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AN INTERNATIONAL JOURNAL

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Field-testing an iCST touch-screen application with people with dementia and carers: a mixed method study

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Abstract

Objectives: To test the individual Cognitive Stimulation Therapy (iCST) application with people with dementia and carers in order to modify and refine the application, and improve its usability. In an iterative development process, two different prototypes were used to elicit the subjects' views and preferences. This application may address the current need for more innovative approaches to support people with dementia and their carers.

Methods: An opportunistic sample of 13 people with dementia and 13 carers participated in four focus groups and ten semi-structured interviews to obtain feedback in key areas, including the layout and content of the application, and the experience of its use as a dyad. Data were audio-recorded, transcribed and analysed thematically. An additional 18 people with dementia and 16 carers completed a short usability and acceptability questionnaire regarding a subsequent version of the iCST application prototype.

Results: Most participants expressed enthusiasm about the iCST application, its usability, design, and content. Participants highlighted the importance of adaptability to individual preferences, indicating a need for a wider range of activities and flexibility in the use of the application. Furthermore, participants reported perceived benefits, including mental stimulation, quality time spent together, and enjoyment. The application was rated slightly better by carers than people with dementia in terms of usability and acceptability.

Conclusions: This study gives insights from people with dementia and carers concerning the usability, feasibility, and perceived benefits of the iCST application. The feedback will be incorporated in an updated version of the iCST application for commercial release.

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Keywords: Dementia, Cognitive Stimulation Therapy, touch-screen application, usability testing, user experience.

Introduction

There is a growing need for innovative approaches to better support people with dementia in their daily lives related to the global rise in the prevalence of dementia and a current lack of resources to reduce the burden (Prince et al., 2015). Psychological treatments such as Cognitive Stimulation Therapy (CST) can reduce the impact of the disease by keeping people with dementia mentally stimulated and engaged. CST has shown to improve cognition and quality of life (QoL) of people with dementia (Spector, Thorgrimsen, Woods, Davies, & Orrell, 2003). Usually, CST is delivered in a group format and includes various enjoyable activities accompanied by discussions to optimise learning and mental stimulation. Individualised CST (iCST) is typically delivered by a carer at home and can improve the quality of the relationship between the person and their carer, and the carers' QoL (Orrell et al., 2017).

A future direction for iCST may be to explore delivery via a computerised platform, such as a touch-screen tablet, as this could improve accessibility and would have the potential to make iCST more interactive and therefore, more novel. Developing an iCST application (app), which could be used on touch-screen tablets, could be useful given the evidence that some people with dementia may be able to use tablets independently, since these are intuitive and easy to handle (Joddrell & Astell, 2016; Nordheim, Hamm, Kuhlmey, & Suhr, 2015; Orpwood et al., 2009). A significant proportion of the current applications available for people with dementia focuses on providing assessments, screening tests, or serve an assistive function. This means that there is a gap in the availability of technologies which provide more mentally stimulating and enjoyable activities (Joddrell & Astell, 2016; Smith & Mountain, 2012).

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In terms of the effectiveness, more research is warranted with individual CST (iCST) as previous research found benefits for the carer but did not find significant results in terms of cognition and QoL for the person with dementia (Orrell et al., 2017). This can be explained by the low adherence in the trial as the majority of the participants completed fewer than the recommended amount of activities. By contrast, group CST has a robust evidence base for effectiveness in these domains (Woods, Aguirre, Spector, & Orrell, 2012). Technology can potentially have mentally stimulating effects in older people (Chan, Haber, Drew, & Park, 2016; Tyack & Camic, 2017; Xavier et al., 2014), and a systematic review concluded that computerised cognitive interventions can lead to improvements in cognition for people with dementia (Garcia-Casal et al., 2017). Therefore, combining iCST with technology could lead to benefits in terms of cognition and QoL. In addition, an iCST application would allow for improved monitoring of the adherence rates allowing us to better investigate the effects of an iCST-based approach.

The aim of this study was to try out the iCST application with people with dementia and carers in order to modify and refine the application and improve its usability.

Methods

The Medical Research Council (MRC) Framework and the Centre of eHealth Research (CeHRes) roadmap were applied in the development of the iCST application (Craig et al., 2008; van Gemert-Pijnen et al., 2011). A key feature of both frameworks is the involvement of service users throughout the developmental and testing cycle in order to ensure the intervention is tailored to the needs and interests of people with dementia. Previous research suggests that, especially for technology-based interventions, people with dementia are able to give useful feedback ranging from the content to the design (Span, Hettinga, Vernooij-Dassen, Eefsting, & Smits, 2013). It is worthwhile to involve various stakeholders such as carers in the developmental process in order to obtain a well-rounded view as different

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stakeholders may point out different issues with a technology (Lopes et al., 2016; Meiland et al., 2014).

