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What are the factors that may influence the implementation of self-managed computer therapy for people with long term aphasia following stroke? A qualitative study of speech and language therapists' experiences in the Big CACTUS trial

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Abstract

Purpose: To explore speech and language therapists' (SLT) experiences of delivering therapy using a computerised self-management approach within a pragmatic trial, in order to identify and understand key factors that may influence the implementation of computerised approaches to rehabilitation for aphasia in routine practice.

Methods: Qualitative semi-structured telephone interviews were conducted with eleven SLTs delivering computer therapy in the multisite Big CACTUS trial. The interviews were recorded, transcribed verbatim and analysed using thematic analysis in NVivo11.

Results: Five themes with implications for implementation emerged: 1) characteristics of the intervention: complexity and adaptability 2) knowledge and beliefs about the intervention: familiarity with computers and the benefits of training; 3) patient needs and the service resource dilemma: "is there anything I can be doing on my computer at home?"; 4) networks and communications; 5) reflecting and evaluating: adaptations for sustainability.

Conclusions: Personalisation, feedback and volunteer/assistant support were viewed as benefits of this complex intervention. However, the same benefits required resources including therapist time in learning to use software, procuring it, personalising it, working with volunteers/assistants, and building relationships with IT departments which formed barriers to implementation. The discussion highlights the need to consider integration of computer and face-to-face therapy to support implementation and potentially optimise patient outcomes.

Keywords

aphasia; stroke; rehabilitation; computer therapy; self-management; implementation

Implications for rehabilitation

- Benefits of the self-managed computer approach to word finding therapy evaluated in the Big CACTUS trial included the ability to personalise content, to provide feedback, and provide support with volunteers or assistants depending on availability in different clinical contexts to enable repetitive self-managed practice of word finding.
- Whilst use of computer therapy approaches can facilitate self-management of practice and increased therapy hours in an efficient manner, services need to consider the resources required to implement and support the approach: costs of software and hardware SLT time required to learn to use the software, tailor and personalise it and manage volunteers/assistants.
- Readiness for successful adoption of computer approaches requires building of relationships and mutual understanding of requirements between SLT and IT departments within an organisation.
- For time efficiency, it is recommended that SLTs providing self-managed computer therapy approaches pilot the approach with each individual to check patient ability and engagement before fully investing SLT time in personalisation and tailoring of software.

Introduction

Aphasia is an acquired impairment or loss of language as a result of damage to the brain affecting the understanding and expression of spoken language and the ability to read and write to varying degrees [1]. Aphasia affects around a third of all people who experience a first-time stroke [2], and of these, approximately half will have significant long-term impairment of their ability to communicate [3]. Speech and language therapy can continue to produce functional improvements in communication abilities in people with longstanding aphasia (beyond six months) [4]. Optimising intensity, dose and duration of rehabilitation is key to recovery from aphasia [5]. The National Clinical Guideline for Stroke [6,p.25] recommends that patients with stroke should have access to rehabilitation "for as long as they are willing and capable of participating and showing measurable benefit from treatment", and that they should be offered a minimum of 45 minutes of each appropriate therapy, 5 days a week. However, therapy for people with aphasia (PWA) is often restricted to the first few months' post stroke and is not always offered intensively, as a consequence of limited National Health Service (NHS) resources [7,8]. The challenge exists, therefore, to find ways to provide the opportunity to optimise provision of Speech and Language Therapy input for PWA in a cost effective way. Computerised therapy for aphasia is one possible solution that has attracted much interest [7,9]. Computerised therapy enables practice to be self-managed by the PWA at home between or in addition to face-to-face therapy sessions to maximize the therapy input with minimal additional demand on therapist resources. Computer therapy programs for aphasia have been developed to focus on different areas of language impairment, for example, word retrieval, writing and spelling, auditory and reading comprehension, and sentence production. A systematic review of the efficacy of computerised therapy in aphasia found that computer-based speech and language therapy may be as effective as that delivered by a clinician, but concluded that their findings should

be viewed as preliminary due to lack of high-quality evidence [10]. The clinical and cost effectiveness of one approach to using computers to optimise the provision of speech and language therapy has therefore recently been studied in 21 NHS trusts in the Big CACTUS (Cost effectiveness of aphasia Computer Therapy after Stroke) randomised controlled trial [11,12]. This approach is a complex intervention consisting of the following key components:

1. Computer word retrieval exercises in the StepByStep© software (version 5, Steps Consultancy Ltd.).
2. Personalisation of target vocabulary and individual tailoring of the exercises by a qualified speech and language therapist (SLT) following specialist assessment of the language profile of each PWA.
3. Independent practice of the computerised therapy exercises by the PWA recommended to be carried out daily over a six-month period.
4. Volunteer or SLT assistant support to encourage independent practice and facilitate generalisation of the new vocabulary to everyday situations.

The SLT was responsible for assessment and monitoring of the PWA and individually tailoring the computer exercises to the individual therapy requirements using personally important vocabulary. Personalisation was important as the study found that participants improved their retrieval of words that they practised in therapy but there was no generalisation to words that were not treated [12]. The SLT role also involved identifying, training and supporting volunteers or assistants to support self-managed practice, as well as organising provision of the necessary hardware and software for each individual patient. For more detail about the intervention please see the online therapy manual: https://www.sheffield.ac.uk/polopoly_fs/1.525339!/file/TherapyManual_Nov15.pdf

The trial found that the adoption of this asynchronous computerised therapy approach resulted in a mean of 28 hours of independent word finding practice per person, an increase from the mean of 3.8 hours of usual speech and language therapy observed to be offered per person by routine services in the same 6 month period. The computer therapy approach significantly increased the ability to find words of personal relevance irrespective of length of time post stroke. Whilst the computer therapy approach delivered was beneficial for learning new words the study did not show improvements generalised to conversation [12].

Computer therapy approaches, such as the one used in the Big CACTUS trial, can therefore be clinically beneficial for improving naming impairment, however little is understood regarding factors involved in their implementation. It is commonly known that the process of implementation is complex and challenging, resulting in many interventions and technological advances that show promise failing to reach those they were intended to benefit [13,14]. Furthermore, allied health professionals working in stroke rehabilitation acknowledge that the implementation of complex interventions such as digital technologies is difficult [15].

As the Big CACTUS study was a pragmatic randomised controlled trial, the computerised therapy approach was implemented by each NHS trust taking place in the trial, using SLTs, assistants and volunteers who provided routine care, and using existing equipment or existing local procedures for procuring and setting up equipment. This study therefore aimed to explore the factors that may influence implementation of computer therapy approaches for aphasia into NHS services though the views and experiences of SLTs who were involved in implementing the computer therapy approach in their NHS trusts for the Big CACTUS trial.

Methods

A qualitative descriptive approach [16] employing semi-structured interviews and thematic analysis was used for this research exploring the individual accounts of SLTs who implemented the self-managed computer therapy intervention in the Big CACTUS trial. The design was underpinned by a subtle realist stance [17]. Ethical approval was granted from the University of Sheffield (ScHARR) research ethics committee (reference: 009020).

