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TOUCHSCREEN INTERVENTIONS FOR PEOPLE WITH DEMENTIA

Section A: How do touchscreen interventions impact on the wellbeing of people with dementia and their carers?

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Section B: Can viewing art on a touchscreen computer help the wellbeing of people with dementia and their carers?

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Portfolio summary

Section A

This section reviews literature covering touchscreen based interventions designed to be used by people with dementia with reported psychological outcomes. The introduction covers dementia, wellbeing and technology based interventions that have been trialled in the care of people with dementia. Peer-reviewed literature relating to touchscreen based interventions for people with dementia is critically reviewed in relation to outcomes for people with dementia, their informal carers, and aspects of the interventions considered to be important. The implications of the reviewed literature are discussed, in relation to evidence supporting the psychological benefits of touchscreen based interventions, clinical implications and future research priorities.

Section B

This section covers a mixed-methods exploratory study investigating the impacts of a novel touchscreen art-viewing application on wellbeing. Volunteers completed measures of wellbeing before and after the intervention, and before and after each art-viewing session. They were also interviewed and the transcripts thematically analysed in relation to wellbeing impacts and the experience of using the app. Analysis of quantitative data showed a beneficial impact on wellbeing following app sessions, which increased in magnitude as sessions progressed. The thematic analysis found a wide range of impacts on wellbeing from the perspectives of people with dementia and their informal carers, as well as important aspects of the intervention from their perspectives. Implications for clinical practice and future research are discussed.

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Section A: Literature Review

How do touchscreen interventions impact on the wellbeing of people with dementia and their carers?

Word count – 7948 (287)

Abstract

A range of computer-based interventions, including touchscreen based interventions have been trialled for use by people with dementia, in the hope that they might help to improve psychological wellbeing. A systematic review identified examples of touchscreen based interventions designed to be used by people with dementia with reported psychological outcomes. Five search engines yielded 411 papers, of which fifteen were eligible. Research was reviewed in relation to reported psychological outcomes, and key aspects of the interventions according to the researchers. Whilst much of the existing research is relatively small-scale, the findings tentatively suggest that touchscreen based interventions can improve the subjective wellbeing of people with dementia, and possibilities for more rigorous future research are suggested.

Keywords

Dementia, touchscreen, technology, wellbeing, informal carer.

Introduction

The current review focuses on computer-mediated interventions for people with dementia and/or their carers, delivered using touchscreen devices. The aims were to explore the psychosocial impacts of touchscreen based interventions for people with dementia and/or their carers, identifying relevant theories and key aspects of these interventions. The benefits and drawbacks of the various intervention approaches are presented, concluding with recommendations for further research and a discussion of practice implications for clinical psychology.

Dementia

As life expectancies increase, support for people with a dementia (PWD) and the people who care for them is becoming increasingly important. There are an estimated 835,000 people living with dementia in the UK, and dementia costs twenty-six billion pounds annually in the UK alone, despite 670,000 people acting as primary informal carers (ICs) for people with dementia, which is estimated to be worth a saving of eleven billion pounds (Alzheimer’s Society, 2014). “Dementia” encompasses a range of subtypes, including Alzheimer’s disease, vascular dementia, dementia with Lewy bodies and frontotemporal dementia. These subtypes can occur independently or simultaneously in those affected. Dementia is a progressive condition and currently there is no known cure, so interventions that can help maintain quality of life for people with dementia and informal carers can make substantial improvements to people’s lives and can have positive financial implications for the nation.

Wellbeing

The concept of “wellbeing” is hard to define. “Subjective wellbeing” (Diener, 1984; 2006) denotes experience of positive emotion, low levels of negative emotions and high life satisfaction. Quality of life (QoL), defined as “An individual’s perception of their position in life, in the context of the culture and value systems in which they live, and in relation to their goals, expectations, standards and concerns” (World Health Organization QoL Group, 1995, p. 1404) has been described as synonymous with subjective wellbeing (Camfield & Skevington, 2008). Galloway and Bell (2006) concluded in their review of indicators related to QoL that, “An accepted uniform definition of either term does not exist.” Despite this lack of consensus, government policy has integrated wellbeing as a key component of both public health and mental health strategies (Department of Health, 2010, 2011).

The World Health Organization (1946) defines wellbeing as being a component of overall health: “Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.” (p. 100). A state of “complete” health in all areas is perhaps not realistic with certain groups, such as people who are ageing, or those with a progressive illness such as dementia. Huber et al. (2011) proposed an amendment to the definition to take chronic disease into account, by defining health and wellbeing through ability to adapt to changing physical, emotional and spiritual challenges, and to self-manage. This shift in conceptualisation is reflected in the World Health Organization’s 2011 definition of wellbeing as, “a positive state of wellbeing, one which allows individuals to fully engage with others, cope with the stresses of life and realise their abilities” (p. 1).