Sample

People with dementia and family carers were recruited for this study. The inclusion criteria were modified from Spector et al. (2003).

Person with dementia:

- Meet Diagnostic and Statistical Manual of Mental Disorders (DSM IV) criteria for dementia (American Psychiatric Assocation, 2000).

- Score 10 or above on the Mini Mental State Examination (MMSE) (Folstein, Folstein, & McHugh, 1975) or score of 16 or above on the Montreal Cognitive Assessment (MoCA) (Nasreddine et al., 2005; Trzepacz, Hochstetler, Wang, Walker, & Saykin, 2015)

- Sufficient ability to communicate and demonstrate understanding, including to give informed consent

- Ability to speak and understand English

- See/hear well enough to participate

- No major physical illness or disability affecting their participation

- Age range: over 50 years – no maximum age limit

- Availability of a carer (or friend/befriender) to participate in the interviews and focus groups

Carer:

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- Minimum age: 21

- Ability to speak and understand English

- See/hear well enough to participate

- No major physical illness or disability affecting their participation

A Research Delivery Officer from the Nottinghamshire Healthcare NHS Trust made initial contact and completed eligibility checks for participants recruited through primary care settings. Participants were also recruited through leaflet advertisements in secondary care settings including memory clinics providing specialist services for people experiencing memory difficulties, and voluntary sector organisations. Researchers presented at several support groups for people with dementia and carers in Nottinghamshire to support recruitment. Participants were able to express a preference for either a focus group or an interview and researchers aimed to accommodate their preference wherever possible. A participant information sheet (PIS) was sent after initial contact was made and if still interested, participants were recruited.

Study Design

Semi-structured individual interviews and focus groups were used to gather qualitative data on the feasibility and experience of using a prototype version of a computerised iCST programme. These methods are appropriate in order to gather rich and in-depth data. While focus groups allow participants to share thoughts with each other and explore varying opinions (Alshenqeeti, 2014), individual interviews may be more suitable for participants who do not feel comfortable to voice their opinions in groups. Discussion guides, developed by the researchers, consisted of semi-structured questions, which explored key areas about the usability, layout and content of the application, using the application together and general

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points.

Following feedback from the qualitative study and the creation of the next prototype of the iCST application, <mark>a new sample of</mark> people with dementia and carers completed a short usability and acceptability questionnaire as part of a feasibility trial over 11 weeks.

Intervention – iCST application

The qualitative study included a second version of a prototype of the iCST application, which is intended to be delivered with an informal carer in the home and has been adapted using materials and principles from paper-based iCST (Yates, Leung, Orgeta, Spector, & Orrell, 2015). The study tested a sample of the application content as part of its early development. This included a welcome section which described the aims of the application, information on how to use the application, and several key principles of CST and iCST. In addition, seven activities were included compromising word games, number games, discussion activities and a creative activity namely: *Being Creative, Hangman, Odd One Out, Past Events, the Price is Right, Sounds, Useful Tips.* Screenshots of the application can be found in Figure 1. Participants could choose between two levels of difficulty, where activities on level two were more challenging than level one and the discussion questions went into greater depth.

INSERT FIGURE 1 HERE.

<mark>The feasibility trial</mark> used the third version of the iCST application prototype with an additional 14 activities based on feedback from the qualitative study (Table 1).

INSERT TABLE 1 HERE.

Procedure

Focus groups

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Four focus groups were held in various locations across Nottingham; one carers only group (n = 4), one with people with dementia only (n = 4) and two mixed groups (n = 8). In keeping with previous iCST research, different types of groups were used to gather a holistic view of the impact of the iCST application on each member of the caregiving dyad (Yates, Orrell, Spector, & Orgeta, 2015). Two researchers (HR, RG) were present in each focus group, with one to facilitate discussion and the other to take notes and assist with the interactive aspect of the group where participants tested the application. Participants were given 20 minutes to try the application together in pairs whilst written observational data was recorded by researchers. Researchers provided support regarding any technical difficulties or questions from the participants. However, guidance was kept at a minimum in order to assess whether the application was intuitive. The focus groups lasted approximately one hour, and were audio recorded and transcribed by the researchers. All audio recordings and transcripts were anonymized and stored on a password-protected University of Nottingham computer drive.