Participants

Participants were SLTs using the computer therapy intervention in the multi-site Big CACTUS trial (ISRCTN: 68798818) [11,12]. SLTs were eligible to participate in the interviews if their NHS Trust was a Big CACTUS trial research site, they had received training on the Big CACTUS approach and had set up and carried out the Big CACTUS intervention with at least one PWA within the 12 months prior to recruitment to this interview study. A total population sample was used with all 21 SLTs invited to participate.

SLTs were approached by the Big CACTUS trial management team, with whom they were already familiar, on behalf of the researcher (JB), via email. This included a letter of introduction and the participant information sheet. The SLTs responded directly to the researcher if they were interested in taking part. A follow-up email was sent after two weeks to those who had not yet responded. The researcher (JB) contacted each of the responding SLTs via email, providing the consent form and demographic information form for them to complete. The SLTs were given time to decide whether to take part and were encouraged to contact the research team by telephone or email, with any queries or concerns before returning the signed consent form prior to the interview taking place.

Data Collection

The semi-structured interviews followed a topic guide (see table 1), which outlined key areas to be explored, ensuring a degree of consistency whilst allowing flexibility and responsiveness. Topic guide development was informed by the domains identified in the Consolidated Framework for Implementation Research (CFIR) to ensure all aspects of intervention implementation were explored at a conceptual level as well as a procedural level [18]. Whilst a variety of implementation frameworks are available, the CFIR was selected because it has previously been applied to the implementation of speech and language therapy interventions [19,20]. Using this determinant framework to underpin the data collection enabled identification and description of the key contextual factors that impacted upon the implementation of this intervention, as recommended by Nilsen [21] and Graham et al. [22]. Topic guide development is illustrated in Appendix 1, where the links between question topics and the domains and constructs of the CFIR can be seen. The topic guide reflects the stages involved in implementing the Big CACTUS approach [11,12].

----------*Table 1 here*----------

External and internal piloting of the topic guide was carried out enabling revisions to be made where any limitations in the interview design were found [23]. For the external pilot, a research SLT working in the central Big CACTUS team, who would not have been eligible to take part in the study but had a good level of knowledge and skill regarding the intervention, was asked to review the topic guide and suggest refinements. For the internal pilot, the first participant to be interviewed was asked for feedback at the end of the interview, and further minor amendments were made following this discussion. The data from this interview was included in the analysis.

A demographic information form collected details about participants': level of experience as an SLT; current role; the setting in which they worked; familiarity with computer aphasia therapy prior to the Big CACTUS trial; and the geographical characteristics of the NHS Trust.

Interview Procedure

The interviews were conducted over the telephone by the first author (JB), who had received training in qualitative interviewing and data analysis as part of a Masters programme, with support regarding design, conduct and analysis provided by co-authors with considerable qualitative research experience (MH and RP). JB is an SLT independent of the Big CACTUS team, whereas RP was the Chief Investigator of the trial and MH was a researcher working on the trial. JB had prior clinical experience of using computer therapy approaches, including the StepByStep software, and had a positive attitude toward the integration of technology for the purpose of self-management, however her clinical experience made her question whether the approach was suitable for all. It was important to acknowledge the interviewer's insider position and existing assumptions in the context of knowledge construction throughout the research process.

The interviews took place at a prearranged, mutually convenient time, to ensure both the researcher and the participant were in a quiet and comfortable environment, where disruptions and distractions could be minimised. Interview length ranged from 30 to 60 minutes. Audio recording was carried out using a digital voice recorder with a telephone pickup microphone. Notes made during the interview were used for feedback at the end of each interview, providing participants with the opportunity for clarification and provision of supplementary information. The participants were assured that the data from the telephone interviews would be anonymised at the point of transcription by the independent researcher

(JB) and would not be shared directly with their trust to allow them to speak openly, thereby enhancing the credibility of the data generated [24].

Data Analysis

The data set was transcribed in full and analysed concurrently with data collection by the first author, with reference to Braun and Clarke's [25] six phase approach to thematic analysis, in order to inductively explore and describe patterns of meaning across the data set. The majority of the coding was completed by the first author (JB), however all authors were involved in the process of interpretation. The first author transcribed the interviews in full to facilitate familiarisation through immersion in the data (phase 1). Initial codes were generated inductively for the first three transcripts (phase 2), which were then categorised into themes and sub themes (phase 3). At this point, the coded transcripts and the initial thematic framework were reviewed by the first author and discussed with authors RP and MH to check that the themes were developing coherently (i.e. logically and consistently) with any disagreements resolved through consensus (phase 4). Concurrent data collection and analysis allowed for additional probing of areas of interest, for example topic areas in which limited depth or conflicting findings were noted in earlier interviews could be focused upon with additional prompts and more time devoted to that topic in later interviews. Notes and memos were used to record the decisions made during the coding process, to promote reflexivity in the analysis and facilitate transparency. In order to manage the quantity of the data, and facilitate indexing and retrieving text, computer assisted qualitative analysis was utilised, and the coded transcripts were imported into NVivo 11 software [26]. Coding of the residual transcripts was carried out in NVivo, with refinement of the thematic frame where new codes became apparent. Next, the data within each theme was reviewed for completeness by checking that the latest coding refinements were not adding anything substantial. This

decision was achieved through group discussion and consensus. At this stage the CFIR [18] was consulted again and several of the themes identified inductively were related to constructs identified within the framework, as such constructs from the CFIR were drawn upon to help to compose meaningful and descriptive theme names (phase 5). The final phase involved writing up the findings (phase 6). Considerations relating to the trustworthiness of the analysis process included: using NVivo 11 to code the data and documenting regular team discussions to ensure the research process was traceable and clearly documented to ensure dependability and the involvement of multiple researchers in the process of analysing, interpreting and writing-up the findings adds to the credibility of the research [24,27,28].

Results

Participants

Telephone interviews were conducted with eleven SLTs who had implemented the computer aphasia therapy approach within the Big CACTUS trial [11,12]. The characteristics of the individual participants are presented in table 2. The role of all participants in the trial was to implement the intervention by arranging software and hardware resources, training and supporting existing assistants or volunteers, assessing the patients and tailoring exercises in the StepByStep software accordingly. Ten of the eleven participants had been working for more than 15 years with PWA. Most of the participants had senior specialist SLT roles (band 7 on the NHS national pay system), with the majority holding largely clinical positions, and three participants employed in a predominantly managerial capacity (all managers were also clinical speech and language therapists). Six participants described themselves as having a level of proficiency in the use of computers in aphasia therapy, with three participants having had only limited experience prior to their involvement in the Big CACTUS trial. The study sample represented diversity in geographical location between rural, urban and mixed rural

and urban locations (as reported by the local SLTs), which was particularly relevant for this community-based intervention where SLTs and volunteers/assistants visited PWA in their own homes.