Ryff (1989) proposed adding to the existing empirical wellbeing conceptualisations which tended to be based on affect and life satisfaction by locating wellbeing both within and around the individual, contingent upon autonomy, positive relations with others, purpose in life, and personal growth. She determined that previous measures of wellbeing had not taken these key personal developmental aspects of wellbeing into account, despite their being supported in contemporaneous theoretical literature. Deci and Ryan’s (2000) Self-Determination theory linked wellbeing with three related psychological needs: autonomy, competence and relatedness. This was key in developing the concept of wellbeing by linking it to intrinsic goals such as improving society, cultivating close relationships and personal development rather than extrinsic materialist goals.

Efforts have been made to construct standardised measures of wellbeing. Dupuy (1984) was one of the first contributors and he constructed the psychological general well-being index, which measured wellbeing according to six dimensions: anxiety, depression, positive wellbeing, self-control, vitality and general health. These are measured with 22 items and completion takes around ten minutes. Analysis yields scores for each dimension, as well as an overall score. It does not measure physical health, and in practice would have to be used in conjunction with other measures if this information was required.

Bowling et al. (2015) reviewed sixteen dementia-specific QoL measures. Their theoretical bases ranged from being poorly defined to being more well-elaborated. The most commonly cited theoretical framework was that of Lawton, (1997) which encompasses a wide range of psychosocial domains as well as health. Some measures which cited Lawton in fact focussed purely on observable activity or events, or other areas but not all of the domains. Other measures were based purely on health-related conceptualisations of QoL. The level of involvement of people with dementia in the development and the completion of the measures was limited, with measures many measures based on proxy assessments. Bowling et al. concluded that the wider applicability of all of the measures had not been satisfactorily established, nor had their predictive validity. They recommended the development of a more all-encompassing and robustly tested measure, which reflects the perspectives and requirements of people with dementia. Furthermore, they acknowledged the necessity of pragmatic compromise between the information provided by a comprehensive measure compared with the reduction in respondent and researcher burden posed by briefer measures.

Technological interventions

If the UK's ageing population continues to grow as predicted (Alzheimer's Society, 2014), it is likely that there will be insufficient carers to provide adequate support. A range of types of non-pharmacological interventions have been trialled with people with dementia and their carers. Technological approaches present a possible solution to this issue, as they can allow people to be live independently for longer through the use of smart technology to monitor potentially dangerous situations in the home, such as a gas tap being left open (Adlam & Orpwood, 2004), or more controversially, electronic tagging, to reduce 'wandering' and heighten safety (McCabe & Innes, 2013).

Some critics of technological approaches suggest that they can undermine one's personhood defined by Kitwood (1997) as, "a standing or status that is bestowed upon one human being, by others, in the context of relationship and social being. It implies recognition, respect and trust." Astell (2006) reviewed various types of technological interventions (e.g. electronic tagging, assistive technologies, and psychosocial interventions) and found they “run a particularly high risk of crossing the line into doing things to people with dementia, rather than with them” (p. 15), possibly diminishing their personhood. She concluded that maintenance and enhancement of personhood should be central to the design of technological interventions, and that to this end they should be developed in partnership between those with dementia and caregivers. According to Astell, future developments should “put the needs of people with dementia first and make explicit how the technology will both enable them and maintain them as human beings” (p.23).

In a review of novel technology by older people, Age UK (2011) concluded that technology, such as internet based communication tools, was being increasingly adopted by people aged over 65, and that it could reduce loneliness and isolation, enhance their sense of being in control, and help them to live in their homes independently for longer. They suggested that factors mediating the effectiveness of technology-based interventions included accessibility, motivation and people’s appraisal of their own skills and confidence. This suggests that whilst some have recommended caution in relation to the possibility that technology might undermine personhood, there might also be ways in which it could be implemented that maintain personhood.

McKechnie, Barker and Stott (2014) reviewed the outcomes of computer-mediated interventions for carers of people with dementia and found that higher quality studies having greater reported beneficial impacts on carer burden and mood, supporting the value of computer-based interventions for carers. They suggested subsequent investigations into computer-based support might benefit from mixed-methods approaches. Godwin, Mills, Anderson and Kunik (2013) reviewed eight studies from four randomised controlled trials (RCTs), which covered three interventions, looking at the psychosocial effects of technology-driven interventions for the carers of people with dementia. They concluded that whilst the studies all showed beneficial outcomes, the delivery of the interventions was inconsistent, as was outcome measurement.