Individual interviews

Individual interviews were conducted with five people with dementia and carer dyads. All interviews took place in participants' homes. Prior to each interview the dyad were given 20 minutes to try the iCST application whilst written observational data was being recorded by the researchers. Interviews were conducted individually with the person with dementia and the carer to allow each participant to share their opinions and to gather a well-rounded view of the application. Each interview lasted between 20-50 minutes. All interviews were audio recorded and anonymized in transcription and stored securely as already described.

Usability and Acceptability Questionnaire

In order to gain a comprehensive view on the iCST application and gather more standardised feedback from a larger sample of people with dementia and carers, a usability questionnaire

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was presented to participants evaluating iCST application v3.0. A total of 16 people with

dementia and 18 carers completed the Usability and Acceptability Questionnaire for older

people (translated from Spanish) which is a ten-item measure used to identify user opinions

on perceived ease-of-use, confidence and control whilst using an application (Castilla et al.,

2016). Responses range from strongly disagree (0) to strongly agree (4) on all items. A

researcher completed the questionnaire by telephone at the end of the trial when dyads had

used the application for 11 weeks. Data from the Usability and Acceptability Questionnaire is

also used to help interpret the qualitative findings, by indicating which comments are more

representative of the users' views.

Ethical approval

Ethical approval was obtained through the NHS Health Research Authority – Yorkshire &

The Humber – Bradford Leeds Research Ethics Committee (REC number 17/YH/0405).

Participants with dementia were in the mild to moderate stages of the disease, and were able

to provide informed consent for participation (Yates, Orrell, et al., 2015). Written informed

consent was gathered from the carer and person with dementia separately on the day of the

research activity. However, participants were given a choice to sit together during the

consenting process if they wished to. Consent forms were checked by researchers once signed

to ensure they had been fully completed. Each participant was given a copy of the signed

consent form to keep.

Analyses

Quantitative data from the Usability and Acceptability Questionnaire was entered into SPSS

version 25 and was analysed using descriptive statistics. This data is reported using response

percentages as given by people with dementia and carers on each questionnaire item. These

findings informed our inferences from the qualitative data, by showing which aspects were

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most frequently agreed upon.

The qualitative data was coded and analysed thematically using an inductive approach to ensure the themes were strongly linked to the data itself (Thomas, 2006). This approach is guided by detailed readings and interpretations of the raw data. The researcher's evaluation objectives help to provide a framework for domains and topics to be investigated while coding and analysing the data. During the analysis process, the researcher makes decisions about what is of importance within the data which helps to make the findings more applicable (Thomas, 2006). Consequently, the findings are based on analysis of the raw data rather than presumptive ideas and expectations of the researcher. This data-driven approach best suited the aims of the research, which was to gather exploratory data regarding opinions of the iCST application. Two researchers (HR, RG) analysed the data independently using NVivo software for entering the coding categories and supporting data excerpts from the transcripts. Where needed, observational notes where examined to provide additional clarifications. Hereafter, a proportion of the data which was coded by a second coder was exchanged and any discrepancies were clarified to reach consensus and ensure reliability of analysis. In order for the themes to be relevant to the evaluation objectives, the emerging categories were reviewed and revised on a continuous basis.

Results

The sample for the qualitative study included 13 people with dementia and 13 family carers (Table 2). Most participants had some experience with using related technology prior to participation (77% of the people with dementia, 100% of the carers). Usage ranged from desktop computers to touch-screen tablets and smartphones. Three people with dementia indicated they had no previous experience with using such technology.

INSERT TABLE 2 HERE.

Thematic analysis of the qualitative data led to the following main themes: 'approaches to technology', 'quality of the iCST application', 'perceived benefits of the iCST application', and 'involvement of a relative or friend'. Most main themes included several subthemes and supporting quotes can be found in Table 3.

INSERT TABLE 3 HERE.

Theme 1 – Approaches to technology

Some participants noted that it would be helpful for older people to have some prior experience with technology before using a new intervention such as the iCST application and they might need more guidance on how to use it. Familiarity was also related to the platform or operating system itself. Some found touch-screen tablets easy and useful because of their size. Participants were also optimistic about the potential uses such as a map application to help navigate

Both people with dementia and carers recognised some limitations associated with the use of technology. Even though all carers used technology, one mentioned the attitudes of older people could hinder the acceptance of technology and a person with dementia said they need to be empowered. Lastly, participants identified some practical challenges regarding the use of technology such as faults or minor technical difficulties and mentioned having support would help to navigate these issues.

Theme 2 – Quality of iCST application

Content

Participants felt activities were relevant and spoke about enjoying the interactive features of the application including the discussion questions. The variety of the activities was thought to be appropriate, but a clear need for more diverse content was identified in order for the application to retain its appeal, and to cater towards the interests of as many people as

possible. Lastly, participants discussed ideas for future iterations of the application including personalisation by uploading their own content.