---------- *Table 2 here* ----------

Findings

The analysis identified five themes that influenced the implementation of self-managed computer therapy for aphasia. Each theme is described in turn below supported by quotations. In addition to the five themes, the barriers and enablers to implementing aphasia computer therapy are also summarised.

Characteristics of the intervention: complexity and adaptability

This first theme introduces the perceptions and experiences of the speech and language therapist participants regarding the different components of the self-managed computerised approach to word finding aphasia therapy. This theme introduces concepts for which implications for implementation are further developed in subsequent themes.

Participants identified that the software used in the Big CACTUS trial (StepByStep) is focussed on impairment-based word finding therapy and although it does not also assist with the delivery of wider quality of life aspects of aphasia therapy (e.g. supported conversation, communication strategies, conversation partner training) it was perceived as a useful part of the therapy toolkit.

Participants valued the functions of the aphasia computer therapy program, including: the ability to personalise the therapy material; tailor the exercises to the individual's impairment; and the software's capacity to provide feedback on success directly to the PWA, all of which

make the software adaptable and responsive to the needs of individual patients. The participants also appreciated the opportunity it provides for intensive self-managed practice.

> I think I like it [StepByStep software] because you can put personal vocab on there, it makes a really big difference to the participant. And I like it that they can get on with it on their own, and effectively deliver their own intensive therapy in an independent way. (R3)

> I think that's what really recommends it [StepByStep software] because people are really going to benefit from getting that feedback and being able to put your own stuff onto it is one of the really standout features. (R6)

Although provision of feedback on whether a PWA retrieved the correct word was recognised as a unique offer from the StepByStep software used in the Big CACTUS trial, all participants discussed the element of complexity this added into the software set up due to difficulties in getting the speech recognition to provide accurate feedback when installed on the wide range of personal and loaned devices used which are not always fit for purpose. The benefits of tailoring and personalising for the patient were also recognised as introducing elements of complexity and added therapist time requirements into the set up of the software for PWA.

Volunteer/assistant support, one component of the complex intervention, was perceived to be particularly valuable to enable the PWA to continue to engage in self-managed therapy, both in terms of encouraging practice and ensuring the PWA was engaging with the therapy. As the Big CACTUS approach used SLT assistants or volunteers to deliver the support, participants described how this component of the approach was adapted to the local context and the support most easily available. SLT participants found the assistant/volunteer support

useful, especially when those individuals were experienced in working with PWA, however the time commitment needed by SLTs in organising and overseeing volunteers/assistants was identified as an additional area of complexity for the delivery of the computer therapy approach, which if not consistent with the expectation therapists have in supporting self-managed computer based therapy, is likely to have implications for the uptake or sustainability of the approach.

> There are quite a lot of implications on the therapist, in terms of communicating with the volunteers, and organising things when their arrangements don't work out or replacing volunteers. It's still time – it's not like you can go away and forget about it" (R7)

Knowledge and beliefs about the intervention: familiarity with computers and the benefits of training

The knowledge and beliefs of all of those involved in delivering and receiving the aphasia computer therapy were perceived to impact upon the implementation of the intervention. SLT participants' knowledge and beliefs about the intervention were highly influenced by their own computer literacy and their beliefs regarding how the PWA's degree of familiarity with computers impacts upon their ability to engage with self-managed computerised therapy. Training provided on use of the StepByStep software was praised for being "practical" and was perceived to have been important to enable implementation of the computer therapy by all participants. Despite the usefulness of training, approximately half of participants identified that they had experienced difficulties getting to grips with setting-up and delivering the computer therapy due to their level of proficiency with technology, e.g. selecting only the exercises that the patient assessment indicated they need, creating new prompts for new vocabulary items. However, although participant R2 described herself as proficient with

current computer software she used in aphasia therapy, she described how it can still be difficult to learn how to use new software applications. This is an important consideration for the implementation of computer- based therapy approaches – an ongoing process of familiarisation with new applications is required.

> Getting familiar with it [StepByStep software] initially was a challenge, because technology for me isn't something that comes easily. (R2)

Common beliefs held by the participant therapists were that patient motivation and prior familiarity with technology were key factors in patient adherence to the computer therapy and resulting success. Similarly, some PWA were perceived to be reluctant to use computer therapy due to lack of belief in their own ability to use technology. This is likely to instinctively be a factor in who SLTs offer computer therapy to if implemented in clinical practice.

> 'I think the person I'm about to give the software to will do quite well. He's [person with aphasia] quite motivated and familiar with technology' R5

However, the experience of implementing the computer therapy within a trial, with prescriptive eligibility criteria and randomisation, challenged participating SLTs beliefs about the need for familiarity with technology for participants to engage well with computer therapy, and that trying different types of hardware (e.g. touch screen or mouse) and introducing the computer therapy at the right time for the patient may be key.

> The one person that didn't want it [computer therapy], got it, but actually her response to it was interesting, because she got it, and was quite reluctant to do it, but she got into it and actually loved it, and her family have since bought her a laptop. R2

> It can be surprising how many people who you wouldn't have thought would manage it [using the computer], can. You can sometimes pigeon hole people and think I don't think you could manage technology, but actually it's not making those assumptions actually , and maybe sometimes it's finding the right way in for that person, and the right time for them. (R6)

> Some people felt a little bit worried never having used a computer, whether they would manage, and it was surprising how people took to it and needed that encouragement, but were quite successful. (R9)

Provision of the encouragement described by R9 was built into the computer therapy approach used in Big CACTUS in the role of SLT assistants or volunteers. Participants perceived this supportive role to be welcomed by the people with aphasia using the computer software to provide human contact and help with the computer practice. Participants also described the importance of the support to ensure the patients practice how the therapist intended. However, some participants believed the volunteers or assistants required a certain level of skill. e.g. understanding of how to use and update the software according to patient need and experience of working with people with aphasia. They raised concerns about whether assistants/volunteers support the patients as the SLT intended. If SLTs are to implement the assistant/volunteer part of the approach that is seen as important for patients, SLTs need to be confident in assistant abilities. The training the SLTs provide to the assistants/volunteers is key to upskilling and hence therapist confidence in skills and is therefore an important consideration in the implementing of the Big CACTUS approach to computer aphasia therapy.

Patient needs and the service resource dilemma: "is there anything I can be doing on my computer at home?"

This theme highlights the expectations of services delivering speech and language therapy in balancing provision of care with resource constraints. It also highlights the expectations some patients have of services to provide computer-based therapy options and the attraction and expectation of service providers that this will enable services to be delivered efficiently. The support patients require from services to enable them to carry out self-managed computerised therapy is discussed and the consequent resource implications of implementing the computer therapy approach used in Big CACTUS.

An expectation (recommendation) to provide 45 minutes of therapy a day was stated by participants. However, constraints were described by several participants in terms of not having sufficient resources to do lots of one to one therapy sessions anymore, or only having short windows of therapy time with patients after their stroke and not being able to give as much therapy as they would like to, e.g. 6 weeks, and once a week for 12 weeks were described.

