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Using a touch screen computer to support relationships between people with dementia and caregivers

Arlene J. Astell [a,*], Maggie P. Ellis [a], Lauren Bernardi [a], Norman Alm [b], Richard Dye [b], Gary Gowans [c], Jim Campbell [c]

[a] School of Psychology, University of St. Andrews, St. Andrews, Fife, Scotland, KY16 9JP, UK
[b] Applied Computing, University of Dundee, Dundee, Scotland, DD1 4HN, UK
[c] Graphic Design, Duncan of Jordanstone College of Art & Design, Dundee, Scotland, DD1 4HT, UK

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ABSTRACT

Progressive and irreversible cognitive impairments affect the ability of people with dementia to communicate and interact with caregivers. This places a burden on caregivers to initiate and manage interactions to the extent that they may avoid all but essential communication. CIRCA is an interactive, multimedia touch screen system that contains a wide range of stimuli to prompt reminiscing. The intention is that people with dementia and caregivers will explore CIRCA together, using the recollections sparked by the media as the basis for conversations. This paper reports an evaluation of the utility of CIRCA looking particularly at whether CIRCA can meet the needs of both people with dementia and caregivers to engage in mutually satisfying interactions. The findings confirm that people with dementia can use the touch screen system and that the contents prompt them to reminisce. The system also supports caregivers to interact with people with dementia as more equal participants in the conversation. The results suggest that interacting with the touch screen system is engaging and enjoyable for people with dementia and caregivers alike and provides a supportive interaction environment that positively benefits their relationships.

1. Introduction

1.1. Dementia

Dementia is a progressive neurological disorder that at present cannot be prevented or reversed. The biggest risk factor for developing dementia is age and as life expectancy continues to grow, the number of people in the world with dementia is predicted to rise from 25 million in 2000 to 63 million by 2030 and to 114 million by 2050 (Wimo et al., 2003). There is no single cause of dementia and no single pattern to the way it affects people. Alzheimer's disease (AD) is the most common cause of dementia, accounting for 42% of cases (Brunnström et al., 2009) although vascular dementia (VaD; 23.7%) and mixed AD and VaD (21.6%) are also common (Brunnström et al., 2009).

An early symptom of AD is problems with working memory, such as difficulties recalling and discussing recent events, although people's memories for events from earlier in their lives, especially childhood and early adulthood, are typically unaffected. As the illness progresses, all aspects of cognitive function are implicated which in turn affects people's social, emotional and everyday behaviours. The progressive debilitation these cause makes people with dementia increasingly reliant on family or professional caregivers for meeting all of their needs.

The challenges presented by living with dementia both for people with a diagnosis and those who care for them are magnified in respect of communication. From early in the disease process people with dementia have problems participating in daily social interactions. They frequently repeat phrases that they have just said and their responses can give the appearance of not listening to what their conversation partner is saying. This can be frustrating and disempowering for people with dementia and distressing for the family and care staff they are trying to communicate with. Developing interventions to support communication and maintain relationships between people with dementia and those who care for them is a growing social and healthcare priority.

1.2. Technological solutions

The potential for developing technological solutions to meet the needs of an ageing population is increasingly being recognized (Goodman-Deane et al., 2009). Developments must take account of the "needs, abilities and desires" of the intended users

* Corresponding author. Tel.: +44 1334 462056.
E-mail address: aja3@st-and.ac.uk (A.J. Astell).

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(Goodman-Deane et al., 2009), especially in respect of those with cognitive impairments, which can interfere both with their ability to participate in the development process and their ability to use the technology once created (Astell et al., 2009).

The past decade has witnessed a revolution in the way we communicate and conduct social interactions. From instant messaging through both Short Message Service (SMS; i.e. "texting") and Multimedia Message Service (MMS: e.g. Skpe™, iChat™) to social network sites such as to FaceBook™ and Bebo™, technological means of communicating and interacting have exploded into all aspects of daily life. The concept of online communities has spread beyond hardcore gamers to all sectors of the population with the rise of YouTube™, as many thousands of people upload videos every day. Similarly, thousands more share their lives with the rest of the world by blogging and tweeting.

Whilst younger people are at the forefront of driving and adopting many of these developments, the relevance for engaging and supporting older people has not been unrecognized. For e.g. the potential for social interactions across the Internet is being harnessed through intergenerational activities such as online gaming (Khoo et al., 2007). One e.g. is the "Age Invaders" system, designed to facilitate intergenerational family entertainment by enabling one or two different generations to play games together from different locations (Khoo et al., 2009). This system is interesting in that it takes account of both differences in game playing ability due to age and experience and changes in cognitive ability associated with age (Khoo et al., 2009). For e.g. in the Space Invaders game, the system allows older players more time to react to rockets fired by younger players (Mixed Reality, 2009).

"Age Invaders" highlights the potential for developing systems for the ageing population that take account of specific user needs. The working memory problems of older people with dementia make it very difficult for them to learn new information and use it explicitly. Therefore, any technological solution to support them in communication with caregivers must take account of their memory difficulties, whilst maximizing their unaffected abilities. Essentially, the aim is to develop cognitive prostheses that "leverage and extend human intellectual capacities... [develop] systems that fit the human and machine components together in ways that synergistically exploit their respective strengths and mitigate their respective weaknesses" (Institute for Human and Machine Cognition: IHMC). To be maximally useful for people with cognitive impairments such developments must be designed to reflect individual needs (Cole, 2006).

