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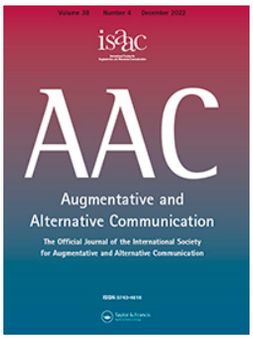

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RESEARCH ARTICLE

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A qualitative study exploring the effect of communicating with partially intelligible speech

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ABSTRACT

Few studies have investigated how individuals with partially intelligible speech choose to communicate, including how, when, and why they might use a speech-generating device (SGD). This study aimed to add to the literature by exploring how this group of individuals use different communication strategies. Qualitative interviews were carried out with 10 participants with partially intelligible speech with the aim of investigating participants' perceptions of modes of communication and communication strategies. Transcripts were analyzed using Framework Analysis to investigate the role of SGDs alongside other communication strategies. Factors that influence why, when, and how a person chooses to communicate were identified and these were interpreted as an explanatory model of communication with partially intelligible speech. Participants described how they made the decision whether to attempt to communicate at all and then which communication method to use. Decision-making was influenced by the importance of the message, how much time is available, past experience, and the communication partner. Each communication attempt adds to an individuals' experience of communicating and influences subsequent decisions. This study suggests that individuals with partially intelligible speech are at risk of reduced communication environments and networks and that current SGDs may not be designed in a way that recognizes their particular needs.

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Augmentative and alternative communication; communication breakdown; Intelligibility; speech-generating device (SGD)

The intelligibility of a speaker can be measured over a scale from unintelligible to intelligible by most native speakers (Enderby, 1980). Intelligibility varies between communication partners, some speakers may be considered fully intelligible to familiar listeners but have limited intelligibility to unfamiliar listeners (Yorkston et al., 1996). Even those who are classified as unintelligible on dysarthria scales may have some speech and speech sounds that are intelligible to familiar communication partners. Bloch and Wilkinson (2011) discuss the distinction between intelligibility and understandability in considering dysarthric speech. In the current study, we took a pragmatic approach and defined partially intelligible speech to be speech that is difficult to understand for most unfamiliar listeners but may be intelligible or partly intelligible to familiar listeners.

The use of speech-generating devices (SGDs) is a recognized form of augmentative and alternative communication (AAC) for people with dysarthria and other conditions resulting in partially intelligible speech. Dysarthric speech can be present for a range of diagnoses both congenital and acquired and across age ranges. Some studies have suggested that many people with partially intelligible speech prefer to speak, even if this is effortful and often fails, as they perceive it as being quicker and more responsive than using a SGD (Murphy, 2004; Palmer et al., 2010). In clinical practice, the use of SGDs as an AAC strategy for this group is generally considered where there are regular communication breakdowns and frustration as a result of reduced intelligibility. Bloch and Wilkinson (2004) found that the participants who used their speech in conversations with familiar partners used SGDs during the conversational breakdown, however, the use of AAC was not always effective in the full repair of the conversation and therefore the use of AAC in these conversations did not necessarily aid understanding.

Other authors have looked at the communication strategies of those with partially intelligible speech. Smith and Connolly (2008) carried out a qualitative interview study with adults with cerebral palsy who used aided communication to look at their experiences of aided communication. Participants in this study described choosing how to communicate as being linked to where they were and who they were speaking with, along with personal preferences and their mood at the time. Paterson and Carpenter (2015) also carried out an interview study and investigated how adults with acquired dysarthria perceived and choose between different methods of communication and identified the

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important role of digital communication methods such as messaging and email. The qualitative metasynthesis undertaken by Ripat et al. (2019) investigated the meaning ascribed to the use of SGDs by those who used them. This analysis identified a theme relating to choosing when to use (or not to use) the SGD, describing this decision as choosing based on the communication partner and the complexity of the communication.

The current study reported was carried out as part of a broader program of research aiming to develop speech recognition technology to create an SGD that uses partially intelligible speech as its input – a Voice Input Voice Output Communication aid (VIVOCA). The aim of this work was to explore if the use of speech as an input could make the use of an SGD quicker and less physically demanding and hence more successful (Hawley et al., 2007, 2013; Parker et al., 2006). Other groups have also investigated the potential for speech recognition of partially intelligible speech (Hird & Hennessey, 2007; Holyfield & Drager, 2022; Hux et al., 2000).

Having considered the previous research rather than focusing on the speech recognition aspect of potential VIVOCA use, the current study aimed to inform the design of the VIVOCA by exploring and situating the wider experiences of those with partially intelligible speech. The study aimed to build on the existing literature and increase the understanding of how people with partially intelligible speech make use of the options they have for communication, including when and how they use SGDs.

Method

Participants

Identification of potential participants was carried out via speech and language therapists and other healthcare professionals specializing in AAC across the UK. These professionals were identified using national contact lists and sending requests via national AAC networks. Potential participants were approached by identifying professionals, asked if they could be contacted about the study, and if they agreed were then sent a letter and information sheet describing the study. Informed consent was then completed with potential participants who expressed interest in taking part in the study.

Participants were recruited purposively to ensure a range of potentially contrasting perspectives. Participant sampling was governed by a sampling frame with two dimensions: SGD use and speech intelligibility. The research team wished to capture the experiences of those who successfully use SGDs and were deemed to be expert SGD users by the identifying professional, as well as those who had decided not to adopt an SGD preferring instead to use other communication strategies. "Expert" was defined, for the purposes of this study, as being able to use a SGD functionally in a range of communication environments and with a high degree of competence as evaluated by the identifying professional. As well as including participants with partially intelligible speech, the study included participants defined as having unintelligible speech by their therapist. This maximum variation sampling aimed to include a range of participants in order to attempt to capture the range of experience and to investigate any variation in the lived experience. This method also recognized the inherent heterogeneity in the population of those using AAC due to the nature of individuals' disabilities and experience.