Usability

The design of the application was judged by participants to be sophisticated. Although there was a consensus that the text and images were appropriate, most felt that both could be slightly larger to improve readability. Opinions were divided in terms of the use of colours. Whereas some people liked the calmness of the green and would find too many colours to be distracting, others expressed a preference for a more colourful design.

Participants were usually able to find their way around the application with minimal support and apart from suggestions to improve the button placement in terms of clarity and prominence, the navigation of the application was user-friendly.

Feasibility

In terms of feasibility, most participants were happy to use the iCST application for the recommended time of one and a half hours per week however, some did worry about finding the time to schedule it into their day. Participants felt the iCST application would be useful during 'empty' times of the day and also during the winter months as they are then more likely to spend time at home.

Often carers described a few limitations related to symptoms of dementia or physical limitations such as backache and hearing problems which would make it more difficult for them to use the iCST application with the person they were caring for. Interestingly, a person with dementia mentioned that the iCST application could be used as a distraction for herself when experiencing pain.

Comparison to paper-based iCST

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Most people with dementia ($n = 10$) and carers ($n = 12$) expressed a preference for a computerised version as they felt it was the next logical step after using books, and was more fun due to the interactive features. Although three people with dementia and one carer said it very much depends on an individual's preference. Finally, having the availability of both versions would also be beneficial as it would allow for a choice.

Theme 3 – Perceived benefits of the iCST application

Mental stimulation

Participants said mental stimulation provided by the iCST application was important. Several people with dementia mentioned things like 'keeping the brain active' or 'keeping the brain alert' after being asked why they would use the iCST application. Carers also valued mental stimulation. One was concerned about uncertainties in the future regarding the dementia. Another carer also mentioned that the content of the application was quite novel and therefore encouraged the dyad to think about it more. This suggests that benefits in terms of cognitive stimulation for the person with dementia would be a leading reason for people to use the iCST application.

Quality time together

When asked how dyads currently spent their time together, some mentioned gardening, walking, and going out with family or friends. Others were less active and said they would like to spend more time together doing various activities. Often this was not possible due to the progression of the dementia or lack of time. One of the perceived benefits of using the iCST application was being able to spend more time together as a dyad. Several participants made it clear that the iCST application would be an extension of the time already spent together and not a replacement of activities. On top of the time spent together, another carer pointed out that she found the physical proximity pleasant while doing an activity on the

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application. She felt this would not happen when doing more conventional activities such as playing cards. Another carer would consider this to be quality time spent together with the person with dementia. Lastly, participants said the iCST application could be particularly useful when there are difficult or tense moments.

Sharing ideas and opinions

The iCST application led to discussions between the person with dementia and the carer with some activities allowing for more discussion than others. Carers valued this and pointed out that starting a conversation with the person they are caring for can be difficult at times. The iCST application provided useful prompts to get a conversation started. The content could be used to generate various topics ranging from new ideas to more reminiscence-based topics. Some pointed out that the discussion should be pleasant and one should be cautious not to evoke frustrations or disagreement. But there was agreement that this was not necessarily a problem as these issues could be resolved between themselves by respecting the other person's opinion. Having differing opinions or perspectives was also a positive, allowing people to reflect in a different way. A carer mentioned that if a particular activity leads to conflict, then you would not do it again and try something else, as you would always have this choice within the application.

Enjoyment

The activities of the iCST application were enjoyable and fun. People with dementia expressed several reasons for this enjoyment including having to use logic and reasoning to do some of the activities and also that the application was informative. Carers enjoyed doing activities together and the communication aspect. One carer mentioned that enjoyment would come from seeing the person with dementia benefit from using the application.

Theme 4 – Involvement of a relative or friend

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Choosing the right person

Some people with dementia said they would put some thought into who they would use the iCST application with and most participants said they would use it with their spouse. A daughter felt that the application was perhaps more suitable for couples, to help bring them closer together. Some participants said they would use the application with their grandchildren as they are generally more tech-savvy and the discussions could lead to different thoughts and perspectives:

Using it alone or together

Some participants with dementia expressed a preference for using the iCST application on their own or at least to have the choice, saying that a family member or friend might not always be available and therefore it would be good if they could then use the application alone. Others preferred to do the activities with another person and found it more enjoyable. Some participants mentioned that the application was quite straightforward and would be able to use it by themselves. Others said they would reach out to someone within their own network for support in order to resolve the issues that way or in case of any technological difficulties. A person with dementia mentioned it might be useful to have a way to reach out to other users of the application and be able to share experiences.