Technological solutions to the cognitive problems associated with dementia have to date focused around cognitive rehabilitation and training (e.g. Butti et al., 1998; Schreiber, 1999) rather than communication. However, examples of cognitive prostheses specifically aimed at promoting and supporting communication can be found in the Augmentative and Alternative Communication (AAC) field. AAC interventions have mostly been developed in respect of developmental and acquired brain injury using both aided and unaided systems. Unaided AAC systems are communication techniques that do not require equipment, but instead are based around nonverbal aspects of social interaction such as gestures, facial expression and pantomiming. Aided AAC refers to the use of external devices, both high and low tech, that "generally involve devices that display symbols a person selects to convey messages to listeners." (http://www.circleofinclusion.org/english/augcomm/index.html).

Aided AAC systems are tailored to the needs of the individual, reflecting the principles of user-centred design. Depending on the physical and cognitive abilities of the users some systems contain a limited set of pre-stored messages (e.g. TALK: Todman et al., 1994), whilst others provide the flexibility for the users to create their own novel output (e.g. Waller et al., 2005). Designing systems to support people with dementia who retain speech for much of the illness but experience progressive cognitive impairment, the focus must be on making the system easy to use, with little or no learning required and a simple means of operating and interacting with the system. This was our goal in developing CIRCA.

1.3. CIRCA

CIRCA is a multimedia computer system developed to support and promote communication between people with dementia and caregivers (Alm et al., 2004; Astell et al., 2005). CIRCA is based on reminiscence, which is a popular activity in dementia care services (Jackson, 1991). Reminiscence refers to the process of recollecting memories from one's life, for e.g. about work or hobbies, and speaking about these with one or more other people. The process of recollecting personal memories can be prompted by various stimuli including photographs and artefacts. Engaging in reminiscing is considered to contribute to well-being and provide a positive activity for people with a diagnosis of dementia (Brooker and Duce, 2000).

In dementia care settings reminiscing is typically carried out as a group activity with one or more care staff acting as facilitators. To prompt reminiscing the facilitator(s) may bring along photographs or other items such as post cards that are passed around the group. Such sessions require care staff to generate themes and find and organise materials to prompt reminiscing and discussion within the group. Due to time constraints and the need to find stimuli, reminiscing is rarely carried out as a one-to-one activity.

CIRCA was developed to provide a broad range of stimuli to prompt reminiscing among people with dementia, both in group and one-to-one sessions. CIRCA utilises hypermedia to address the memory and conversation maintenance problems experienced by people with AD. Two features of hypermedia make it particularly suitable for people with dementia. First is its inherent flexibility. Users of the computer have the freedom to move between interconnected but individual items as they choose. This is beneficial for people with memory loss as it does not put any penalty on 'losing the place' in the system (McKerlie and Preece, 1992). Whatever place the user is in is the right place to be and exploring and 'getting lost' are actively encouraged as strategies to enjoy experiencing the material. Second hypermedia provides the opportunity to link items from a range of media in a dynamic way. Text, photographs, graphics, sound recordings and film recordings can be seamlessly intertwined to present an inviting and lively activity for people with dementia and caregivers to explore and discuss together (Alm et al., 2004; Astell et al., 2005: Fig. 1). CIRCA contains photographs, music and video clips to provide an engaging reminiscence experience.

The CIRCA system was developed with a user-centred design approach arising from the need expressed by caregivers and relatives of people with dementia diagnosis for a way of supporting conversation. Due to their progressive working memory problems, people with dementia find it increasingly difficult to keep track of conversations, which can lead to them being disempowered and leave caregivers feeling demoralised. The usefulness of reminiscing as a means of getting older people, including people with dementia, talking provided a clue to an approach that might be fruitful. We set out to develop a system that would relieve caregivers of the burden of supporting and stimulating the conversation, leaving them free to engage in more natural interactions with people with dementia.

From this starting point we consulted with 40 people with dementia and their carers, both professional and family, about potential content for such a system. This involved one-to-one interviews, focus groups and demonstrations with paper and

