatigue from communication in therapy sessions when communicating in-person. It is therefore likely that the reduced bandwidth for communication associated with Zoom will have a further impact on people with aphasia's fatigue when communicating.

Future work might investigate equitable ways of prioritising participants in videoconferencing. Current prioritisation methods, such as prioritising the video feed of the speaker, are potentially problematic as they do not prioritise the forms of visual communication used by people with aphasia. They also likely do not effectively recognise speech with aphasic or apraxic qualities effectively. 'Pinning' a video in Zoom can help mitigate these issues for some users but requires a number of steps to complete and this can be challenging for people with aphasia.

Related to this last point, the multi-step interactions associated with many videoconferencing UIs likely make them challenging for people with aphasia (see [28, 55, 56] for similar work on social media platforms). Highly configurable UIs (c.f [67]) are a potential solution, but would likely require support to configure to individual needs.

5.2 Challenges of Turn-Taking and Informality

The results of this study support findings from other studies regarding the specific challenges of turn-taking in videoconferencing and the more stilted conversations that result (c.f. [26, 38, 49]). These "*Delay-Generated Troubles*" [57] likely have a greater impact and repair cost for people with aphasia. It was clear that this substantially affected the members with aphasia's ability to engage informally and emotionally. Although many were able to communicate, they were (as Ch14 put it) "*Just not together*". Informality and emotional engagement – vital to both the members with aphasia and the staff at the charity – was something that videoconferencing failed to replicate.

Reflecting on the *Indiana Jones conversation* from our observations, the power imbalance of three people with varying aphasia, who cut each-other off due to Zoom-related lag and issues with audio processing, required some form of mediation for a successful conversation. While the staff member was successful in supporting this, it was a far less effective and satisfying exchange than it would have been in person, especially for ObsM8 when excitedly announcing his answer. Moreover, skilled conversation mediators – such as those at Dyscover – are uncommon. *Supported conversation* [36], where a third party without a language impairment supports the conversation, requires skill and expertise. However, it was also clear in this study that the turn-based conversation support had been increased to the point where the sessions were viewed as too structured by all parties, leaving less room for flexibility and informality. This, coupled with co-located family members who sometimes guided the conversation, resulted in a decreasing level of independence for those with aphasia.

From a technological infrastructure point of view, the processing of speech by videoconferencing platforms increasingly relies on machine learning models. Many use deep learning to determine when a speaker is speaking, to recognise individual speakers, or to suppress unwanted noise. Unfortunately, the datasets on which these models are trained do not typically include a diverse set of users, so are likely not processing the speech of users who have aphasia or or other speech challenges optimally. Future work in videoconferencing must be more inclusive of those with speech difficulties, extending work such as Theodorou et al. [65], who explore a 'disability-first' dataset for machine learning.

A future direction for research is to design for those who support communication in dealing with the additional challenges that videoconferencing presents. Future directions might consider how feedback might play a role to allow for appropriate reflection in

conversation support (c.f. [21]). Finally, reflected in our data from people with more severe aphasia, we might consider how we can offer more equal ability to *interject in conversations*, or generally shift focus. This might be done by allowing easier access to interface elements (e.g. 'hand up' reactions) by using simple computer vision approaches such as recognising a *Speaking Totem*, or by considering technologies which promote empathy in members who face less challenges (c.f [29]).

5.3 Videoconferencing as a Conversational Window

Finally, while staff members used the features of the Zoom platform, the members with aphasia did so less. They mostly used Zoom as a window into the homes of others. It is likely that this is not reflective of Zoom, but of videoconferencing platforms in general. Knowing the challenges that the members with aphasia were likely to face in using the menus and features of Zoom, the staff members actively encouraged the use of explicit feedback via the 'stick props' – physical proxies for the reaction functionality of Zoom. These challenges support the findings of prior work such as that by [28, 55], who report the issues that people with aphasia have with ambiguous, multi-step user interfaces. There is also an interesting possibility of using stick props that could be recognised by computer vision techniques, offering 'shortcuts' to the functionality of the videoconferencing platform.

5.4 Limitations and Future Work

This study was undertaken with a charity that had 18 months experience of successful online delivery and is explicitly aimed at supporting people with aphasia in communication. Therefore, the findings likely represent an optimistic view of the experience of people with aphasia with videoconferencing as, unfortunately, many others will not benefit from similar expert support and (relatively) high-speed internet. Our findings, therefore, might not be fully generalisable to other settings. The study was also undertaken in a WEIRD (Western, Educated, Industrialised, Rich, and Democratic) context [40]. However, we argue that this is also a strength of our work – that even in these advantageous circumstances, we still surfaced a range of challenges with communication via videoconference. We also note that only one videoconferencing platform was used in the sessions at a fixed point in time – i.e. the Zoom platform as of mid-2021. Future work might extend our observational findings by offering a detailed comparison of videoconferencing versus in-person sessions. Although we were able to draw out some comparisons from the interview data, a more direct and controlled comparison of the two could be undertaken in the future.

6 CONCLUSION

Communication by videoconference has become the norm during the Covid-19 pandemic. It is therefore vital that videoconferencing platforms support communication for everyone, else they risk deepening social inequalities. Prior to this study, little was known about the experience of people with aphasia when communicating via videoconferencing. Our findings in this paper, drawn from three complementary approaches, indicate that while people with aphasia can engage successfully with videoconferencing, challenges remain. In particular, we found that the use of props and gestures was affected by videoconferencing, and that conversations were strongly impacted by the turn-taking nature of videoconferencing – resulting in more structured sessions and reduced informal and emotional contact. Given that people with aphasia have greater reliance on total communication strategies, this likely has a disproportional effect on their communication. We hope our findings inspire designers to consider videoconferencing from a total communication perspective and provide a starting point for inclusive videoconferencing platforms.

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