Methodology

In order to explore existing research into the use of touchscreen based technology with people with dementia and their carers, a systematic review (Grant and Booth, 2009) was carried out. Initial searches were conducted in relation to technology-based interventions with people with dementia and their carers. Correspondence with fellow researchers also yielded some papers, which guided the researcher’s thinking and search patterns. For the main literature search, PsycInfo, ASSIA, Medline, Cinahl and Cochrane databases were searched; only peer-reviewed journal articles were included. The search terms used and the results from each database are shown in Table 1. In order to capture as many relevant papers as possible, and since touchscreen technology itself is a relatively recent development, no date constraints were used. Inclusion and exclusion criteria can be seen in the section below. Reference lists from the papers which were read and included were checked for other potentially eligible papers. A flow chart of the search process can be seen in Figure 1. Since much of the research uses mixed-methods or qualitative approaches and small sample-sizes, it was decided that a systematic review with narrative and tabular synthesis of findings would be the best way to combine the research evidence with views of service users and practitioners. Quality of papers was appraised by reviewing designs and methodologies. The Mixed Methods Appraisal Tool (MMAT) checklist (Pluye et al., 2011; Appendix A) was used as a guide for appraisal. This tool was selected as it allows concomitant appraisal and scoring of mixed methods, qualitative and quantitative designs, is designed for use in reviews, has been pilot tested for reliability and content validated with feedback from experts and workshops. Where papers reported quantitative measures related to psychological outcomes, these were reported (see Table 2). Outcomes were grouped into domains for review in the narrative section. Findings reported by researchers in relation to aspects of the interventions they believed to be important were grouped into domains and reported in a narrative style.

Table 1

Search terms and results from databases

Database	**PsycInfo**	**ASSIA**	**Medline**	**Cinahl**	**Cochrane**
Search 1	(“dement*” OR “Alzheimer*”)				
Results	74 129	6 390	163 556	14 672	8 639
Search 2	(“touch screen*” OR “touchscreen*” OR “touch-screen*” OR “iPad*” OR “Android*” OR “tablet*” OR “haptic*”)				
Results	5 560	518	47 504	188	129
Search 3	(Search 1) AND (Search 2)				
Results	99	3	224	44	42

Inclusion and exclusion criteria

1. At least part of the intervention must be delivered via touchscreen, operated by people with a dementia.

2. Psychological wellbeing outcomes must be reported for people with dementia or their informal carers. ‘Psychological outcomes’ was kept to a broad definition, including related outcomes such as carer burden and independence of people with dementia.

3. Studies must include a form of dementia as the diagnosis of the person using the touchscreen device. All subtypes and stages of dementia were included.

4. Studies must describe the intervention offered. Studies with no intervention component, such as assessment tools, were excluded.