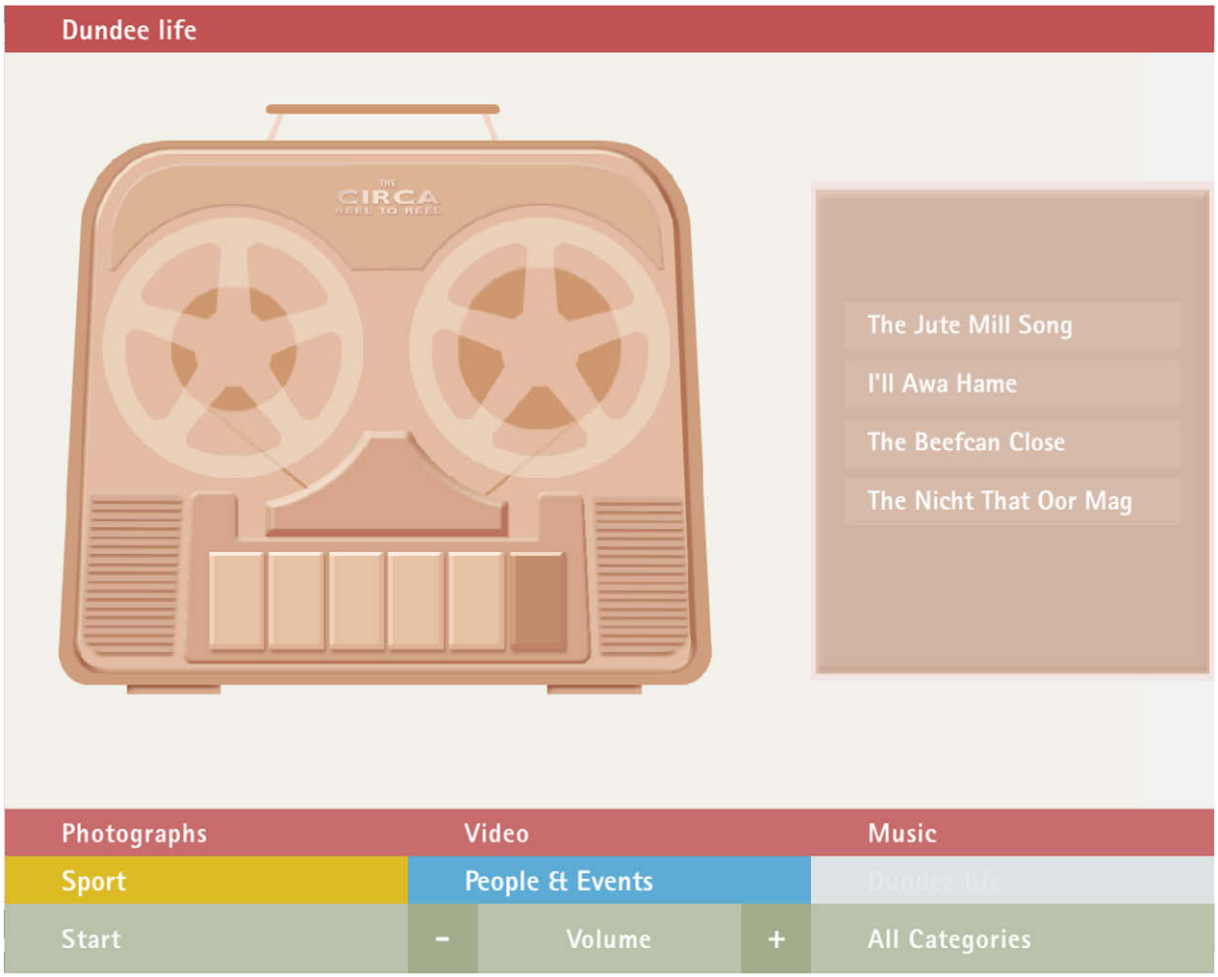

Fig. 1. Example of the CIRCA interface – radio themes.

photograph prototypes. We also felt it important to familiarise the whole team of software engineers and designers, as well as the psychologists, with the unique difficulties posed by this condition, by ensuring that they all spent time interacting with people with dementia (Astell et al., 2009). The development of the prototype was then carried out iteratively, with the input of people with dementia and caregivers throughout.

We have previously found that when compared to traditional reminiscence, CIRCA provides a more enjoyable activity for people with dementia and caregivers to carry out together (Astell et al., 2005). The present study was designed to further explore the utility of CIRCA by examining its impact on (i) the behaviour of people with dementia, (ii) the behaviour of caregivers, and (iii) the interaction between the two. To do this we examined the verbal and nonverbal behaviour of both parties. In the verbal behaviour we were interested in caregivers offering choice to the people with dementia and instances of people with dementia making choices themselves. In respect of nonverbal behaviour we explored the utility of CIRCA for providing a focus of joint attention and in supporting the caregivers in scaffolding the people with dementia during communication.

1.4. Scaffolding and joint attention

Joint attention is said to occur when two individuals attend to the same object, due to one person interpreting the attentional cues of the other (Emery, 2000). It forms the basis of referential communication (Butterworth, 1998) involving shared understanding between individuals of an object or event (Flom and Pick, 2003). Joint attention is pivotal in the development of communicative interactions between parents and infants (Corkum and Moore, 1998) and is a key component of scaffolding behaviour that occurs in parent-infant relationships and other dyads of unequal status (Wood, 1980).

Scaffolding refers to the provision of structure, guidance and encouragement by the higher status partner in a relationship (e.g. parent; caregiver), which takes into consideration their partner's (e.g. infant; patient) abilities (Hustedt and Raver, 2002). Successful scaffolding has three components (Wood, 1999). First, 'intersubjectivity' (Rogoff, 1990) or joint attention must be established between the two parties. Second, the facilitator must offer a suitable level of guidance, which is sensitive to their partner's competencies (Vandermaas-Peeler et al., 2003). Finally, the lower status partner must be encouraged to actively participate and "take ownership of the situation" (Greenfield, 1984). The most effective forms of guidance involve the lower status partner in decision-making processes regarding joint attention activities (Rogoff, 1990).

1.5. Exploring relationships in dementia

In the present study we examine the interaction behaviour of care staff and people with a dementia diagnosis during reminiscing using both verbal and nonverbal measures. We were interested to

examine both individual and dyadic behaviour to understand the contribution of CIRCA to the relationships between caregivers and people with dementia. Based on our previous research with CIRCA the following hypotheses were proposed in respect to verbal behaviour:

1. Caregivers will offer people with dementia a choice less often in traditional reminiscence sessions (TRAD) than in CIRCA sessions.
2. Caregivers will engage in more conversation maintenance activities in TRAD than CIRCA sessions.
3. People with dementia will make more choices in CIRCA than TRAD sessions.
4. People with dementia will initiate topics of conversation more often during CIRCA sessions than in TRAD ones.

Support for these hypotheses would confirm our previous findings that CIRCA can facilitate a more equal interaction by enabling caregivers to support people with dementia to make choices and provide opportunities for them to lead the conversation.