Participants were recruited, excluding those younger than 12 years of age or where they had a cognitive impairment that limited their ability to give informed consent and/or to actively take part in interviews. Key demographic information including age, previous SGD rejection, and current SGD use were requested from the identifying therapist. In addition, the identifying therapist was asked to classify each potential participant either as having unintelligible speech or partially intelligible speech. Participants were recruited until data saturation was achieved, as described in the analysis section below. Ten participants took part in the study (Table 1) ranging in age from 12 to 46 years. The participant identification numbers are not consecutive because the information was sent to some people who then did not consent to being part of the study. Of these, five participants used a SGD and

Table 1. Participant demographics, including age, condition, and intelligibility as classified by their speech-language therapist; and current SGD use.

Participant	Disability	Age	Intelligibility (as defined at recruitment)	SGD use	Communication method (s) used during interview	Communication partner
1	Cerebral palsy	28	Partial	None	Speech	Family member
2	Cerebral palsy	43	Partial	None	Speech	None
3	Head injury	46	Partial	None	Speech	Family member
4	Cerebral palsy	38	Partial	None	Speech	Family member
12	Cerebral palsy	36	Partial	None	Speech	Family member, Personal support assistant
10	[a]	31	Partial	SL40[b]/Grid2[c]	Speech, SGD	Personal support assistant
6	Cerebral palsy	12	Unintelligible	Vmax[d]	Speech, vocalization, SGD	Family member
8	Cerebral palsy	41	Unintelligible	Vantage[e]	Speech, SGD	Family members
9	Cerebral palsy	29	Unintelligible	Liberator (LLL)[f]	Speech, vocalization, SGD	Family member
11	Cerebral palsy	25	Unintelligible	Tellus[g]	Speech, vocalization, SGD	Family member

SGD: speech-generating device.
[a]This participant did not declare disability, which was not a requirement for the study
[b]SL40 was a product of Abilia, https://www.abilia.com.
[c]Grid2 is a product of Smartbox AT, http://www.thinksmartbox.com, and can be used on Windows based devices.
[d]VMax was a product of TobiiDynavox, https://www.tobiidynavox.com/
[e]Vantage was a product of Liberator, https://www.liberator.co.uk/
[f]Liberator (LLL), LLL is a language package available from Liberator https://www.liberator.co.uk/
[g]Tellus is a product of Techcess, https://www.techcess.co.uk/

five had previously rejected SGDs; six were classified as partially intelligible by the identifying therapist; and four were classified as unintelligible. When interviewing participants, it was found that all participants, even those identified as unintelligible by their therapist, presented as partially intelligible when with familiar listeners.

Setting

Two interviews were carried out with each participant in their own home, each taking around 2 h. These interviews were audio recorded. The first and second authors undertook the interviews. The second interview was performed 2 weeks after the first interview. Carers, personal assistants, or family members (familiar listeners) were present during interviews if requested by participants.

Research design

This was a qualitative study that used semi-structured interviews to gather data to explore how individuals with partially intelligible speech use different communication strategies. Qualitative interviewing with individuals with communication impairments poses particular challenges. It has been demonstrated in some studies that interviews can be an effective way of collecting qualitative data with these participants, while others have highlighted the need for other methods of data collection to be considered (Teachman & Gibson, 2018).

When conducting interviews with people with communication impairments, the process of establishing a point that the speaker wishes to make takes longer; a single sentence or idea may take several minutes to establish. To establish the meaning of a statement the interviewer may have to suggest interpretations of what they have heard and check with the speaker as to whether that was their meaning. This may appear to be in direct contradiction with the principles of qualitative interviews such as open-ended and neutral questioning. Other authors have discussed the challenges of qualitative research and analysis within the field of AAC and with those with partially intelligible speech and also the representation of participants' voice in qualitative research with this group (Teachman & Gibson, 2018). The current study aimed to ensure participants voices were represented by using whatever preferred communication method they chose (e.g., speech, gesture, SGD) and, where needed, by co-constructing utterances between the participant, interviewer, and in some cases a familiar listener, while ensuring a robust process of validating authorship of statements made by participants.

Ethical approval for the study was obtained from the appropriate research ethics committee. The Consolidated Criteria for Reporting Qualitative Research (COREQ) standards have been followed in the reporting of the findings (Tong et al., 2007).

Researchers

The interviewers (the first and second authors) were both AAC practitioners with over 10 years' experience with AAC assessment and provision and communicating with individuals with unintelligible and partially intelligible speech.

Materials

A topic guide (Supplementary Appendix A) for the interviews was developed based on the study aims and covered the participants' perceptions of their communication and their experiences of using SGDs. A communication diary (Supplementary Appendix B) was also developed and used. A handheld recording device was used to record the interviews.

Procedures

Data collection

During the first visit the researcher carried out an initial semi-structured interview with the participant based on selected components from the Social Networks Communication Inventory (Blackstone & Berg, 2004) and the Communication Effectiveness Survey (Donovan et al., 2008). These tools were completed and used as prompts to discuss with participants their communication environments and modes. Participants were then asked to complete the communication diary (Supplementary Appendix B) over the period between the first and second visit.

After approximately 2 weeks, a second semi-structured interview was carried out. The completed communication diary and notes from the previous interview were used as discussion tools during this interview with regard to participants' perceptions of their communication and their use of SGDs; thus, the second interview provided a method of checking the interviewers' and participants' reflections on the first interview (i.e., a participant check) as well as allowing participants to expand upon topics following a period of reflection.