An efficiency expectation from NHS organisations to focus more on self-management was highlighted, and participants felt self-directed therapy was also a benefit for many patients in terms of having access to some therapy when face to face therapy was limited, having something positive to do in between face to face therapy sessions that focuses on working on aphasia, and in some situations reducing reliance on the therapist. It was also seen as having a place in the long-term management of people with aphasia when other therapy had been completed, recognising the fact that people can continue to improve their language for years.

> It [computer therapy] would fill that awful gap of going from really fairly intensive input, to nothing at all, to a couple of months down the line getting once weekly, it might be a way of bridging that (R7)

> We [local NHS speech and language therapy service] don't have the staffing any more to provide that kind of 1:1 therapy that we used to, so I think… and being independent and people working by themselves is very much part of the push at the moment, that's what we're being told, to do lots of self-management. (R5)

In addition to limited resources and focus on self-management drivers for implementation of self-managed computer therapy approaches, the increasing prevalence of technology use by people of all ages and growing expectations of patients to find something they can do on a computer was seen as an important driver.

> People more and more are using computers aren't they, and people ask "is there anything I can be doing on my computer at home?" (R10)

Therefore, implementation of computer-based approaches may be driven by the need to provide services efficiently, and by patient expectations to receive computer-based activities. However, participant interviews also discussed the fact that this approach isn't right for all patients that services provide aphasia therapy to, in particular those with cognitive difficulties in addition to aphasia were perceived to struggle. Participants discussed how, in the trial, all patients with word finding difficulties were offered the computer therapy, but it was only perceived to be useful/needed by patients for whom word finding was their primary difficulty, and not so useful if the patient had other priorities.

Whilst self-managed home practice does not require the time of a speech and language therapist and is therefore seen as efficient from this perspective, people with aphasia using the Big CACTUS approach to computer therapy have support needs that need to be met by speech and language therapy services and consequently incur other time and resource costs. Many participants required support to use the computer software and whilst informal carers were seen to be of help for many participants, those living on their own required support from assistants or volunteers.

> I did have a couple of patients… who didn't really have family to support them but they managed with it [computer practice], surprisingly well, with a good volunteer doing it. (R1)

As described in theme 1, assistants and volunteers need to be identified, trained and supported by SLTs when implementing the Big CACTUS computer approach. Identifying volunteers was seen as a challenge by some of the participants. Where identification of volunteers was easiest was in departments where they were already part of the SLT team e.g. for conversation partner schemes, or where there was access to student SLTs. One perceived disadvantage of volunteers was that there can be a high turn-over requiring continuous recruitment and training. Turn over was experienced with assistants as well due to sickness, maternity leave etc.

The computer software needs to be set up, tailored to the needs of the person with aphasia and personalised which many participants described as time consuming for the speech and language therapist. The process of personalising the therapy was perceived to be complicated by some participants, however many commented that set up time decreased in line with their experience, and that allowing time for familiarisation was essential in order to use the software effectively.

> The thing that has really opened my eyes during this trial has been how much time it takes to set up for individuals, and if you're wanting it to be self-managed for a reasonably long period, you need to have quite a lot of words in there. (R7)

Participants also felt some patients needed regular reviews and SLT support often involving significant travel time and related costs.

Services within the NHS are free at the point of access and consistent with this is the provision of the specialist aphasia software and hardware to people with aphasia. Some participants perceived the cost of software licenses to be an issue for implementation of a computer therapy approach, whereas others thought that increasing use of technology was on the organisation's agenda and therefore investment in software may not be difficult.

> Personally, myself as a manager, I think it's [computer software] costly, as an investment, in the licenses, for a small department like us (R7)

> They're [local NHS trust] keen to move the department forward technologically, I don't think we're most technical of departments [speech and language therapy department], and you know they see a place for it [use of computers for self-managed therapy] but you know I think they'd be supportive if you decided to go that route…I mean if we've got money in the budget and we can prove that it's useful, you think that it works then we'll get it. (R8)

Experiences of hardware availability were mixed in the trial. It was identified that technology in patient's own homes is now relatively common and most people have a device of some description. However, the participants found that many patients do not own devices that can run the specific software they require or live in rural areas where poor internet connection limits use of technology for therapy. As therapists working for the NHS, some participants

highlighted discomfort in their routine practice when not being able to provide the technology for their patients.

> We haven't got iPads to loan out, so we're just in the process of showing people what's on the iPad and then taking it away, which to me seems a bit bonkers. I feel unhappy just saying well this is what's out there, if you've got however much money it is… (R8)

Funding of devices to loan to patients was seen as a barrier to being able to offer self-managed computer aphasia therapy. Participants described a reluctance of Central Commissioning Groups (CCGs) to provide monies to purchase lap-tops or iPads for patient use, and many participants described using existing, old equipment that was repurposed for loaning to patients, or applying for charitable funding to purchase new equipment. Sourcing equipment for loan was not straightforward and required time and creative thinking on the part of the therapists. Infrastructure to support provision of equipment once purchased is discussed in the next theme 'networks and communications'.

This theme recognised both patient need and service resource drivers for self-managed computerised aphasia therapy, at the same time recognising many less well acknowledged resource costs to providing and supporting a computerised approach to service delivery.

Networks and communications

The previous theme identified securing costs for hardware and software as a resource issue for implementing self-managed computerised aphasia therapy. This theme describes how relationships between speech and language therapy providers of computerised aphasia therapy and IT departments are intrinsic to implementing this approach. Participants described IT departments' role in procuring hardware and software, loaning equipment and

making it accessible for use by people with aphasia during the Big CACTUS trial. Some participants described that this could take them many months. When equipment arrived, difficulties were reported around IT departments not being happy about loaning the equipment out to patients in their own homes, 'locking it down' so that installation of the software was sometimes compromised and requiring standard password protection that can be difficult for people with aphasia to use to gain access to the computer therapy exercises. In addition, establishing communication with IT departments could be difficult and required persistence from therapists.

> Quite mortifying after 12 months to hear from IT that they were still checking up which laptops they wanted to buy. (R6)

> Ours had to be funded through the IT finance department and it seems to be the IT department that were blocking it, they were effectively not wanting to hand over any of the equipment. (R4)

> They wouldn't let them have them password free, so they had a simple password but still a stumbling block for someone who's aphasic and they had to be made so they couldn't be connected to the internet at all. (R7)

It was acknowledged amongst participants that IT departments did not usually have a clear understanding of the context of using technology to provide speech and language therapy services to people with communication difficulties and that the frustrations described above could be reduced by building a joint understanding of the purpose and forging new working relationships, a factor to be considered for smooth implementation of computerised therapy in the future.

> They [IT department] don't really understand what speech therapy does and why we might need a laptop that's not encrypted, or the particular tight security, so I think there's work for our department to do with our IT department to find someone who understands what we want to do with patients. (R10)

> I've got the name of someone in IT now who has been involved with all these glitches, so now I've got his direct number, and I can ring him and he'll pretty much come out the next day, so that helps, to have a named contact. (R2)

Reflecting and evaluating: adaptations for sustainability

Previous themes have described the experiences of SLT participants who implemented self-managed computer aphasia therapy at their NHS trust for the purposes of the Big CACTUS trial. This theme focusses on the reflections of the participants on if and how the computerised approach to delivering word finding therapy for aphasia used in Big CACTUS could be continued/implemented in routine practice beyond the trial.