In respect of nonverbal behaviour we are interested in the caregivers' attempts to scaffold their partners' behaviour within reminiscing interactions by recording the frequency of dynamic nonverbal behaviours such as eye gaze and pointing that are thought to reflect the degree of involvement individuals invest in social situations (Segrin and Abramson, 1994). Turning eye gaze away is taken as an indicator of discomfort in an interaction from infancy upwards (Carter et al., 1990; Kogan and Carter, 1996), which has also been reported in children with autistic spectrum disorder (Nadel et al., 2000). The occurrence and duration of participants' laughter is also examined to provide a measure of positive and negative affect. Temporal overlap between participants' laughter indicates shared humour, whereas solitary laughter by either party is more suggestive of a nervous coping mechanism (Milgram, 1963). We are also interested in learning more about the nature of the interactions in terms of engaging in shared activity, specifically listening to music and singing, which we have previously observed but not measured.

In respect of the nonverbal aspects of interactions the following hypotheses were proposed:

1. There will be more music played in CIRCA sessions than in TRAD sessions.
2. There will be more singing during CIRCA sessions than TRAD sessions.
3. There will be more temporal overlap in laughter during CIRCA sessions than TRAD sessions.
4. People with dementia will look at the screen during CIRCA sessions more than they look at reminiscence objects during TRAD sessions.
5. In TRAD sessions people with dementia will look away from the caregivers and the reminiscing stimuli more than during CIRCA sessions.
6. Caregivers will point more to attract attention during CIRCA sessions than TRAD sessions.

2. Method

2.1. Participants

Eleven people with dementia, including six women, who met the NINCDS-ADRDA criteria for probable Alzheimer's Disease (McKhann et al., 1984) were recruited from a number of day care and residential facilities. Their mean age was 83.54 years (range 65–95; SD 8.98) and they had an average of 10.2 (range 9–12) years of education. The severity of their dementia was assessed using the Mini-Mental State Examination (MMSE; Folstein et al., 1975). Their MMSE scores ranged from 23 out of 30 (mild) to 9 (severe), with a mean of 15.9 (SD 5.53).

A two-stage consent procedure was used for the participants with dementia. First, letters were sent out to people with dementia in the partner organisations and their families informing them of the study and asking if they were agreeable to the study team approaching them to take part. On receipt of this consent, individuals with dementia were approached individually within the care services and the study explained to them. They were then asked if they would like to take part. They were asked to give written consent where possible and if not, verbal consent was obtained and witnessed by a neutral third party. All participants were free to leave the study at any time.

Eleven professional care staff were also recruited from the partner organisations to take part. Each person with dementia was paired with a caregiver for the study sessions.

2.2. Materials

CIRCA: An Apple G4 laptop was used to run CIRCA and it was presented through a 20-inch touch-screen monitor. SONY SRS-T77 speakers were used to output stored speech and music. CIRCA was viewed at a resolution of 1280×1024 pixels. Macromedia Director 8.5 was the authoring software for CIRCA and the following additional software were used to provide the content: Adobe Photoshop 6.0; Adobe Illustrator 9.0.1; Adobe Premier 6.0; QTVR Authoring Studio 1.0; SoundEdit 16 version 2; Infini-D 4.5. The CIRCA database contained 113 items comprising 80 photographs, 10 video clips and 23 pieces of music or songs. The average size of photographic content in CIRCA was 800×600 pixels. The average length of videoclips was 180 s. Songs and pieces of music varied in length, ranging between 30 s and 210 s. The stimuli were mainly drawn from the1930s to the 1960s and were presented in a simple visual format (see Fig. 1). Material in CIRCA was organised into three themes and into three media types. In the interface each theme was associated with a colour, and when a theme was selected, the hue of the background and of all the buttons changed to reflect the hue of the selected theme. Primary colours were chosen for the interface (Fig. 1).

TRAD: In these traditional reminiscence sessions caregivers were asked to choose their own stimuli based on materials they used to run reminiscence sessions in the normal course of their work. The sort of stimuli used include artefacts and information, such as replica newspapers and ration books from the Second World War. Some staff used commercially available reminiscence products such as cards and photographs.

Mini-Mental State Examination (MMSE; Folstein et al., 1975): This is a standardized measure of global cognitive function for older adults.

A Sony Mini DV Digital Handycam and tripod were used to record all sessions.

A *checklist* was also used to record dyadic activity, with sections for recording the activities of the caregiver and the person with dementia separately. The checklist comprised the following categories:

Person with dementia – choosing with prompt and initiation.
Caregiver – Prompting and conversation maintenance.
Dyad – singing and laughter.

The coding categories employed were used for both types of session and were designed to capture the nature of the interaction between the dyad.

2.3. Tasks

Each pair participated in two 20-min sessions.

CIRCA sessions: These were one-to-one sessions using CIRCA as the basis for an interaction between a person with dementia and a caregiver.

TRAD sessions: These were one-to-one sessions using typical reminiscence stimuli as the basis for an interaction between a person with dementia and a caregiver.

2.4. Procedure

At the start of each session the study was explained to the caregiver and the person with dementia together and both parties were asked if they had any questions regarding their possible participation. Reiteration of consent to record the sessions was sought at this time. The MMSE was conducted with the person with dementia before the start of the first session. During this time the caregivers practiced using CIRCA in the CIRCA sessions. In the TRAD sessions the caregivers planned the reminiscence activity. All sessions were conducted in a designated unoccupied room within each of the participating care facilities. Each room was set out to allow the caregiver and the person with dementia to sit side-by-side at a table.