Participants' preferred communication methods were used during the interviews and interviewers ensured that all forms of communication were acknowledged (i.e., they responded to all gestures, utterances, speech, and SGD utterances). The majority of participants ($n = 9$) chose to have a familiar listener present at the interviews, and generally these listeners played a significant role in the interviews by interpreting and supporting the speech of the participants. Particular care was taken to ensure that participants had clear authorship of any statements co-constructed with the familiar listener or interviewer. In the data presented contributions from familiar listeners are quoted often in an interpreting context. The researchers sought direct confirmation from the participant when a familiar listener had interpreted – an example of this process can be seen in Excerpt 1 (Supplemental material). Interviews included open questions but allowed for a process of coming to a shared understanding involving asking closed questions or suggesting possible meanings in order to clarify the participant's response. As appropriate, the interviewers would also look for non-verbal clues such as eye contact, gesture, and body movement to confirm that their

understanding was correct and where possible would restate this for the recording.

Data analysis

Framework analysis (Ritchie & Lewis, 2003) was chosen as the basis for the analysis of the data; the stages of familiarization, coding, framework development and interpretation were carried out as detailed in the section that follows. This approach is suitable for working with specific questions while also allowing for inductive analysis and for themes within the data to emerge that were not anticipated by researchers. The method is also appropriate for use with multi-disciplinary teams and allows for a rich interpretation of the data (Gale et al., 2013).

Themes were drawn from the data over four stages of analysis, with NVIVO[1] software used to manually code the data and to create the theme hierarchy. The analysis steps as described in Gale et al. (2013) were completed. The initial working analytical framework was developed by coding the first three interview transcripts with subsequent interviews being transcribed and coded after each interview. This process continued until data saturation was reached and no new themes emerged from the analysis of new interviews (Ritchie & Lewis, 2003). During these stages the first and second authors coded the data independently and then jointly compared and agreed the coding through discussion to consensus. The PPI representative on the project (TG), who participated in the study, reviewed the framework of themes to provide additional participant checking.

Following the completion of this initial analysis, the research team (all the listed authors, including TG the PPI representative on the project) reviewed the resulting framework of themes and discussed the interpretation of these results (Stage 7 as described by Gale et al). An explanatory model of communication emerged from this review as a richer way of presenting the results. This use of an explanatory model was inspired by the analysis reported by Smith and Murray (2011). Table 2 lists the framework of themes and sub-themes and their contribution to the explanatory model, which is represented in Figure 1.

Reliability measures

The audio recordings were transcribed by the first author team, all of whom had significant experience listening to partially intelligible speech. The second author was consulted when a spoken statement could not be understood and if both did not agree on the transcription then the utterance was marked as unintelligible.

Results

The results of the analysis are presented in line with the emergent explanatory model illustrated in Figure 1. The interviews often included long periods of discussion with continuous confirmation by the interviewer; thus, for ease of reading, quotes have been shortened but still include the conversational turns taken by those involved in the interview in order to demonstrate and make clear, the authorship process.

Shall I communicate?

When faced with an opportunity to communicate, participants described making an explicit decision about whether to communicate. This decision was based on the importance and value of the message, the time available to communicate, who the individual was speaking to, previous experience within that situation, and the personality of the individual.

Shall I communicate: is the message important enough?

Participants found communication effortful regardless of the method and so when deciding whether to communicate, the value and importance of the message was considered and the value of the message may not have outweighed the effort of communicating it. In the following example, the participant expresses when they choose to use their VOCA:

> Interviewer: *So are you using your VOCA to tell them things that you would struggle to tell them otherwise?*
>
> Participant 11: *"Yes"*
>
> I: *And is that why you feel it is particularly valuable?*
>
> P11: *"Yes, Yes"*

Shall I communicate: how much time is available?

The decision as to whether to communicate was also influenced by the time available to deliver the message. In situations where the conversation moved on quickly (e.g., in meetings), participants reported deciding whether to either slow the conversation down or make a point after the conversation had moved on. The inability to spontaneously contribute to the conversation can be frustrating for an individual and may influence whether they then decide to contribute to conversations. The following example, taken from Excerpt 2 (Supplemental material) illustrated this point.

> Interviewer: *H are there frustrating things that people maybe do that make it more difficult?*
>
> Participant 9: *"Yes"*
>
> I: *Have you got any examples*
>
> P9: *"Sometimes they change the subject"*
>
> I: *Before you've got your, what you want to say in?*
>
> FL: *Because the conversation has moved on?*
>
> P9: *"Yes"*

Shall I communicate: who is the communication partner?

When participants were deciding whether or not to communicate their message, the person they were talking to was described as an important factor. When speaking to new communication partners, participants reported that in some cases previous experience was based on a history of

Table 2. Themes and Subthemes Forming Explanatory Model.