Usability and Acceptability Questionnaire

The iCST application prototype v2.0 underwent some changes including an expansion of the number of activities, changes to the layout (e.g. button placement) and discussion questions (e.g. questions made more open, addition of a prompt), and change in the timer. The iCST application prototype v3.0 was presented to a new sample of 16 people with dementia and 18 carers. The majority of people with dementia were male (n = 10) and the majority of carers were female (n =14). The mean age of people with dementia was 73.88 years (*SD* = 7.86) and

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the mean age of carers was 68 years (*SD* = 10.41). Most people with dementia (n = 10) and carers (n = 13) indicated they had either some or quite a lot of experience with using technology. Results from the Usability and Acceptability Questionnaire are shown in Table 4. The iCST application v3.0 was rated particularly well on several aspects including ease of learning to use the application, being able to use it in different contexts, and the font/button sizes. Both people with dementia and carers also felt confident about their ability to use the application and found the instructions to be easy. However, both groups gave their lowest rating to willingness to use the application frequently and people with dementia in particular gave a lower rating to the application's usefulness. Overall, the iCST application was rated better by carers than people with dementia on every aspect of the questionnaire.

INSERT TABLE 4 HERE.

Discussion

People with dementia and carers were positive about the iCST application and liked the sophisticated design and the variety of content. They also suggested how it can be improved by adding more activities or an option to personalise it. The application was perceived to be useful with several potential benefits identified by the participants. Limitations to using the application were also identified, and participants reflected on different approaches to technology such as familiarity which could contribute to the uptake of the iCST application.

Approaches to technology

Some degree of familiarity with technology, including the platform on which the intervention is offered, would make it easier for people with dementia to use the iCST application. Generally, participants were able to operate the iPad without much help from the researchers, they found that touch-screen tablets were useful due to their practicalities such as size, and that they can be used for other purposes as well. Nordheim et al. (2015) also found that

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touch-screen tablets were considered to be intuitive by people with dementia.

Wandke, Sengpiel, and Sonksen (2012) argue that the attitudes of older people towards technology depend on factors such as age, gender, education, and previous computing experience but there can be misconceptions about attitudes, even among older people themselves. The current study showed a need to empower people with dementia to use technology which could increase the uptake of technology-based interventions such as the iCST application.

Technical difficulties or faults could make the use of the iCST application more difficult but these can be overcome with access to the right support in the family or external.

Quality of the iCST application

The content was well received, but more and diverse content was needed to appeal to a wider audience and could include an element of personalisation as well. Tyack and Camic (2017) note that the content of touch-screen interventions should be tailored where appropriate to the user and should include a slight challenge to invite the user to apply more complex cognitive skills rather than just simpler ones. Our participants also stated that enjoyment would come from engaging in more challenging activities. The iCST application has two levels of difficulty with a potential to include more levels to cater to the individual's cognitive skills.

The design was appropriate even though there was no clear consensus on the use of colours. The navigation was clear as well as the text and images with some minor suggested changes. A simple and intuitive interface which is aesthetically pleasant, error-free, and provides some guidance to the user on what to do, could help contribute to the uptake of an intervention (Tyack & Camic, 2017). The iCST application adopted these usability factors and was purposefully developed to be kept simple and appealing. Moreover, every activity includes a short summary with instructions. These features were received positively by the majority of the participants who found the design to be sophisticated and intuitive. This

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feedback was in accordance with ratings on the usability and acceptability questionnaire for the iCST application prototype v3.0 with carers rating it slightly better than people with dementia. Despite giving a positive rating to its design, the majority of people with dementia and carers were less willing to use it frequently and people with dementia gave a low rating to the usefulness of the application. This may be explained by some feedback obtained in the feasibility trial. For some people with dementia, the activities were not relevant enough to their interests or not aligned with their level of dementia e.g. people who reported to be high functioning did not find the application sufficiently challenging. This may have compromised the usefulness of the iCST application for these participants and affected their willingness to use the application more often. Therefore, there is a need to develop the existing content further in order to make it more suitable for a range of users, by adding more topics that will engage people with dementia as well as gearing the activities to different stages of impairment. These improvements would potentially increase its usefulness.

In terms of feasibility, participants were positive about spending one and a half hours a week on the iCST application but there were some concerns about fitting it into their daily routine. This is congruent with qualitative findings from Yates et al. (2015) regarding paper-based iCST however, findings from the large-scale randomised controlled trial (RCT) with paper-based iCST found adherence to be relatively low suggesting participants experienced challenges with implementing iCST in their daily lives for the recommended amount of time (Orrell et al., 2017). Difficulties with monitoring usage and adherence in the iCST study could be addressed with the iCST application, which could track usage and progress. In the current study, participants additionally mentioned physical limitations such as hearing problems which could affect the feasibility of using the iCST application. Therefore, there is a need for flexibility so that people can tailor the usage according to their own needs.