CIRCA sessions: Each pair sat side-by-side in front of the touch screen. Each pair was shown how to start CIRCA and was then left to use it together.

The first screen has a 'start' message. Viewers are then offered a choice of three categories: Entertainment, Recreation, Local life. Viewers make a choice by touching the relevant category name on the screen (Fig. 2). The next selection is to choose from video, photographs or music.

TRAD sessions: Each pair sat together in positions they chose. Some pairs sat side-by-side and others sat face-to-face. Care staff used the materials they had chosen to facilitate the sessions. Typically the staff members showed the people with dementia photographs or artefacts from the past and used these to generate conversation.

All sessions were video recorded. The video recorder was set up on the tripod in such a position to film both participants at all times. In addition, a member of the research team sat in and observed all sessions. The observer sat behind each pair of participants, out of their view, and kept a tally of items on the checklist. Online coding involved noting down any pieces of information/memories produced by the dyad. The amount of times each event occurred during the session was coded from the videos.

2.5. Coding verbal measures

All reminiscence sessions were observed online and again from videotape. The coding categories and their operational definitions are explained below (Table 1):

2.6. Coding nonverbal measures

Each videotape was blind coded by two raters: an independent investigator who had not been involved either in developing CIRCA or recording the sessions and a member of the CIRCA team. A

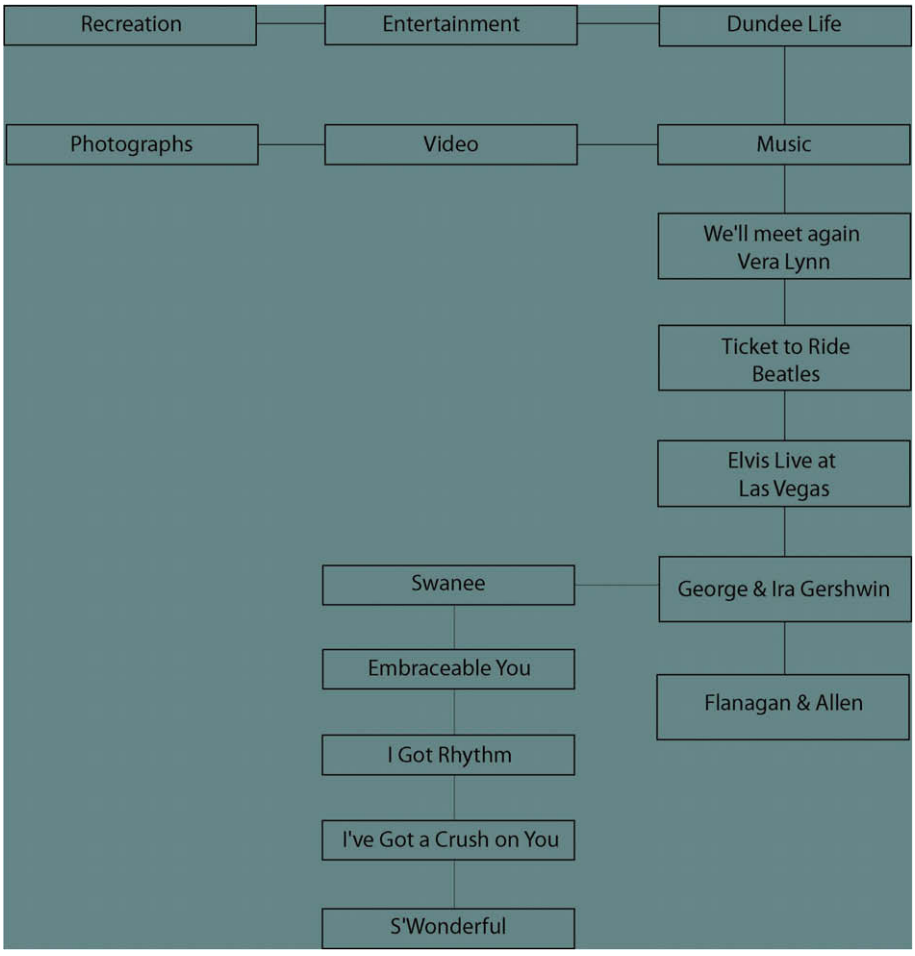

Fig. 2. Flowchart demonstrating an example decision tree in CIRCA.

Table 1
Verbal coding categories.

Person with dementia	Caregiver
Choosing with prompt – amount of times the person with dementia chose what they wanted to talk about/see/listen to in response to being offered a choice of stimuli by the caregiver	Prompting – prompts given by the caregiver to the person with dementia to make a choice about what he/she wishes to talk about. For e.g. during TRAD sessions the caregiver might ask, "What would you like to talk about?" During a CIRCA session, the caregiver might ask "Would you like to look at photographs, music or video?"
Initiation – Speech was coded as 'initiation' when the person with dementia made the first comment on viewing/listening to new stimulus i.e. saying "That's the main street" on seeing a new photograph or starting to sing on hearing a song.	Conversation maintenance activities – contributions from the caregiver classified as serving to maintain the conversation. For instance the caregiver might ask the person with dementia a question such as "did you enjoy going to the pictures when you were younger?"

randomly sampled 5-min interval was selected for analysis from each of the 11 TRAD and 11 CIRCA 20-min interactions. The random sampling ensured that these intervals represented the entire interaction duration. Each dyad was coded for the same 5-min portion (i.e. identical start times) for the two reminiscence conditions. The dyads were randomly allocated to staggered coding intervals, 90 s apart (at times: 0, 90, 180, 270, 360, 450, 540, 630, 720, 810, and 900 s).