Theme	Subtheme	Subtheme notes made by researchers	Explanatory Model
Considerations Around VOCA (Voice Output Communication Aid) Use	Access (to VOCA) considerations	Where physical use of the device (as opposed to usability) is a constraint/consideration	How shall I communicate?
	Negative perceptions of VOCA use	Participants negative perceptions of VOCA use	Shall I communicate: Who is communication partner? Communication loop
	Positive perception of VOCA use	Participants' positive perceptions of VOCA use	Shall I communicate: Who is communication partner? Communication loop
	Practicing VOCA use	Perceptions of the need to practice or learn the device	How shall I communicate?
	Specific strategies of VOCA use	Personal choices/characteristics of VOCA use (that imply successful use)	How shall I communicate: How do I prefer to communicate? Communication loop
	Usability considerations	Considerations/constraints around device usability (i.e., the operation and functions of the device	Shall I communicate: How much time is available?
Conversational Examples	Breakdown and recovery in conversation	Breakdowns in conversation (initiated by speech or other method) and repaired using various methods	Shall I communicate: Who is the communication partner? Communication loop
	Communication partner interventions	Situations where the communication partner has supported the communication	Shall I communicate: Who is the communication partner?
Person	Experience of VOCA use	Past experience of VOCA use	How shall I communicate: How does my personality affect my communication? Communication loop
	Highly motivated to communicate	Participants demonstrating motivation to communicate	Shall I communicate: Is the Message Important Enough? How shall I communicate: How does my personality affect my communication? Communication loop
	Other people's perceptions of individual's communication	Comments on how other people (usually unfamiliar) respond to participants communication	Shall I communicate: Who is the communication partner? How shall I communicate: How does the situation affect my communication? Communication loop
	Supportive Communicative Environment	Where a supportive environment as a reason for success is referenced	How shall I communicate: How does the situation affect my communication? Communication loop
Role and Context of VOCA use	Decision making Around When to NOT use VOCA	Where the participant decides not to use VOCA	How shall I communicate? Communication loop
	Decision making re: when to use VOCA	When the participant decides to use VOCA	How shall I communicate? Communication loop
	Use of VOCA after other methods (backup)	When VOCA is used as "last resort" or after attempts with speech, other methods	How shall I communicate: How important is the message? Communication loop
	Use of VOCA as main or preferred method	Examples where participants use, or prefer to use, their VOCA as their main/predominate method	How shall I communicate: How do I prefer to communicate?
	Use of VOCA in specific environments	Specific environments refers to particular places where the participant communicates	How shall I communicate: How does the situation affect my communication? Communication loop
	Use of VOCA in specific situations	Specific environments refers to particular circumstances where the participant communicates	How shall I communicate: How does the situation affect my communication Communication loop
	Use of VOCA with specific people	Specific environments refers to particular people the participant communicates with	Shall I communicate: Who is communication partner? Communication loop
	Difficulty in introflection around VOCA use	Where participants discuss the difficulty in considering their communication/AAC/VOCA use	Shall I communicate? Communication loop
	Experience of communication breakdown with VOCA	Where participants discuss the effect of communication breakdown	How shall I communicate: How does the situation affect my communication? Communication loop
	Motivated to innovate with VOCA	Where participants demonstrate a desire to improve or innovate their use of their VOCA	How shall I communicate: How am I feeling?

(*continued*)

Table 2. Continued.

Theme	Subtheme	Subtheme notes made by researchers	Explanatory Model
	Potential for VOCA use	Participants perceptions of the potential benefits of using a VOCA - either the one they currently have, or could have	How shall I communicate?
	Rationale and motivation for use of VOCA	Rational for the reason a participant has chosen to use a VOCA	How shall I communicate? Communication loop
	Rationale and motivations for NOT using VOCA	Reasons for not using VOCA in situations/environments or generally	How shall I communicate? Communication loop
Use of Other Communication Methods	Communication partner interpretation	Experience of communication partner interpretation to support communication	Shall I communicate: Who is communication partner?
	Experience of breakdown of spoken communication	Experience of breakdown rather than recognition that breakdown occurs or solutions to breakdown	Shall I communicate?
	Non-aided strategies to support communication	Experience of alternative communication methods such as vocalizations, signs	How shall I communicate?
Rationale for Using Speech	Practice and therapy to improve speech	Identification of wanting to use speech to enable practice of or therapy for speech	How shall I communicate?
	Preference and strong motivation to use speech	Participants reflections on their preferences around speech	How shall I communicate: How do I prefer to communicate?
	Speed	Participants reflections on the speed of communicating with speech	Shall I communicate: How much time is available? How shall I communicate: How long will it take?
	Self-perceptions of speech	Participants reflections on their own speech in the context of communication	How shall I communicate: How do I prefer to communicate? How shall I communicate: How am I feeling?
	Recognition of difficulty with spoken communication	Participants reflections on the challenges with their own speech	Shall I communicate? Communication loop
	Use of other aided communication methods and media	Participants that use alternative aided systems (e.g., alphabet board) and media (e.g., email)	How shall I communicate?

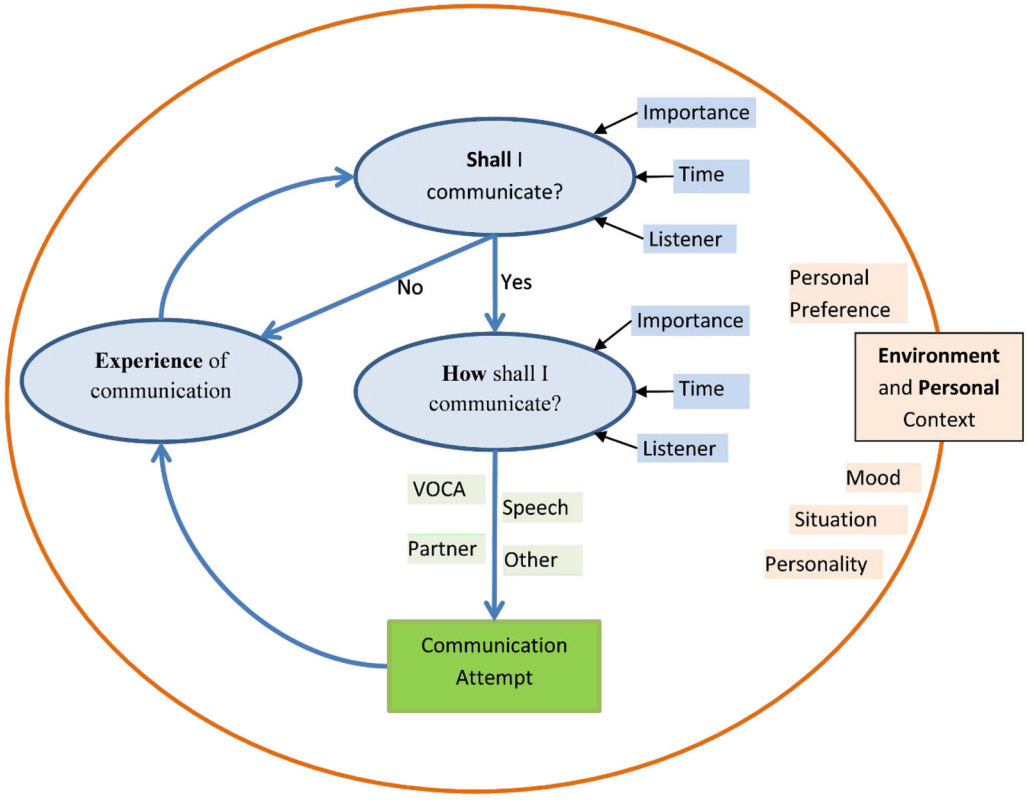

Figure 1. Model of communication with partially intelligible speech.