All participants perceived that the approach could be adapted to fit their local context outside of the trial. Many described plans to continue offering the computerised approach to aphasia therapy in their NHS trusts after the end of the Big CACTUS trial.

> We've recently appointed a new assistant so that [computer therapy] will definitely be something that she'll carry on with. It's [computer therapy] part of our model of service delivery, and we will carry on with it. (R2)

> I would say, yes, trying to roll it [computer therapy approach] out, and I've got some funds that I'll look at buying a tablet and a clinician's license, and that's set aside so we'll certainly have something with the latest version of the software on and we will

> definitely be looking at continuing with it, we are trying to use assistants more, to do more hands off therapy (R6)

Investment of time in upskilling therapists, whole therapy teams and assistants was identified by several participants as necessary for sustainable implementation of a computerised therapy approach.

> I think it's really just allowing yourself time, or being allowed, having time to become familiar with the software and knowing how it works really. I think you need to do that to be able to set up the exercises appropriately for your clients and I think it's like anything, you need to be doing it quite a lot, if you're going to maintain your competency and your knowledge really. Just acknowledge that it can be time consuming initially, but once it's set up, it's worth investing the time really if you can, and once you get going, it can be very valuable (R10)

> What I'd like to do actually is do a little training session with the rest of the SLTs in XX (other trust) to maximise the chances of them using it (R3)

A previous theme discussed difficulties with networks and communications as a barrier to implementing computer therapy and recognised the need to build relationships with IT departments. In order to implement the approach in routine clinical practice, one participant advised:

> don't give up, if you're having issues with IT [department] and those kind of issues, I think people can…. just think oh, it's too much trouble, when you're pushed for time. But I just think it's worth maybe meeting with your IT department, telling them about what you want to do, erm, and getting them on board so that they can support you, you're not just trying to do it on your own (R10)

Several participants described possible solutions to the concerns regarding the cost of funding computerised resources within their local services to enable the intervention to be available sustainably. Participants reported they would make use of the free trial period offered by some software developers, encouraging self-funding by the PWA after this time, or exploring charitable funding. One participant described an initiative within their National Health Service (NHS) Trust to facilitate provision of self-managed computer therapy.

> You can order a laptop on a named basis, so it'll be like a rolling stock of laptops and iPads, so that person will use it for as long as they need it and then it'll come back to the stock in our department for loaning out again. (R2)

Participants recognised that using computer programmes to provide opportunities for self-managed practice requires ongoing support from therapists and should not be seen as a way of reducing existing therapist input. The Big CACTUS protocol recommended set up of 100 words for practice and therapists could do this all at the beginning or over several sessions. As one of the main adaptations for sustainable implementation in routine clinical practice, participants reflected that they would wish to introduce the computer therapy over a longer period of time to patients with aphasia to provide more general support.

> I think all of them would have benefitted from more regular reviews, particularly to start with, as some of them do have cognitive issues, and the older ones aren't so confident on a computer, although if you know computers, the programme is quite simple (R11)

The majority of participants thought that through more regular visits, in practice they would set up a smaller number of words at a time rather than setting 100 up at once in order to avoid large time commitments at the start of therapy, and to see if the approach suits the individual

before investing more time in set up. Participants also described the need to be flexible with the number of words worked on according to patient need with some requiring smaller numbers of words, and others, particularly those who are more mild requiring larger numbers of words to practice.

> I would feel my way with it, check that they are practising, check that they are able to manage the software and the computer before I set up a lot of exercises or put a lot of personalised vocabulary into it because, we all know that the personalised vocabulary, you get better compliance, there's good evidence for using personalised vocabulary but that's the most time consuming bit of setting up the software. I think that the people who are going to benefit from it, do really benefit from it, if they take to it and practise it. But the thing that I have learnt … I haven't found it easy to predict those that won't get on with it, or will, you know I have been surprised both ways, you know, so that again would lead me to starting small before I attempted anything big (R7)

It was also suggested that if implemented in clinical practice, more of the personalisation could be carried out by a lower grade (junior) SLT or SLT assistant to maintain the benefits of the intervention without being too costly.

Context was also acknowledged to influence adaptations to the approach trialled in Big CACTUS for clinical practice. Firstly, participants reported they would investigate having a range of software and apps, devices and platforms available to manage the different language rehabilitation requirements and usability needs of different PWA. Although the approach used in Big CACTUS was intended to provide ongoing therapy opportunities for people with chronic aphasia, participants described a range of locations (physical contexts) along the stroke pathway, in acute-phase care, rehabilitation and longer-term management, where self-

managed computerised aphasia therapy could be implemented and identified it as being useful to bridge a gap between different parts of speech and language therapy services.

> There are possibilities around some of our stroke patients on the wards as well, like on our rehab ward, if there's something that people could be working away on by themselves because we can't give the level of rehab that we feel people need, because we just don't have the staffing level that we used to have, so it's something that could be used in the hospital setting as well. (R5)

Summary of the barriers and enablers

Throughout the analysis process and discussion of themes, barriers and enablers to the implementation of aphasia computer therapy from the perspective of SLT participants delivering the intervention as part of a pragmatic trial and beyond in routine clinical practice were identified. Table 3 provides a summary of factors to take into account for those considering implementing the intervention in the future.

----------*Table 3 here*----------

Discussion

This study aimed to investigate factors that may influence implementation of a self-managed computerised approach to providing word finding therapy for people with long term aphasia following stroke including assessment and tailoring of software by a qualified SLT and support from a volunteer or paid therapy assistant. Eleven SLTs from across the UK, who had been responsible for implementing this approach in their local NHS setting as part of the Big CACTUS trial [11,12], were interviewed to explore their experiences. It is important to note that, at the time of interviews, the results of the Big CACTUS trial were not yet known and therefore not discussed by participants. However, findings from the interviews will now be discussed in the context of the trial results. From the interview data, five themes were generated inductively using thematic analysis and named to reflect how they related to the CFIR [18]: 1) characteristics of the intervention: complexity and adaptability; 2) knowledge and beliefs about the intervention: familiarity with computers and the benefits of training; 3) patient needs and the service resource dilemma: "is there anything I can be doing on my computer at home?"; 4) networks and communications; 5) reflecting and evaluating: adaptations for sustainability.