5. Studies without explicit methodology were excluded.

6. Only articles in the English language were included.

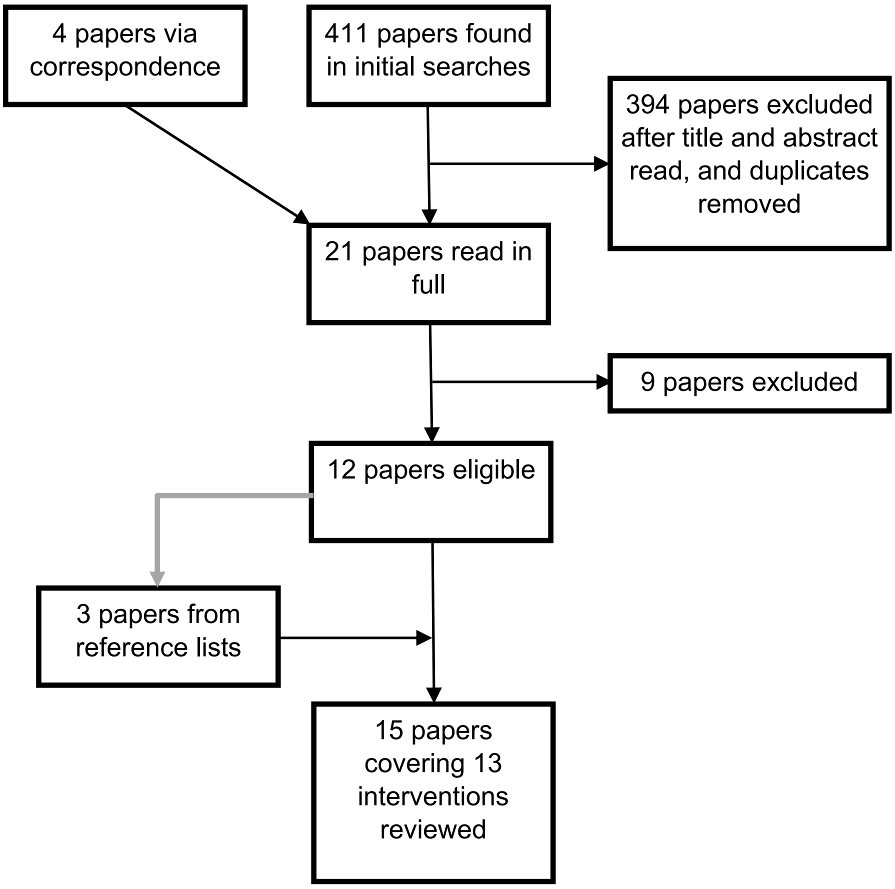

Figure 1. Flow diagram of article selection process.

Table 2

Study characteristics

Authors, date	**Participants**	**Aim**	**Touchscreen Intervention**	**Design** ***(MMAT appraisal)***	**Measures**	**Psychological impact finding(s)**	**Important aspects of intervention**
Alm et al., 2004 **Phase 1**	6 PWD – 3 male, 3 female. Mean age 74.3 (range 57-95), MMSE scores 10-25, mean 15.6. 6 carers – 3 informal, 3 formal.	Pilot study, to test the feasibility of PWD using the technology.	“Cognitive prosthesis”. LCD touch pad – sound, videos and photos	System evaluation – exploration of user experience and carers’ views.	Structured interviews with PWD. Self-report questions and Likert scales with carers.	“All participants liked”. Care staff said prompting meant PWD interacted more than usual.	Hypermedia - no penalty on “losing the place” Not reliant on short-term memory Simple presentation All found touch screen ‘easy’.
Phase 2	9 PWD – 4 male, 4 female (sic). Aged 65-95, mean 83. MMSE range 8-22, mean 16. 9 professional care staff across 5 day	Prototype evaluation to explore: 1. Interest and involvement of PWD. 2. Impact on care staff	Refined version of cognitive prosthesis, with sections on entertainment, recreation and local Dundee life.	Qualitative exploration of clients’ views *(qualitative checklist: 25% researcher position, ethics*	Evaluation questionnaires with PWD and staff.	All PWD and staff said they enjoyed, and named aspects they liked. PWD named stimuli they had liked the best.	PWD expressed desire for stimuli with personal relevance. Staff able to

Authors, date	**Participants**	**Aim**	**Touchscreen Intervention**	**Design** ***(MMAT appraisal)***	**Measures**	**Psychological impact finding(s)**	**Important aspects of intervention**
	centres.	enjoyment in keeping company with PWD.		*and analysis unclear)*		Staff believed PWD learned new things, put focus of attention back on PWD, and remembered things. Better quality time together.	use system with little preparation.
Alm et al., 2007 **Phase 1**	40 PWD, 30 informal carers.	Initial prototyping with a number of potential interfaces	CIRCA (Computer Interactive Reminiscence & Conversation Aid) – evolution of cognitive prosthesis	Informal evaluation – demonstrations of different interfaces across settings.	Unclear, but apparently observation of PWD in care homes and conversations with their carers.	PWD "interested and motivated". Videos only engaging when resonated with PWD.	Hypermedia structure Simple interface, muted colours. No need to duplicate paper scrapbook look. Touch screen essential. Photos & music appreciated more than videos.

Authors, date	**Participants**	**Aim**	**Touchscreen Intervention**	**Design** ***(MMAT appraisal)***	**Measures**	**Psychological impact finding(s)**	**Important aspects of intervention**
							Animations of music players helpful.
Phase 2	18 PWD – 13 female. "Moderately to seriously affected."	To compare impact on interactions between PWD and carers when using CIRCA vs traditional reminiscence (TRAD)	CIRCA	Between participants - random assignment to CIRCA or TRAD *(mixed methods checklist: 25% - allocation and data completeness unclear, integration consideration unclear)*	Sessions videoed. CIRCA logs scrutinised. Coding of interactions: - PWD choosing - Caregiver prompting - Memories, humour, laughter or movement	Changes in interaction pattern: PWD offered more choice with CIRCA (U=1.50, p<.001), and made more choice (U=2.00, p<.001) More choice led to PWD sharing more reminiscences (r=.40, p<.05). Conversations more equally balanced with CIRCA. "It takes you back and	Attempts to integrate personal information were distressing when PWD could not recall family members: personal material not needed as generic material can provoke recall. "Aesthetic usability effect" meant software was usable.