attempts to communicate with unfamiliar communication partners. If an individual previously had difficulty communicating with an unfamiliar person they may decide not to risk trying to communicate. With a familiar partner, the decision to communicate maybe easier as they may be more likely to know the individual's communication strategies and also may be better at anticipating context, as illustrated in the following quote:

> Interviewer: *Do you think sometimes P12 you limit what you kind of have a conversation about with some people, I know its difficult like you say to generalize about a lot of people, but maybe with people who don't understand as well do you think you*
>
> Participant 12: *(vocalization)*
>
> I: *Reduce down what you say to just the kind of real essentials?*
>
> P12: *Yeah*
>
> I: *So that you just say what you want and maybe what you need?*
>
> P12: *Yeah*

How shall I communicate?

If an individual decides to communicate, participants described making a further explicit decision about what method to use to communicate. This choice was between using speech, unaided or aided AAC, or a combination and was based on the importance of the message; the available time; who they were speaking to; prior experience; personal preference; the environment and situation; and how the person was feeling.

How shall I communicate: how important is the message?

Wanting a listener to receive the exact message suggested a particular method, such as an SGD, whereas wanting to get the message across quickly and with adequate accuracy suggested another method such as speech, an example of which (taken from Excerpt 3, Supplemental material) follows:

> Interviewer: *What about if someone pretends to understand, or seems to understand a bit, do you ever have that as an issue?*
>
> Participant 10:*Well* …
>
> Familiar listener (reading SGD): *So you can either just smile and play along*
>
> FL (reading SGD): *It depends whether you feel sufficiently strong enough to enforce it, if not I might not*
>
> P10: *Yeah.*

How shall I communicate: how long will it take?

Certain situations allowed for the time taken to generate a message using an SGD. Where the situation did not allow for this time (and the individual had chosen not to abandon the communication method), individuals would use speech and accept the potential for communication breakdown or transmission errors, as illustrated in the following quote.

> Familiar listener: *But, you know, you can't just say, stop here a minute, turn right, I mean you are typing it in and it takes a long time and by the time you have actually, they have taken you out of the cab and left you by the side of the road.*
>
> FL (reading SGD of Participant 10): So that's the speed issue, isn't it.

How shall I communicate: who is the communication partner?

As well as influencing whether to communicate, who a person was communicating with also influenced *how* individuals chose to communicate. Participants with speech, independent of their level of expertise or intelligibility, stated that with familiar listeners speech was their preferred method. The quote that follows (taken from Excerpt 4, Supplemental material) illustrates how decisions about communication methods were made with unfamiliar listeners.

> Interviewer: *So, you've got a vocabulary of things that you say. Quite often.*
>
> Participant 10: *Yeah*
>
> I: *So, and when you stray outside them, is that when it gets, or you might start using.*
>
> P10: *Erm, yeah*
>
> Familiar listener: *The prediction dictionary on that is just, a nightmare*
>
> I (reading SGD): *Right, so you've got your "patter" and if you go outside that people just go "huh".*
>
> P10: *Yeah*
>
> I: *So, how do you manage that, that obviously could be frustrating.*
>
> I (reading SGD): *Right, yeah, so that's when you type and make your point.*
>
> P10: *Yeah*

How shall I communicate: how do I prefer to communicate?

How to communicate was influenced by many factors but one was simply an established personal preference. Most participants with partially intelligible speech, even if it was very difficult for unfamiliar partners to understand, had a strong desire to use speech when possible. This personal preference for speech over an SGD or other methods often outweighed other issues such as the effort required, the likelihood of a communication breakdown, or lack of understanding by the partner. This preference was exhibited both in the transcribed data and also in the interviews themselves (i.e., what people said and also the way they said it during the interviews). In all the interviews carried out, participants used their available speech and vocalizations, often in conjunction with translation by the familiar listener, to communicate:

> Interviewer*: You'd rather speak to me with your speech*
>
> Participant 8: *Yeah*
>
> I: *And only use your communication aid if I can't understand*
>
> P8: *Yeah*

Participants had other reasons for when they would choose to use their own speech to communicate. These included using the speech they had in order to maintain their ability, described by participants as "practicing," as illustrated in the following example:

Interviewer: *You do too. So, you like to keep using your speech*

Participant 5*: Yeah*

I: *To practice*

P5: *Yeah*

I: *But you've got a backup so that you're independent.*

P5: *Yeah*

Other participants reported alternative preferences, including using familiar partners to support communication predominately by translating utterances or by asking a series of closed questions.

Interviewer: *And FL is your preference if your mum's here or your dad's here for them to help rather than use your communication aid?*

Participant 8: *Yeah*

I: *Is that cos it's quicker?*

Familiar listener: *Hmm*

P8: *Quicker*

I: *Quicker?*

P8: *Yeah*

How shall I communicate: how does my personality affect my communication?

Personality was a clear factor in how participants behaved in different situations and how they communicated. It was clear that motivation was key in choosing to communicate a message or not and in choosing to persist with a particular message or communication method. One participant described to the interviewer how he felt his determination over many years had led to him being an effective communicator despite the difficulties he faced:

Interviewer: *Why do you think you are as effective as you are at communicating cos you're very good at communicating what do you think makes you so successful?*

Participant 4: *Determination, determination*

I: *Determination*

How shall I communicate: how does the current situation affect my communication?