The four nonverbal measures of the dyadic interaction were operationally defined as follows (Table 2).

The 5-min portions of each dyad's reminiscence sessions were recorded, digitised and compressed from analogue (on the camcorder) to MPEG (on the computer) using the MPEG encoder 'Canopus MVR1000SX'. The resulting 22 MPEG files were coded/scored using 'The Observer' (version 5) (Noldus, 2003) – a behavioural observations software package. This entailed setting up a configuration, which outlines the study's coding parameters. Eye gaze, laughing and drawing attention were coded separately for each person, with each dyadic interaction consequently being viewed seven times (including once for the music variable) with the researcher concentrating on each aspect individually. An alphabetic keyboard character represented each dependent variable, and pressing these caused the corresponding factor to be time-stamped and listed in the event-time log of the dyad being observed.

The reliability of the coding system was established by an inter-rate reliability Pearsons's correlation, which revealed a significant relationship between the ratings of two coders ($p < .05$). The mean inter-rater agreement was 100%.

The eye gaze direction variables "Experimenter' and 'Obstructed' were omitted from the statistical analysis. They were coded to provide an accurate and complete temporal observational record of each dyad.

3. Results

3.1. Verbal measures

To evaluate the utility of CIRCA in providing an engaging shared activity for people with dementia and caregivers we compared the dyads on a number of measures. In CIRCA sessions the people with dementia were offered a choice more often by the caregivers ($t(10) = 5.9$, $p < .0005$; Table 3) and subsequently made more choices ($t(10) = 3.617$, $p < .005$; Table 3) than in the TRAD sessions. By contrast, in TRAD sessions the caregivers spent a lot more time engaged in conversation maintenance activities, such as asking direct questions to the people with dementia than they did in CIRCA sessions ($t(10) = 3.13$, $p < .01$). In addition, lower levels of initiation were recorded for people with dementia in TRAD sessions relative to CIRCA sessions ($z = 2.03$, $p < .05$).

3.2. Nonverbal measures

CIRCA sessions were marked by a large amount of time spent listening to music (33%) whilst there was no music played in any of the TRAD sessions. One person with dementia did sing during a TRAD session but overall people with dementia sang significantly more during CIRCA sessions than TRAD ones ($t(10) = 2.191$, $p < .05$). Likewise caregivers sang ($z = 2.33$, $p < 0.05$) and moved to music more ($t(10) = 2.39$, $p < .05$) in CIRCA sessions (Table 4).

3.3. Nonverbal measures

To examine where participants were looking during the two reminiscence sessions a 2 (group) $\times$ 2 (reminiscence type) $\times$ 3 (gaze direction) mixed ANOVA was conducted. This revealed a significant effect of gaze ($F(2, 40) = 19.966$, $p < .0005$), a significant gaze by group interaction ($F(2, 40) = 6.58$, $p < .001$), plus a significant gaze by reminiscence type interaction ($F(2, 40) = 33.99$, $p < .0005$). Post hoc analyses revealed differences in the behaviour of the people with dementia and the caregivers (Fig. 3). During CIRCA sessions the people with dementia looked at the screen significantly more than the caregivers ($t(1, 20) = 2.54$, $p < .05$) and the caregivers looked at the person with dementia significantly more than the person with dementia looked at the caregiver ($t(1, 20) = 2.445$, $p < .05$). This was repeated in the TRAD sessions, where the caregivers looked significantly more at the person with dementia than the other way round ($t(1, 20) = 2.24$, $p < .05$). In addition, in TRAD sessions, people with dementia looked away from the caregiver and the reminiscence stimuli (i.e. elsewhere) significantly more than the caregivers did ($t(1, 20) = 3.01$, $p < .01$).

Comparison of the two types of reminiscence sessions revealed further differences in the behaviour of the two groups of partici-

Table 2
Nonverbal coding categories.

Music	Amount of time music was played in each session plus the occurrence of moving to music by one or both partners; and singing by either party.
Pointing to draw attention	The frequency of each participant's pointing behaviour was noted. Pointing events were recorded when there was clear intention to engage the partner's attention within the dyadic interaction (i.e. at the screen, CIRCA/object, TRAD). Pointing was not considered to be 'drawing attention' when elicited as a conversational gesture, with no specific material focus.
Laughter	Temporal duration of participants' laughter, and the overlap between dyadic members' laughter, was assessed. Overlap of laughter between members of a dyad highlights joint attention and engagement of both individuals in the interaction because it signals shared understanding.
Direction of eye gaze	Continuous temporal recording necessitated the use of 5 sub-categories of eye gaze direction, towards: (i) screen (C)/object (T); (ii) other person (dyad member); (iii) elsewhere (i.e. none of the sub-categories); (iv) experimenter (comprising the human researcher *or* the camcorder); and (v) obstructed (if the view of a participant was obscured in the video recording).

Table 3
Mean (SD) and range for participants' verbal behaviours in CIRCA and TRAD sessions.

	CIRCA (n = 11)	TRAD (n = 11)
Person with dementia		
Choosing with prompt	7.27 (6.16) 0–20	0.27 (0.64) 0–2
Initiation	3.36 (2.87) 0–9	1.09 (1.81) 0–5
Caregiver		
Prompting choice	13.27 (6.89) 3–25	0.45 (0.69) 0–2
Maintenance activity	12.09 (8.36) 1–26	27.45 (15.47) 7–59

Table 4
Mean (SD) and range for participants' nonverbal behaviours in CIRCA and TRAD sessions.