Perceived benefits of the iCST application

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Participants identified various benefits including mental stimulation, spending quality time together, sharing opinions and ideas, and enjoyment. Mental stimulation was an important aspect for both people with dementia and carers. Similarly, Yates et al. (2015) noted benefits including engaging in mentally stimulating activities and being able to stay alert.

Using the iCST application with another person could also contribute to the dyadic relationship as dyads valued spending this time together and it may help to settle difficult moments within the relationship. A systematic review by Moon and Adams (2013) also found that dyadic interventions could lead to an improvement in the relationship quality, and highlighted the significance of mutual understanding within these types of interventions. Our participants mentioned the importance of respecting each other's opinions during discussions.

Involvement of a relative or friend

Currently, the iCST application is designed to be used by both the person with dementia and carer jointly which is in line with previous iCST research. Most participants preferred to use it together but some wanted a range of activities that could also be done alone. A combination of both would be a good option as it would allow for a choice. Most participants felt comfortable using the iCST application without the involvement of external support and some mentioned asking friends or family for help with any technical difficulties if needed. However, participants did suggest it would be nice to get in touch with other users of the application. In the future, this could be incorporated in the form of a forum or club directly on the application or the accompanied website.

Methodological strengths

This study permitted an in-depth examination of the usability, feasibility and perceived benefits of the iCST application as it gathered data from both people with dementia and carers, and included a mixture of spousal and adult child caring dyads (Quinn, Clare, &

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Woods, 2009). This approach allowed us to gather feedback from participants from a range of ages and experiences. In addition, three separate types of focus groups were used to gather a well-rounded view of the iCST application. Separate types of focus groups enabled us to collect data from different perspectives of the caregiving dyad in environments which were set up to remove conformity due to the presence of their caregiving partner in the discussion. The use of semi-structured individual interviews allowed for the collection of more rich data and provided an environment in which other participants could not influence one another in their responses. Using discussion and interview guides shaped the discussion and supported participants to go into greater depth when sharing their feedback. Moreover, the data from interviews and focus groups were analysed with complementary observational data from the research settings resulting in a greater amount of feedback on the iCST application, especially regarding usability of the application.

Limitations

During the qualitative study, people were not able to comment on all aspects of all activities (seven activities in prototype v2.0), the longitudinal effects of using the application, or receipt of the full programme with accompanying training and support. However, this may have been reflected in the feedback, as at times there was a lack of elaboration of answers to the questions, limiting the richness of the data. Allowing for more time to try the application and incorporating more focused questions in the discussion guide may help to remedy this in future research. The sample was not representative of the general population of caregiving dyads, as it was a self-selected, White British sample made up of mainly spousal carers.

Implications

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The impact of CST is substantial, with over 25 countries having adapted it to their cultural

contexts (University College London, 2019). The International CST centre at University

College London (UCL) shares information and promotes collaborations between international

CST stakeholders. By following the CST adaptation guidelines and using the international

CST centre as a platform for dissemination, the iCST application can be adapted to various

cultural contexts for international implementation (Aguirre, Spector, & Orrell, 2014). This

will further enhance the impact of CST by granting wider access to CST and its principles for

people with touch-screen tablets. In addition, the iCST application offers multi-sensory

content such as audio-visual stimuli, which could lead to increased mental stimulation for the

person with dementia. The level of flexibility within the usage of the application is another

added benefit compared to paper-based iCST. Lastly, there is scope for adding and changing

content regularly and efficiently making the iCST application highly dynamic for users. In

the long-term, it is hoped that regular use of the iCST application could have several key

outcomes such as improvement in cognition and quality of life for the person with dementia

leading to delayed admission to care or nursing homes, and reduced staff time and costs.

Conclusion

The study highlighted the acceptability and usefulness of prototype versions of the iCST

application confirmed through focus groups, interviews, observations and a usability

questionnaire. The design was rated positively with only minor changes to the layout in

certain areas. Level of familiarity and attitudes among users could affect the use of the

application. The content was welcomed but with a need for additional, diverse activities to

appeal to individual preferences, and for flexibility in the usage of the iCST application.