The CFIR [18] was a valuable and comprehensive framework to guide data collection and interpretation of findings. It was selected as the sensitising framework for this study as it has previously been applied to the implementation of speech and language therapy interventions [19,20]. The themes identified were related to constructs within the five domains of the CFIR (domains and constructs are presented in italics in order to identify which concepts from the implementation literature were relevant to the implementation of this approach). In the *characteristics of the intervention* domain *cost* and *complexity* were barriers to implementation, whereas the *adaptability* of the intervention to individual patient needs

(through personalisation and tailoring) and across different contexts (volunteer vs assistant) was perceived to promote implementation. *Networks and communications*, particularly relating to interactions with IT departments and a lack of joint understanding of the purpose of providing technology for supporting self-managed computerised speech and language therapy, was found to be a barrier in the *inner setting* domain, with strategies suggested for overcoming these barriers including building relationships between SLT and IT departments. The CFIR's limited reference to patients as a stakeholder in the framework and the placement of *patient needs and resources* in the outer setting domain felt incongruous when evaluating implementation of this approach to SLT given patients' central role in the self-managed intervention. *Patient needs and* service needs and *resources* were intentionally conflated with *cost* in one theme due to the interconnectedness of these constructs for this approach. The primary *characteristics of individuals* that impacted upon the implementation of aphasia computer therapy was the *knowledge and beliefs* of all of the stakeholders. Training enabled implementation, whereas there were mixed views on the impact of prior IT knowledge on implementation particularly in relation to how this affected an individual's belief in their own ability to use the computer therapy (*self-efficacy*) or the SLTs ability to set it up. Given the timing of the interviews coincided with the majority of therapists having delivered the intervention as part of the Big CACTUS trial and considering how the intervention could be implemented in routine clinical practice, the fact that therapists focused on the *reflecting and evaluating* construct within the *implementation process* domain was unsurprising. The authors recommend other researchers consider using the CFIR to guide future implementation research in the field of rehabilitation.

Participants felt the aphasia computer therapy approach could be a useful part of the speech and language therapy offer to PWA for whom word finding was a priority if barriers related to the amount of therapist time to set up the software, time to engage/support volunteers and

assistants, procurement and loaning of devices and software could be addressed. Perceived benefits of the approach were its adaptability to individual patient's needs (could be personalised and tailored), provision of feedback (when this worked), and the opportunity for self-managed practice across a range of NHS settings and stages during patients' care in the acute, subacute and chronic phases post stroke. Participants described the benefits of this approach to address limited SLT resources, as described by Code and Petheram [7], by increasing therapy input, and bridging the gaps in therapy provision for some PWA. Participants indicated that they would consider continuing to use aspects of the approach in their area, and described adaptations they would make following their experience of implementation to try and address barriers to implementation that they faced during the trial.

As described in the characteristics of the intervention: complexity and adaptability theme, participants particularly valued the ability to personalise therapy software. This was reinforced by Palmer et al. [29] through interviews with patients using this approach, which found use of personalised materials was a key factor in motivation to practise. Naming typically only improves on items not treated in therapy in around one quarter of patients [30], which therefore also supports the need for practice items to be of functional and personal relevance [31]. Indeed, the final results of the Big CACTUS trial (improved word finding for treated items only), published following completion of this qualitative study, further confirms this point [12]. However, in the current study, participants also expressed concern over the length of time required to set up personalised vocabulary, feeling that they would not have the necessary time in routine clinical practice. In addition, the 'knowledge and beliefs' theme highlighted that it is not entirely predictable who is likely to engage in self-managed word finding therapy. From their experience, SLTs had ideas about who would be able to engage effectively with self-managed computer therapy, but found that they were not always correct in their assumptions regarding patients' needs. Park et al. [32] report that psychological

characteristics, such as self-efficacy, were better predictors of acceptance of computer technology than demographic factors such as age. In order for computer therapy to be an efficient solution to the problem of providing increased amounts of therapy practice, there needs to be a balance between the amount of support provided and the amount of self-management that is facilitated. To increase efficiency, and in view of the fact that it is difficult to predict which patients will engage with ongoing self-managed computer therapy, participants proposed setting a patient up with fewer vocabulary items to begin with, thus not investing large amounts of time until it is known that the approach will be particularly useful to an individual. To support therapists to explore self-managed computer therapy practice with a patient before investing time in personalisation, Steps Consulting have introduced a 'useful words' set into version 5 of the StepByStep software based on the words most frequently chosen by PWA as personally relevant [33].

It is an important consideration that provision of computer software alone does not constitute an intervention in its own right. Given that an organisational driver for the use of self-managed computer therapy is efficiency an expectation of service providers may be that it can be 'set up and left'. As with any self-management approach, a successful intervention depends upon support which is thorough and is adapted to the individual [34]. A key feature of the approach was felt to be the support provided to PWA by assistants/volunteers, with therapists experiencing and perceiving use of paid assistants as more favourable to volunteers in terms of retention and turnover. High turnover of volunteers is a well-recognised issue [35]. An increase in the support provided by assistants/volunteers was advocated, in addition to a higher amount of face-to-face contact by the SLT within the approach. This is interesting in light of the suggestion that the time involved in set up and personalisation of computer therapy and supporting volunteers/assistants exceeded SLT expectations, and would seem to be in opposition with the desire to find ways to reduce the SLT time required

to support the approach. On the one hand there is a perception that introducing technology for self-managed therapy should be efficient and not require too much therapist time. On the other hand, SLTs describe benefits of personalisation (which requires their time) and they appear to want to invest time in supporting their patients as much as possible with computer therapy. This may reflect tension around therapists' views of their role and how they spend their clinical time. It may be that providing face to face support for therapy and computer use is viewed as being more valuable than the non-patient contact time required to set up personalised software content and manage volunteers to support self-managed practice. This dilemma is likely to represent an issue for adoption of such supported, self-managed computerised approaches to speech and language therapy, as it suggests that further consideration of how it fits with therapists' values and the range of services offered to people with aphasia is required for sustainable implementation. It is pertinent to reflect further on the findings of the Big CACTUS trial at this point: As stated in the introduction, the trial found that, at group level, there was a significant improvement in the ability to name words practised in therapy, but there was no evidence that this impairment based improvement generalised to functional use of the words in conversation [12]. An average of 9 hours SLT time to set up and support the intervention enabled an average of 28 hours of independent practice (range 0-105 hours, inter-quartile range 15-50 hours) to help achieve the impairment-based word finding gain [12,36]. Part of the intended role of volunteers/assistants in Big CACTUS was to assist with generalisation of new words to conversation (see point 4 in the description of the approach). However, trial fidelity results show that very limited focus was placed on this aspect of the role with an average of only 45 minutes in a six-month period dedicated to generalisation activities [12,36]. The authors propose that the self-managed computerised therapy could be used to enable repetitive practice to achieve impairment-based gains, whilst face-to-face therapy skill focuses on provision of a 'transfer package' to

promote functional use of the new words, thus integrating computer therapy to increase hours of repetitive practice and valued face-to-face therapy time and skill to build on, and make the impairment based gains functionally worthwhile.