The situation and/or physical location in which the participant was communicating also influenced the method. In a relaxed familiar environment, one method may be appropriate whereas a less familiar situation could lend itself to a different method. This factor sometimes led to participants restricting the environments they visited or the situations in which they placed themselves. The choice was also reported as being impacted upon by the availability of a method in an environment. If a method of communication was not available in a particular setting or would be inconvenient in a certain setting then that influenced the decision of whether to use it.

Familiar listener: *Sometimes, er, because P9 belongs to a dance company, but then there is no point taking it because she is not going to use it. You know. Obviously, she is still going to need to say things, but then we rely on the board for that.*

Interviewer*: Kind of choosing your method according to the activity?*

FL: *Yeah, is that right P9?*

P9: *Yeah*

How shall I communicate: how am I feeling?

How a person is feeling (their mood or health status) also influenced how participants chose to communicate. Participants reported that factors such as being tired influenced the choice of how to communicate, as illustrated in the following example taken from Excerpt 5 (Supplemental material).

Interviewer: *So how do you choose? We talked through your communication methods last time and you had quite a few, so how do you choose which one?*

Participant 11: ((*vocalizes*))

I: *What does it depend on?*

P11: *"tens"*

P11: *"It does depend on if I am tense."*

I: *Oh, if you are tense, sorry. I didn't get the pronunciation the first time.*

P11: *Yes*

I: *So, if you are more tense, which one do you use?*

P11: *"Board"*

I: *Oh, OK, you use your board if you are tense.*

P11: *Hmm*

The communication loop

Both positive and negative previous experiences were described as influencing the current communication attempt. Communicating with a person or a group that the individual had previously had a successful interaction with was a positive indicator for attempting communication. Prior communication breakdowns with an individual or in a type of situation led to decisions not to communicate. Prior experience of particular communication methods also encouraged or discouraged further use. Each decision may lead to a communication attempt, the outcome of which will feed forward and influence future decisions, therefore creating a communication loop.

Interviewer: *Yeah, why did you hate it?*

Participant 4*: (())*

FL interpreting speech: *People talk to the machine and they don't talk to him.*

If the message hasn't been successfully delivered then the person may again consider whether to communicate, this

time with more experience of the current situation to feed into the decision. If the message was delivered successfully then this again may feed into the next decision about whether to communicate and with which method. In the following example, the participant explains their experiences of saying goodbye, illustrating how the communication loop can work. The participant explains how conscious they are that there may have been a breakdown and how this influences future communication to avoid this situation. See Excerpt 6 (Supplementary material) for the full quote.

Participant 2: *Communication breakdown, communication breakdown*

P2: *Breakdown*

I: *Breaks down. Yeah, it's like a car crash*

P2: *Yeah. You can't remember what happened*

P2: *You are sat there thinking shit did I say bye I meant to say goodbye. Did I say goodbye and you start panicking, did I say goodbye*

P2: *I can't remember, I can't remember if I said goodbye*

P2: *I meant I meant I meant to say I meant to say see you next week shit. So now I make a point I make a point of saying goodbye to people so I know that I've said goodbye*

I: *… So you know that you've said goodbye*

P2: *Yeah*

I: *So you. When it, when communication breaks down… it makes you panic about whether you've said it right, the right thing*

P2: *Yeah, Yeah*

I: *Or people have understood the right thing*

P2: *Yeah, yeah*

Discussion

The aim of this study was to add to the literature by exploring how individuals with partially intelligible speech use different communication strategies. Undertaking this study informed the broader program of work designing the voice input voice output communication aid (VIVOCA) in a way that considered how people with partially intelligible speech currently use SGDs. The findings suggest that individuals with partially intelligible speech consider a range of factors when deciding whether and how to communicate.

The explanatory model that emerged from these findings (Figure 1) highlights how the importance of the message, how much time is available or would be taken, and the communication partner, all influence the decision to attempt to communicate at all and, subsequently, which communication method to use. Situation-specific factors influence this decision, which takes place against a canvas of environmental and personal factors that in turn are influenced by previous experience. Each decision may lead to a communication attempt, the outcome of which will feed forward and influence future decisions, therefore creating a communication loop. Other studies of those with partially intelligible speech have also identified some of these factors (Paterson & Carpenter, 2015; Ripat et al., 2019; Smith & Connolly, 2008) and so the current findings build on this prior work and give confidence in the explanatory model that emerged.

Comparison of explanatory model with other models of communication

This study included participants with speech classified as partially intelligible; however, some aspects of the resultant explanatory model have commonalities with other models of human communication. Barnlund's transactional model of communication suggests that individuals are simultaneously sending and receiving messages (Barnlund, 2017). Barnlund's model refers to a speech act and identifies that the senders' filters may vary based on a variety of things e.g., gender, beliefs, culture and that this may alter how the message is received. In the context of the participants, their filters are additionally influenced by their disability and their communication methods. The explanatory model presented in the current study could be seen as similar to Barnlund's, with the addition of "How shall I communicate" as a transactional element; however, the addition of this aspect appears to radically change the nature of communication for this group and significantly increase the weighting of other aspects of the explanatory model such as time.

In most communication interactions for those with intelligible speech the elements of this explanatory model would be processed implicitly. For those with partially intelligible speech the steps of this explanatory model are often made explicit to the speaker. We can draw comparisons with other situations when this process becomes more conscious, such as speaking a second language. Literature in this area highlights the process of communicating with insufficient access to the communication system being used. Communication strategies in second-language speakers have been studied and theorized in various ways. For example, the psycholinguistic definition proposed by Faerch and Kasper (1984) describes communication strategies as a way of solving linguistic problems where what you currently have available does not fit your needs. Strategies include avoidance (using reduction strategies to avoid communication that may be problematic) and achievement (using alternative words or means to preserve the original goal). These strategies can include both non-cooperative strategies (the speaker using their own resources) and cooperative strategies (a joint effort between speaker and listener). Elements of this theory are reflected in the findings of this study. Participants gave examples of when they might use avoidance strategies depending on the importance of the message or the person they were talking to. Achievement strategies can be seen in the decisions made about what modality of communication to use in different circumstances where participants were effectively using their communication toolbox to maximize their chances of success in any given situation.