There is potentially a broad scope for future developments and updates. The focus groups and

interviews also gave insights in the perceived benefits of using the application ranging from

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mental stimulation to communication, and effects on the dyadic relationship. Finally, participants in the qualitative study found the iCST application to be useful which is in contrast with the lower ratings for the usefulness on the usability questionnaire.

The iCST application can be a worthwhile addition to paper-based iCST and the feedback obtained from this study will be used to develop the next iteration of the iCST application for commercial release.

Disclosure of interest

Royalties from the sales of the iCST application (Thinkability) go to Eumedianet and the University of Nottingham and provide support for ongoing maintenance of the application including future updates.

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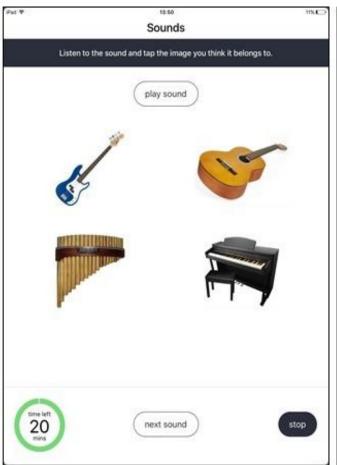Thomas, D. R. (2006). A General Inductive Approach for Analyzing Qualitative Evaluation Data. *American Journal of Evaluation, 27*(2), 237-246. doi:10.1177/1098214005283748

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Tables and Figures

Figure 1. Screenshots from the iCST application. From left to right: a question from the

Sounds activity, and after the correct answer has been selected and the discussion question

below**.**

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Table 1. Full list of activities for iCST application prototype v3.0

Game	Discussion	Game and discussion
Being Creative	Past Events	Sounds
Spaceman	Useful Tips	Odd one Out
Trivia Quiz	My Life	The Price is Right
Word Search	Arts	Globe Trotter
Sudoku	Old Wives' Tales	Food
Being Active	Toys Are Us	In Pairs
Brainstorm		Sayings
		ISpy

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Table 2. Demographics of people with dementia and carers in focus groups and interviews.

Demographics		Focus groups (%)	Interviews (%)
Person with dementia		n = 8	n = 5
Gender	Female	3 (37.5)	2 (40)
Ethnicity	White	7 (87.5)	4 (80)
	South Asian	1 (12.5)	
	Prefer not to say		1 (20)
Age	Mean age (years)	75.50 (range 69 - 86, SD = 5.76)	72.20 (range 67 - 83, SD = 6.61)
Experience with technology	Yes	6 (75)	4 (80)
Carer		n = 8	n = 5
Gender	Female	5 (62.5)	4 (80)
Ethnicity	White	8 (100)	5 (100)
Age	Mean age (years)	70.37 (range 54 - 82, SD = 7.89)	67.20 (range 49 - 82, SD = 11.99)
Relationship	Spouse	7 (87.5)	4 (80)
	Child	1 (12.5)	1 (20)
Living status	Spouse lives with person	7 (87.5)	4 (80)
	Person lives alone at home	1 (12.5)	1 (20)
Experience with technology	Yes	8 (100)	5 (100)

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Table 3. Main- and sub themes with comments from people with dementia and carers.

Main theme	Comment
Theme 1 – Approaches to technology	*It's helpful if the person has got the experience of using a computer. Younger people are brought up with computers, it's always there. So there is no learning curve, it's just there. (…) but if you're older, you might have to ask how to explain it.* – Person with dementia, Focus Group 4.
	For me it would be a tool that I'm using every day of the week. If you was given a new laptop, how would you feel, because it's now a different system you would feel lost I'd tell ya!. – Person with dementia, Interview 9.
	Something that's a bit more like this (…) would be more of an advantage, whereas if it's a little thing like a phone, it'd be too small on the screen. – Carer, Interview 8.
	I can't think of any disadvantages… these sort of machines are not too expensive to buy, and you'd probably use it for other things if you had one anyway, so a lot of people would probably have access to them. – Carer, Interview 2.
	There is a lot of fear with older people with anything electronic. – Carer, Focus Group 3.
	I think that's a big thing for older people. You have got to get them realising that they are actually capable of doing this. – Person with dementia, Interview 1.
Theme 2 – Quality of the iCST application: Content	*I liked the, sort of, you do one thing with the sounds and there's a second bit and that's a question and that's the conversation, I quite liked that idea.* – Carer, Focus Group 3.
	Yeah, well I'm hoping beyond triple (the amount of activities), I hope it goes way beyond that, with more facilities to do more things. I appreciate that it would have to have some sort of confinements for the app, but the more varieties there is available, the more people that are gonna get involved with it. - Person with dementia, Interview 9.