The patient needs and service resource dilemma theme highlighted the fact that self-managed computer therapy is promoted to achieve greater amounts of therapy provision where resources are limited, yet this may be a paradox as investment of resources in terms of devices and use of SLT time is required for the computer therapy approach. The health economic evaluation conducted alongside the Big CACTUS trial suggested that despite the need for investment in these resources, the self-managed computerised word finding therapy evaluated represented a low-cost approach at £733 per patient [36,37]. The health economic evaluation identified that if the same amount of therapy was provided face to face by a mid-grade SLT, this would have cost £1400 (NB it is not known whether face-to-face and computer approaches would achieve the same result). The cost effectiveness (cost vs quality of life improvement ratio) itself remained uncertain due to very small and variable changes in quality of life. However, it was concluded that the approach was more likely to be cost effective for people with mild and moderate word-finding difficulties than for the whole group. The health economists identified a need to explore ways of promoting generalisation of the impairment-based word finding gains in order to increase the chances of quality of life improvements and thus increase cost effectiveness [37]. This chimes with the requirement to consider how self-managed computer-based approaches are integrated into SLT provision as discussed above.

Cost of therapy software was a common concern, and therapists focused on external sources of funding, including charitable or self-funding, and making use of free trials available from software developers. The implication here seems to be that technology is not perceived by

SLTs as an intervention to be funded in the same way as face-to-face interventions provided by SLTs, once again highlighting the lack of integration of computer-based approaches into the SLT package of care for aphasia. If technology can provide a way of enabling patients to receive therapeutic doses of impairment based interventions at a lower cost than if provided face-to-face, it should be considered a resource to be funded from the same financial envelope as therapy personnel. It is possible that therapists may see investment in technology from within the same financial envelope as a threat to the funding of their roles. However, consideration of which resources fulfil which important part of the SLT package of aphasia care most effectively and efficiently, and allocating one funding source accordingly may assist with ensuring computer based therapy and face-to-face therapy is integrated, potentially promoting optimal outcomes for patients.

The networks and communications theme highlighted an additional important barrier to implementation of computer-based therapy approaches. Almost all the participants found that IT departmental processes caused difficulties and delays in obtaining the computer equipment needed to for the computerised aphasia therapy. SLTs had problems in negotiating which equipment was purchased, and in enabling it to be loaned to PWA. The NHS is experiencing increasing challenges to data security, with lost or compromised data and cancelled appointments and operations a very real consequence [38], so it is understandable that provision of technology for therapy needs to be balanced with controlling and maintaining security integrity [39]. An additional consideration in loaning equipment will be infection control policies, an essential consideration particularly in light of the COVID-19 pandemic. Loaning/use of a range of devices that were not fit for purpose led to poor functioning of the speech recognition software with consequences for the accuracy of feedback received (now addressed by Steps Consulting Ltd by providing software on the appropriate device as one package). Participants identified a need to build networks and relationships with IT

departments to promote a shared understanding of SLTs requirements. In order to build these relationships and ensure that services are ready to support technology for self-management purposes it would also be important for SLTs and other health professionals wishing to use technology for therapy purposes to understand the challenges and the context within which IT departments work.

Study limitations

The data was collected, transcribed and coded solely by the first author (JB), which represents a weakness of this study. Whilst all three authors were involved in the interpretive analysis process and writing of the paper, it would have been preferable to have an independent person to check the interpretive process to increase transparency. Although the sample constitutes more than half of the total population of SLTs implementing the intervention in the Big CACTUS trial, it is a small sample, which may not be wholly representative, since the participants may differ in some way from those who were not involved, and SLTs taking part in the Big CACTUS trial represented a particular subset of those providing routine care. However, all of the SLT participants worked at different NHS Trusts across the UK meaning consideration of implementation in a wide variety of contexts was included, thereby potentially increasing the transferability of the findings [24]. The trial required SLTs to have experience of working with stroke survivors and opportunities for involvement in research within NHS organisations are often given to more senior/specialist staff rather than junior staff. Consequently, the interviewees represented the views of more senior staff giving the data a bias towards their experiences. This subset of SLTs are more likely to have views on implementation issues as procurement and service set up than junior SLTs, but it is also possible that junior SLTs, being younger on the whole, may be more confident with using technology for therapy potentially influencing perceptions of ease of use

and how long it takes to set up. Given the participants chose to deliver the intervention in their NHS trusts within the trial, they may represent the SLTs with stronger views regarding the intervention, since the participants were largely supportive of, and keen to be involved in the clinical trial, viewing the approach to intervention positively. Although the study sample represents a subset of people, working in different contexts and settings across the UK, who have all had different experiences, the authors believe that the findings provide useful insights into what might be experienced in implementation of a similar intervention within routine NHS services outside of a clinical trial.

Conclusions and clinical implications

This study suggests that drivers for implementation of self-managed computerised approaches to speech and language therapy include therapy resource limitations, an organisational interest in self-management, and requests from some patients. Benefits and therefore facilitators to the implementation of the approach evaluated in the Big CACTUS trial were perceived to be the adaptability of the intervention in terms of the ability to personalise content, to provide feedback, and provide support with volunteers or assistants depending on availability in different clinical contexts to enable repetitive self-managed practice of word finding. However, whilst limited resources partly drives the demand for implementing the approach, the 'patient needs and service resource dilemma' theme identified a paradox in that the resources required due to the adaptability of this complex intervention (facilitators) are not insignificant and represent barriers to implementation: time for SLTs to learn to use the technology and ongoing familiarisation; time involved in individualised software set up and personalisation; time to establish procurement and provision of technology; time for ongoing programmes of identifying, training and supporting volunteers and assistants; costs of software and hardware. Furthermore, the study identified

the need to focus on building relationships between SLT and IT departments to form a joint understanding of service and patient needs. This may be a factor in the readiness of services to deliver self-managed computer therapy approaches, and in the case of the software used in Big CACTUS, ensure appropriate hardware is provided to support accurate provision of feedback (one of the perceived benefits). Considerations and adaptations to the approach to facilitate implementation were described by participants including acknowledging and investing time to become familiar with software (managing expectations) and building relationships with IT departments; proposed models for loaning equipment; use of a stepped approach to set up, setting up a few items to start with and then investing time once evident that the approach is suitable for the individual patient; use of SLT assistants to help with personalisation of therapy content; and broadening the range of software/apps used and the clinical contexts the approach is used within. The discussion proposed potential implications of SLT values for the implementation of computer based self-management approaches and the need to consider how to integrate this approach with SLT skill in face-to-face provision so they complement one another for optimal patient outcomes. The authors proposed use of therapist skill to focus on generalisation of learned words to conversation, to potentially make a greater contribution to quality of life and thus the cost effectiveness of the therapy. The insights provided in this paper are from therapists delivering the intervention within the context of a pragmatic clinical trial. Further research should focus on the implementation of the approach and identify successful implementation strategies within routine practice in different contexts.