The interactional definition of communication strategies puts more emphasis on the role of the listener, describing a mutual attempt at shared meaning (Tarone, 1981). The current study did not look in detail at the strategies of the listener but this is implied in the influence of who when

deciding whether and how to communicate. If the participant was with someone they knew from previous experience had the appropriate skills to be able to understand the message, then the participant was more likely to persist. Tarone describes the strategies used by a second-language speaker thus, conscious communication strategies are "used by an individual to overcome the crisis that occurs when language structures are inadequate to convey the individual's thought." (Yule & Tarone, 1997, p. 19)

The explanatory model presented in the current study suggests that individuals with partially intelligible speech navigate a similar problem space to a second language speaker but use a different set of tools to overcome the challenges. The parallel with second-language speaking is limited, however, as these theories assume a level of competence in the listener (assuming the language being spoken is their first language) whereas a novel listener to a dysarthric speaker may not be equivalently competent. In addition, other factors of time, importance of the message, and listener are likely to have a heavier weighting for people with partially intelligible speech. As well as the practical implications of these factors, the difficulty in communicating can also weight the power balance significantly toward the listener.

Clark (1997) described the conversation as a joint activity that involves achieving common ground through communicative turns and where the message affects the choice of modality but also where the modality affects the message. Clark cited examples such as phone and emails as affecting the number and length of turns. Higginbotham and Caves (2002) applied Clark's model to the use of AAC and proposed that a variation of this model can be used to explain the use of AAC and in common with the explanatory model presented, identify that AAC and SGDs pose their own particular constraints.

Clinical implications

The communication loop described in this explanatory model is significant in its possible implications for the participation of individuals with partially intelligible speech. Experiences of communication interactions that are negative will affect future decisions about communication and this in turn may affect the environments and situations in which an individual chooses to communicate. Those with partially intelligible speech are therefore potentially at risk of reducing their communication environments and social networks and thus may reduce their general participation in society. Participants who did not have an SGD described times when they were outside of their usual situations as being times when they identified a potential need for an SGD, as these were times when their routine strategies failed.

Personal preferences, developed over time, also have potential implications. For example, to communicate via a familiar listener translating speech means that the familiar listener needs to be with the individual if successful communication is to occur; use of speech with unfamiliar partners without supplementary strategies may lead to communication partners disengaging with conversations due to lack of understanding.

Just the very existence of the question "Shall I communicate" in the explanatory model highlights the extra physical, cognitive, and emotional effort that an individual with dysarthric speech must make in order to successfully communicate. It is understandable that this additional load influences choice about communication and environment. Conversely it can be seen that change in any of the elements of the explanatory model could support an individual to expand the environments and situations in which they communicate. For example, the use of an alternative method could support communication in a new environment. Similarly, the provision of therapeutic interventions to provide positive communication experiences may help an individual experience success and feed this forward into future interactions. The potential of providing support or training to potential communication partners could also enable an individual to expand where they go and who they communicate with.

There is substantial evidence to suggest that individuals who rely on AAC experience loneliness and difficulties forging relationships (Balandin et al., 2006; Cooper et al., 2009). A study by Walshe and Miller (2011) concluded that while the impact of dysarthria is highly individual and needs to be seen in the context of other disabilities it has a clear negative impact on the lives of people who experience it, both psychologically and socially. Comrie et al. (2001) found that dysarthria affects the balance of conversational interaction, with dysarthric speakers taking the same amount of turns in a conversation but less major turns, a finding that can be linked to Clark's (1997) work on how modality affects turn taking. This lack of major turns may signify a reduced level of control over the conversation. Trembath et al. (2010) looked at the role of AAC in volunteering for people with communication problems and identified control as a key aspect of moving from a desire to volunteer to actually doing so. Communication ability defined the extent of this control. The findings of this study reinforce the importance of taking control over communication for those with partially intelligible speech on achieving good outcomes (i.e., choosing "yes" when internally deciding, "Shall I communicate").

The consideration of How Shall I Communicate? provides an exploration into the lived experience of multi-modal communication for those with partially intelligible speech. Multimodal communication has long been acknowledged as an important consideration in AAC use. Robinson (2018) suggests that the terminology used to label different AAC methods can inhibit the multi-modal approach, and other authors have used varying methods to explore how those who use AAC use multi-modal communication (e.g., Diehl & Wallace, 2018; Lacono et al., 1993). The explanatory model presented in the current study adds to this work from the perspective of those with partially intelligible speech and suggests the need for further work exploring this topic.

The use of SGDs

Bloch and Wilkinson (2011) advocated including strategies for resolution as part of dysarthria therapy and similarly, this study suggests that SGDs are currently seen as a tool for use

when communication by speech breaks down. These findings also suggest additional specific roles for an SGD including when needing to convey important information or communicating with particular listeners or in specific environments, and this is supported by Ripat et al. (2019).

The pattern of use observed in the study suggests SGDs are predominately used with strangers or in an unfamiliar environment and for communicative tasks to which the individual has ascribed a high level of importance. This pattern of use was evident across the whole sample including with those participants who had been classified as unintelligible and expert SGD users. This pattern of use does not appear to be explicitly reflected in the design or configuration of SGDs. The findings suggest that the role of SGDs needs to evolve from being seen as a speech replacement or prosthesis to being a communication support which actively incorporates person and situation-specific multi-modal communication.