Theme 2 – Quality of the iCST application: Usability	*I thought it was a very usable programme.* – Person with dementia, Focus Group 2.
	I kind of liked the green. That's a bit unusual. – Carer, Focus Group 4.
	It's relaxing. – Person with dementia, Focus Group 4.
	Yes, I mean it's nice, it is a nice layout it's just me I just like things a little bit more colourful. – Person with dementia, Interview 3.
	No it's fine. It's self-explanatory, it's easy so that's exactly what you need. – Carer, Interview 4.
Theme 2 – Quality of the iCST application: Feasibility	*Yes, but it's having the time though... That's the problem with it.* – Person with dementia, Focus group 2.
	Sometimes, (…), they need longer for it to register in the brain and then come out. – Carer, Focus Group 3.
	You know it helps take the, well not the pain away but you don't concentrate on it if you know what I mean. It takes away the thought of it yeah. – Person with dementia, Interview 7.
Theme 2 – Quality of the iCST application: Comparison to paper-based iCST	*If it was somewhere that you've got a piece of paper, fair enough. If you've got something like this, you've got both choices then. So you know you're not stuck either way are you.* – Person with dementia, Interview 5.
	It makes it seem like it's a more academic grown up activity. Some of these games you would think are suitable for children, but if you're doing it on a computer it looks more grown up somehow. – Carer, Interview 2.
	I honestly don't know. He's not really very orientated into technology, he doesn't like it. If it was the book he'd probably like it better. He does like his paper thing... – Carer, Focus Group 3.
Theme 3 – Perceived benefits of the iCST application: Mental stimulation	*I think anything that you do, you do together that stimulates the brain at any time, even if it's a short space of time, I'll have a go at it.* – Carer, Focus Group 1.
	It's not just a reminiscence tool, it's something to get us thinking. – Person with dementia, Focus Group 2.

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Theme 3 – Perceived benefits of the iCST application: Quality time together

To spend more time together really I suppose. Other than that we do different things when we're not together so at least you spend more time together yes. – Person with dementia, Interview 7.

Yes I think I would use it at the times where there has been a little bit of an altercation and then say right ok: so let's sit down and do this or do that. - Carer, Focus group 1.

Theme 3 – Perceived benefits of the iCST application: Sharing ideas and opinions

Gives you variety doesn't it, you're not just trolling through a list of things... Least you've got time to reminisce, give your own opinion... because reminisce and opinions aren't the same are they... – Person with dementia, Focus group 2.

You could have a nice discussion so long as people don't lose their temper... If you listen to each other, and listen to what they say, and then you decide... Am I going to change to what they think, or stay as it is... – Person with dementia, Focus Group 2.

Two people would look at something like that and start to read it slightly differently but if you look at it together and discuss it, you come up with the solution. – Person with dementia, Focus Group 4.

Theme 3 – Perceived benefits of the iCST application: Enjoyment

Yeah I found it erm ... informative and that made it a bit more enjoyable. – Person with dementia, Focus Group 4.

Theme 4 – Involvement of a relative or friend: Choosing the right person

Do you think that I could do this activity with anybody and I think the answer to that would be no. – Person with dementia, Interview 9.

It could be... quite... a revelation... because two different generations, because our perceptions are different on things. – Person with dementia, Focus Group 2.

Theme 4 – Involvement of a relative or friend: Using it alone or together

'If I'm gonna sit with... at a tablet I'm isolating myself again, on my own. To do it with somebody, carer, friend... Somebody I didn't even know (!)... Was much better and more enjoyable. – Person with dementia, Focus Group 2.

I might not be able to get back to the right place, but it seems very simple doesn't it... and, but it would be handy to have somebody to ring if it failed for some reason. – Carer, Interview 2.

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Table 4. Results from the Usability and Acceptability Questionnaire.

Questionnaire item[1]	People with dementia (n = 16)	Carer (n = 18)
	% agree or strongly agree	% agree or strongly agree
1. I think most people could learn very quickly how to use Thinkability.	81	89
2. I felt confident about my ability to use Thinkability.	81	100
3. Overall, I knew what to do at all times.	69	94
4. Once I had learned to use Thinkability, I could perform tasks quickly.	63	94
5. Thinkability can be used anywhere and in any context.	81	94
6. The instructions in Thinkability are easy.	75	94
7. The font and button sizes are sufficient for me.	69	100
8. I would like to use Thinkability frequently.	50	56
9. Overall, I think Thinkability is very useful to me.	26	61
10. Overall, I think Thinkability is easy to use.	63	95

[1]Responses include: strongly agree, somewhat agree, neither agree or disagree, somewhat disagree, strongly disagree.

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