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Declaration of Interest Statement

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Appendix

Procedural stage	**Question topic/area**	**Prompts**	**Conceptual Level** **(CFIR: Damschroder et al 2009)**
Setting up the intervention	Describe how came to be involved in the Big CACTUS study	• How area came to be a site • How came to be SLT for the study • (Initiated or tasked with it)	Intervention Characteristics • Intervention Source
	Describe any challenges encountered in setting up the site ready to implement the approach	• Eg: resources – funding, time, equipment, technology, IT support… • How found ways around the challenges • What helped • What hindered • Anything else that would have been useful to have received	Inner setting • Readiness for implementation: available resources • Structural characteristics
	Describe the support received from managers/leaders with set up of the site	• SLT and wider leadership/management • Examples of what SLT participants have seen/heard from leaders • What level of involvement of leaders/managers • Were any barriers created by managers	Inner setting • Structural characteristics
Carrying out the intervention	Describe views on this approach to intervention for PWA	• How effective is the approach in their setting • Views on evidence base for this approach	Characteristics of Individuals • Knowledge and Beliefs about the intervention Intervention Characteristics • Evidence strength and quality

Procedural stage	Question topic/area	Prompts	Conceptual Level (CFIR: Damschroder et al 2009)
	Describe how approach is viewed by managers/leaders	• Evidence base, clinical guidelines…..	Intervention Characteristics • Evidence strength and quality
	Describe how approach is viewed by the PWA in the Big CACTUS trial	• Have SLTs discussed this with PWA • What are some of the things SLT participants seen/heard	Outer Setting • Patient needs and resources
	Describe views on how well the approach meets the needs of PWA	• Advantages over usual care in their setting • Disadvantages • Have they made any changes to the intervention • What/How	Outer Setting • Patient needs and resources Intervention Characteristics • Adaptability
	Explain how the training helped to prepare for carrying out the approach	• Positive aspects • Anything missing	Inner setting • Readiness for Implementation (Access to knowledge/information)
Future use of the intervention	Describe any plans to continue using the approach	• Describe feelings about long term use in their setting • How they feel and why • Confidence in own ability • What do colleagues think • What do managers/leaders (SLT and wider) think • Who would decide/who need on board	Characteristics of Individuals • Knowledge and beliefs about the intervention • Self-efficacy • Individual stage of change Process

Procedural stage	**Question topic/area**	**Prompts**	**Conceptual Level** **(CFIR: Damschroder et al 2009)**
	Describe any changes that need to be made to make this approach work in their setting	• Intervention • Infrastructure • Will it be possible to do that? • Why/why not • Anything that shouldn't be altered	Intervention Characteristics • Adaptability Inner Setting • Structural Characteristics Process
	Describe how well this approach fits with the existing service for PWA	• Any issues/complications • Complement existing • Conflict with existing	Inner Setting • Implementation Climate
	Outline any advice or recommendations for SLTs wanting to implement a similar approach in their own area		All

Appendix 1: Topic Guide Development

Tables with captions

Question topic/area
Describe how you came to be involved in the Big CACTUS study
Describe any challenges encountered in setting up the site ready to implement the approach
Describe the support received from managers/leaders with set up of the site
Describe views on this approach to intervention for PWA
Describe how approach is viewed by managers/leaders
Describe how approach is viewed by the PWA in the Big CACTUS trial
Describe views on how well the approach meets the needs of PWA
Explain how the training helped to prepare for carrying out the approach
Describe any plans to continue using the approach
Describe any changes that need to be made to make this approach work in your setting
Describe how well this approach fits with the existing service for PWA
Outline any advice or recommendations for SLTs wanting to implement a similar approach in your own area

Table 1. Topic guide for qualitative interviews

Participant	Number of years working as SLT with PWA	NHS Pay Band	Location of their SLT input for PWA*	% Clinical time working with PWA	Proportion of managerial vs clinical duties	Familiarity with computerised aphasia therapy before involvement with Big CACTUS (self-reported)	Geographical characteristics of NHS Trust (rural/urban/even mix)
R1	>20 yrs	7	ACD	< 25%	Mainly clinical	Inexperienced	Urban
R2	15-20 yrs	7	D	< 25%	All clinical	Proficient	Even Mix
R3	15-20 yrs	7	ABD	25-50%	Mainly clinical	Inexperienced	Rural
R4	>20 yrs	6	ABCD	25-50%	Mainly clinical	Very Inexperienced	Rural
R5	15-20 yrs	7	ABCD	< 25%	Mainly clinical	Very Inexperienced	Even mix
R6	>20 yrs	7	D	< 25%	Mainly managerial	Very Inexperienced	Urban
R7	>20 yrs	8	ABD	< 25%	Mainly managerial	Proficient	Even Mix
R8	15-20 yrs	7	CD	50-75%	Mainly clinical	Proficient	Urban
R9	15-20 yrs	7	A	25-50%	Mainly clinical	Proficient	Urban
R10	15-20 yrs	7	BCD	25-50%	Mainly managerial	Proficient	Rural
R11	5-10 yrs	6	AB	50-75%	All clinical	Proficient	Even Mix

*A= Inpatient Acute; B= Inpatient Rehabilitation; C= Outpatient Clinic/day unit; D = Home visits

Table 2. Individual participant characteristics

	Barriers	Enablers
Characteristics of the intervention: complexity and adaptability	Process of personalising software - difficult and time consuming for some SLTs Getting accurate feedback when using a range of devices is difficult Time needed to train and support volunteers, and high turn-over of volunteers Expectations that self-managed therapy can be supported without ongoing oversight by SLTs	Ability to offer independent intensive practice of personalised material with feedback (motivation for provision) Volunteer support (enabler for engagement of patients with intervention)
Knowledge and beliefs about intervention	SLT competence in using technology generally and StepByStep specifically SLT concerns about assistant/volunteer competence SLTs assumptions about lack of patient ability to use computer	Training and upskilling of therapists and assistants SLTs being open minded about potential ability of patients to use computer Trying different methods of using a computer to access and control the software.
Patient needs and the service resource dilemma	Not for all patients and doesn't address all issues people with aphasia need services for Mismatch of patient owned devices and devices needed to run software to deliver therapy/poor internet connections Resource costs: SLT time – volunteer/assistant recruitment and training	Insufficient face to face speech and language therapy resource (motivation for alternative ways of providing therapy opportunities) Self-managed practice on computer thought to be an efficient use of SLT time – organisational push for self-managed approaches (motivation for provision)

	SLT time – set up of software Cost of software and hardware	People ask for language activities on computer (motivation for provision) SLT familiarisation with software and involvement of assistants decreases SLT set up time
Networks and communications	Departmental processes/policies Communication/negotiations with IT departments System readiness – networks outside of SLT not having processes and procedures to support delivery of computerised SLT.	Developing a shared understanding between SLT and IT departments Working jointly and building rapport with a consistent individual from the IT department.
Reflecting and evaluating: adaptations for sustainability	Approach not able to add value in local context	Acknowledge and accept that familiarisation with new software takes time. Training of whole SLT team Don't give up, get support from IT department Explore funding and loaning models that work for the local context Iterative process of checking patient capability to use software, followed by use of a few exercises to check patient engaged before investing time in full personalisation and tailoring Consider software and hardware requirements of individual patients. Consider the contexts in which the approach can add value to the individual service.

Table 3. Summary of barriers and enablers to implementing computer aphasia therapy