While this study was carried out as part of the work to develop a VIVOCA, the aim was not to explicitly consider the role of voice recognition of dysarthric speech as an AAC strategy. However, these findings support the need to carefully consider how an SGD utilizing voice recognition might support the communication of individuals with partially intelligible speech. For example, situations of high importance where a greater role for SGD use is identified might not fit with the use of potentially erroneous voice recognition. If, however, the technology can support an individual's preference to use their speech and also expand the range of people they might feel able to communicate with, then this may create a positive communication loop experience leading to expanded communication and inclusion. For example, an SGD which provided real-time accurate transcription of key context works spoken by those with partially intelligible speech might allow unfamiliar listeners to better communicate with those whose speech they might otherwise be unable to understand.

The current findings also have implications for setting up and choosing the vocabulary for a SGD. An individual with partially intelligible speech may be able and prefer to communicate much of what they want to say using methods other than an SGD such as speech, translation by familiar listeners, gesture or pointing. Thus, the role of a SGD for those with partially intelligible speech may be to support communication of less predictable, fringe, or context-specific vocabulary. These are vocabulary items that in many current SGDs are less likely to be available or more challenging to access and this is particularly true if a person is not literate. Therefore, for all SGD users, but particularly those considered partially intelligible, consideration of how their existing systems can be set up to better reflect their communication preferences is essential. The findings suggest there is scope for further research into how to develop SGDs that are designed to be better at addressing communication breakdown and supporting multi-modal communication. This research could explore current experiences of how vocabulary and communication systems might best be configured to support in this way or consider further technological solutions for accessing fringe vocabulary whilst reducing the operational demands of AAC use.

The preference for speech

This study adds to the understanding of how those with partially intelligible speech communicate and some of the findings appear potentially contradictory to some of the prevailing assumed models. First, the findings suggest that those with all levels of dysarthria prefer to use their speech first in many situations and may choose to only use speech (with or without partner assistance in translation) whereas, for example, Beukelman et al. (2007, p. 234) state based on clinical experience that "Some individuals with dysarthria due to brainstem impairment or cerebral palsy also express strong preferences to utilize their natural speech when they can." The current study suggests that speech may be the first preference for these individuals in most situations. Indeed, in this study, all but one of the participants defined as partially intelligible by identifying therapists did not use a SGD to communicate and relied on speech and other methods.

Second, the findings suggest that those deemed unintelligible are still likely to use speech to communicate in a range of situations whereas, for example, Beukelman et al. (2007), also state that those with dysarthria as a result of traumatic brain injury and with severe and profound dysarthria "require AAC almost all of the time, and typically use their natural speech only with familiar people during highly predictable communication exchanges" (p. 234). Pennington (2008) states from clinical experience that "AAC may be the only chance to produce expressive language and communicate ideas, feelings and thoughts other than basic requests for objects in their immediate environment and responses to others' questions" (p. 407). These findings suggest that the preference to use speech and other person-based AAC strategies first, or exclusively, extends to even those classified as unintelligible.

Limitations and future directions

This study has limitations necessitating the interpretation of its results with caution. The sample size was relatively small; hence, it might have limited representation of the wider views and experiences of people with partially intelligible speech. Participants were included if they were identified by referring therapists as able to take part in an interview, which will bias the cohort. All of the participants were highly motivated to communicate. Individuals with speech and language disorders can become passive and withdraw from communication and may have a different lived experience; however, these individuals are also the hardest to engage in research.

Another limitation of the approach to recruitment is that all of the participants identified as unintelligible by their therapists were SGD users and all but one defined as partially intelligible did not use a SGD. One of the study findings was that participants had a preference to use their speech and this may explain why we only managed to recruit one

participant classified as an expert SGD user with speech classified as partially intelligible. On interviewing the expert SGD-user participants, it was clear that all participants had some intelligible speech when communicating with familiar partners despite being classified as unintelligible by the identifying therapist. This may highlight associations between perceived unintelligibility and decision-making about the provision of SGDs by AAC professionals, which may be worth further examination.

The choice to collect data using interviews was made with the intention of ensuring that participants were able to express their views as accessibly as possible. The communication diary was used to supplement this process. The diary was not analyzed in its own right as it was a tool. The level of compliance with completing the diary varied and may have influenced the discussion in the second interview to varying degrees. Other data collections, such as asynchronous data collection through web forums or surveys, were considered and discounted but might also have been appropriate. Although the approach to the interviews used with the participants appeared successful, more interactive or supported methods might have elicited richer or more information.

Participants were asked to confirm that the researchers or communication partner had heard an utterance correctly and the researchers respected the method each participant chose to undertake this confirmation. Other potentially more robust methods for establishing confirmation were considered but discounted as the need to maintain naturalistic conversation was prioritized.

Participant checking was included because for each participant, the second interview included reviewing concepts discussed in the first interview; however, a more explicit form of checking of transcripts or interpretation could have been included. Only one of the participants, who was also the PPI representative on the project, was involved with the interpretation of the data.

Two of the authors had considerable experience in the assessment and provision of AAC and working with those with partially intelligible speech and will thus brought this viewpoint into the analysis of the data. To avoid potential bias, the authoring team reviewed the coding, interpretation, analysis and development of the explanatory model with continual reference back to the source data.

Conclusion

This study provides insight into the process of communication for people with partially intelligible speech. An explanatory model of communication with partially intelligible speech emerged from these results and this describes a process of a conscious choice of whether to communicate, what method to communicate with, and the impact of the prior experience of these communication attempts. Data from the analysis highlights the complex range of factors that influence these decisions, including the importance of the message, how much time is available or would be taken, and the communication partner. Situation-specific factors influence the communication decision and the decisions take place against a canvas of environmental and personal factors that are influenced by previous experience. The explanatory model highlights the extra physical, cognitive, and emotional effort that an individual with dysarthric speech must make in order to successfully communicate. This work suggests the need for further validation of the proposed explanatory model and also the development of AAC solutions that are better suited to addressing communication breakdown and providing communication support for those with partially intelligible speech.

Note

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