	CIRCA (n = 11)	TRAD (n = 11)
Music (% of time)	33	0
Person with dementia		
Singing	2.19 (2.22) 0–6	0.64 (2.11) 0–7
Moving to music	1.09 (2.21) 0–6	0.45 (1.5) 0–5
Pointing to draw attention	1.63 (2.11)	1.36 (3.1)
Laughter	3.03 (4.02)	3.58 (6.29)
Caregiver		
Singing	1.27 (2.1) 0–7	0.18 (0.6) 0–2
Moving to music	1.0 (1.61) 0–5	0.27 (0.9) 0–3
Pointing to draw attention	11.18 (6.62)	1.18 (1.83)
Laughter	2.36 (1.87)	3.41 (2.89)

pants. People with dementia looked at the screen in CIRCA sessions significantly more than they looked at the stimuli in TRAD sessions ($t(1, 10) = 5.394$, $p < .0005$; Fig. 3). In TRAD sessions although people with dementia looked more at the caregiver than in CIRCA sessions ($t(1, 10) = 3.307$, $p < .01$) they also looked elsewhere in the room a lot more often, avoiding eye contact with the caregiver ($t(1, 10) = 2.62$, $p < .05$).

Caregivers also behaved differently in the two types of reminiscence sessions. In CIRCA sessions they looked at the screen a lot more than they looked at the stimuli in TRAD sessions ($t(1, 10) = 4.46$, $p < .001$). By contrast TRAD sessions were marked by the caregivers looking directly at the people with dementia far more than in CIRCA sessions ($t(1, 10) = 3.56$, $p < .005$).

Examination of pointing to draw attention revealed that caregivers pointed to draw their partners' attention significantly more often during CIRCA sessions compared to TRAD sessions ($t(1, 10) = 3.65$, $p < .005$; Table 3). The amount of laughter did not differ between the two types of reminiscence session ($p > .05$; Table 3). However, examination of the time-event plots revealed that while most of the laughter that occurred during CIRCA sessions was joint, that is both parties in the dyad laughing together, in TRAD sessions much of the laughter was solitary by one person or the other.

4. Discussion

CIRCA appears to support relationships between caregivers and people with dementia by providing an engaging conversation maintenance activity that is not replicated in traditional reminiscence sessions. There were notable differences between the two session types in the verbal and nonverbal behaviour of both parties and in their dyadic behaviour. In traditional reminiscence sessions the caregivers worked very hard to keep the interaction going, particularly by asking lots of questions. These were typically closed questions (e.g. "Did you used to do that?" "Do you remember those?"), that did not encourage either initiation or choosing by people with dementia. This replicates previous findings where caregivers reported in interviews after the two reminiscence activities that they found the traditional sessions much more demanding and that twenty minutes felt like a long time (Astell et al., 2005). By contrast they found it relatively easy to facilitate a shared interaction using CIRCA (Astell et al., 2005), a finding which was replicated in the present study.

Examining how often the caregivers offered the people with dementia a choice in terms of reminiscence topics and how much they encouraged them to make decisions illuminates this finding. The results of the present study replicate our earlier findings that caregivers offer more choice during CIRCA sessions and are much more likely to encourage the people with dementia to decide what they want to look at and talk about (Astell et al., 2005). This is further supported by the finding that caregivers pointed much more during CIRCA sessions to draw their partner's attention than they did during the traditional reminiscence sessions. Research on mother-infant dyads has found that parents often maintain joint attention by pointing to an object of shared focus in a form of scaffolding behaviour (Pratt et al., 1988). The findings in the present study suggest that CIRCA provided a focus for joint attention, which allowed the caregivers to then scaffold the people with dementia to play a more equal role in the interaction.

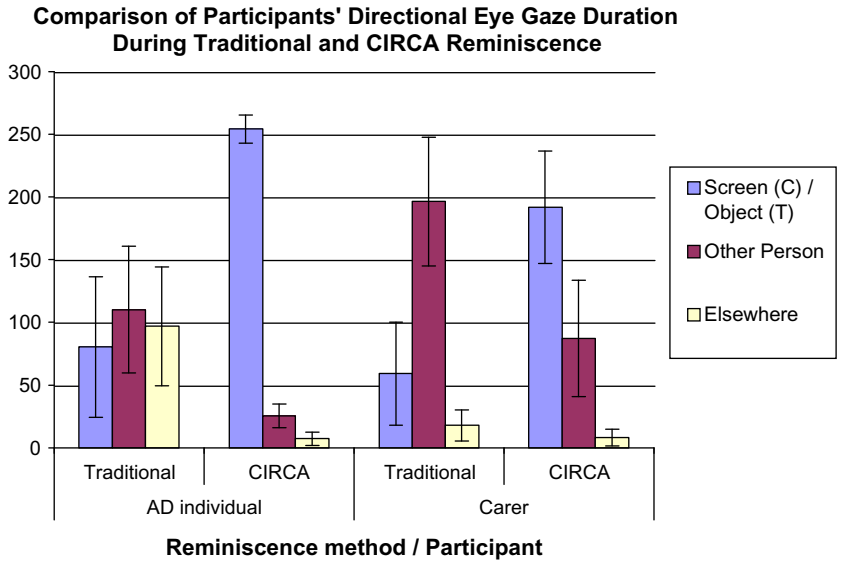

Fig. 3. Comparison of directional eye gaze duration during TRAD and CIRCA sessions.

The different character of the two types of reminiscence session is further illuminated by the examination of the direction of the participants' eye gaze. Eye gaze is thought to reflect an individual's level of engagement in (Segrin and Abramson, 1994) and comfort with an interaction (Nadel et al., 2000). As such this was taken as a measure of participants' attentional focus and a further indicator of the presence or absence of joint attention in the dyads. In CIRCA sessions both caregivers and people with dementia looked at the screen a lot more than they looked at the stimuli during the traditional reminiscence sessions. This suggests that the dyads were able to establish joint attention much more easily in the CIRCA sessions and indeed it could be argued that in many of the traditional sessions they failed to achieve joint attention at all. Thus in these TRAD sessions the caregivers were unable to scaffold the people with dementia to play a more equal part in the interactions.

In both CIRCA and TRAD sessions the caregivers looked more at the people with dementia than vice versa. This can be considered normal behaviour in a conversation, especially when people are sitting face-to-face as occurred in many of the traditional sessions. However, in these sessions the people with dementia tended to avoid eye contact with the caregivers by looking elsewhere in the room, aversion of eye gaze being taken to indicate discomfort in the interaction (Carter et al., 1990; Cheek and Buss, 1981). This may in part reflect the fact that caregivers provided fewer stimuli in the traditional sessions and thus fewer objects for joint attention, relying instead on asking lots of questions. In the participants with dementia this could occur because they feel inadequate when they are unable to answer the caregivers' questions. Unfortunately, when this occurred the caregivers often continued to look at the people with dementia whilst awaiting a reply or possibly composing their next question, thus reinforcing the discomfort.

Examination of dyadic behaviour revealed that there was more singing and moving to music during CIRCA sessions. This suggests that the CIRCA sessions were more relaxed as both parties sang along or moved to the music together. Caregivers never brought music to the traditional sessions and there was only one instance of spontaneous singing in a traditional session. This is worthy of note, given that music was identified by caregivers during the development of CIRCA as an important stimuli in group reminiscing sessions. The finding in this study, however, replicates our previous work that caregivers do not spontaneously use music as a stimulus for reminiscing with people with dementia, especially in a one-to-one situation. This may be because playing music to prompt conversation appears counterintuitive to staff. However, the findings from the CIRCA sessions suggest that listening to music provides an enjoyable way for caregivers and people with dementia to jointly engage in a shared activity.

An indication of enjoyment that was found in both session types was laughter, which occurred as much during CIRCA and traditional sessions. Examination of the time-event plots, however, revealed that laughter during CIRCA sessions was mainly synchronous whereas in the traditional reminiscence sessions most instances of laughter were solitary. This is taken as an indicator of anxiety or discomfort (Milgram, 1963) and examination of the contexts revealed that it often occurred when a person with dementia was unable to answer a question posed by the caregiver or when there was no reply from the person with dementia and the caregiver attempted to cover the ensuing silence.

CIRCA appears to support people with a dementia diagnosis to participate in conversation with caregivers by circumventing their working memory problems. As such, its actions can be seen as similar to an aided AAC device or cognitive prosthesis for people with dementia (Astell et al., 2008). Interestingly, CIRCA also functioned to facilitate caregivers to provide unaided AAC in the form of pointing and movements that supported the exchange of information between the two. Additionally, the caregivers provided more of the nonverbal cues that support the development of intimacy and reciprocity in the CIRCA sessions (McAdams et al., 1984).

We have shown that reminiscence using multi-media allows people with dementia to talk about topics that would not normally come up. This is in contrast to traditional reminiscence where care staff tend to use tried and tested methods, picking topics that they know the person likes to talk about. As such, for carers, CIRCA provides the opportunity to learn more about the person with dementia with minimal effort on their part, as they do not have to spend time finding a variety of stimuli. For people with dementia, CIRCA provides the opportunity to talk about new topics by offering a greater choice and range of items than are typically available in traditional reminiscence.

Additionally, people with dementia are able to exercise choice and control using CIRCA, which contrasts with traditional, carer-led reminiscence, as well as more functional interactions concerning activities of daily living, where people with dementia are typically given little choice. CIRCA encourages care staff to offer more choices, perhaps by providing security in that there are no incorrect choices or responses. Additionally, care staff feel less need to maintain conversation in the multi-media setting, which should have the effect of reducing stress. One consequence of this is increased enjoyment not only in the multi-media reminiscence session but in spending the time with the person with dementia in general. There are obviously positive benefits to both staff and people with dementia of spending one-to-one time, however, the quality of this is clearly influenced by the perceived burden of maintaining conversation that falls on staff in traditional settings versus sharing a positive interactive experience where both parties are more equal participants.

These findings support the use of computers to promote and maintain conversation between people with dementia and caregivers. The results suggest that providing a cognitive prosthesis for people with dementia to support them in conversation, in turn acts to enable their interactions with caregivers. This appears to have a positive effect on the caregiving relationships as caregivers are more relaxed, engaged and enabled to give up control to people with dementia.

In summary the findings of the present study suggest that CIRCA can change the situation of people with dementia and caregivers to improve their relationship. Joint attention can play a key role in interactions between people with dementia and caregivers by promoting scaffolding behaviour in the caregiver. This empowers the person with dementia and redresses the status hierarchy during the course of the interaction. This in turn could positively influence staff's views of the people they work with, making what is traditionally a poorly paid low status occupation more satisfying and rewarding, thus improving their job satisfaction, psychological health and well-being.

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