Authors, date	**Participants**	**Aim**	**Touchscreen Intervention**	**Design** ***(MMAT appraisal)***	**Measures**	**Psychological impact finding(s)**	**Important aspects of intervention**
						refreshes your memory."	
Alm et al., 2009 **Phase 1 – Interactive entertainment**	Initially 5 PWD, 3 male, 2 female. Eventually 12 PWD – 7 female, 5 male	Investigate ways an interactive entertainment system for PWD could engage & prompt them to use it unaided	3D virtual environments, activities and games	Qualitative exploration of clients' views *(qualitative checklist: researcher position, ethics & analysis unclear)*	Interviews and observations	Individual: "appeared to enjoy" 3/5 tried independent use. "Wonderful". "I'd be there all day." "Lovely." In groups : "lots of comments and cheering at … success"	Engaging interface which promises enjoyment Clear goals Challenge and skill mastery Continual feedback – encouragement and praise
Phase 2 – Being musically creative	25 PWD	To devise technology which could help a PWD to carry out a satisfying creative activity.	ExPress Play Chord-based music creator.	Mixed methods *(qualitative checklist: 25% researcher position, ethics & analysis unclear)*	Video of sessions and device logs of activity	Sig increase in duration of music playing in 3rd session. More finger movements & choices. Learning took place? Ppts tended to want to keep playing.	Unclear

Authors, date	**Participants**	**Aim**	**Touchscreen Intervention**	**Design** ***(MMAT appraisal)***	**Measures**	**Psychological impact finding(s)**	**Important aspects of intervention**
Astell et al., 2008 **Study 1**	18 PWD, 13 female. Mean age 82 years. (Same as Alm et al., 2007 phase 2 above).	To examine utility of CIRCA as a communication prosthesis for PWD	CIRCA PWD used with professional care staff in pairs.	Between participants CIRCA vs. traditional reminiscence (REM)	Incidences of PWD initiating topics and making decisions were recorded, as well as aspects of caregiver interactions. Interview data reviewed for feedback from PWD about their experiences.	In both studies: PWD initiation much higher with CIRCA. PWD also made more decisions about what they wanted to do. All PWD said they enjoyed. Staff said CIRCA was easier and less burdensome. CIRCA *restores* PWD's status as equal conversation partners.	Reduces "working memory load" of conversation for PWD. Hypermedia + touch screen → good flexibility for PWD. CIRCA helps conversation partners too.
Study 2	11 PWD, 6 female. Mean age 83.54 years. (Same as Astell et al., 2010 below).	To examine utility of CIRCA as a communication prosthesis for PWD	CIRCA PWD used with professional care staff in pairs.	Within participants CIRCA vs. REM *(Quantitative checklists : 75% as allocation concealment unclear)*			
Astell et al., 2010	11 PWD, 6 female, who met criteria for "probable	To explore changes in verbal and nonverbal	CIRCA	Repeated measures. CIRCA vs.	Wellbeing Verbal	Verbal -more choices offered to PWD	Hypermedia allows PWD to talk about topics that

Authors, date	**Participants**	**Aim**	**Touchscreen Intervention**	**Design** ***(MMAT appraisal)***	**Measures**	**Psychological impact finding(s)**	**Important aspects of intervention**
	Alzheimer's disease". Recruited from day care and residential settings. Age 65-95 (mean 83.54). Mean 10.2 years of education. MMSE scores 9-23, mean 15.9. 11 professional care staff.	aspects of caregiver and caree communication when using CIRCA as opposed to TRAD.		TRAD *(Qualitative checklist 100% well-designed study, with accounting for position of researchers, ethical considerations and consent).*	measures coded online and from video recording. Nonverbal measures from coded sections of video recordings e.g. gaze, moving and singing.	with CIRCA -PWD made more choices with CIRCA -less initiation of interactions by PWD in TRAD Nonverbal -More joint laughter -Interaction easier to sustain -Status hierarchy redressed? -More shared activity	might not arise in traditional sessions. PWD have more choice and control with CIRCA. Improvements in staff satisfaction could feed back into relationship with PWD.
Hofmann et al., 1996	10 PWD, 6 female, mean age 69, mean MMSE 19.4	To evaluate effectiveness of interactive computer-based	ICT – interactive simulation of either local and social	Repeated quantitative measures.	Performance on tasks, and psychometric scales.	Performance on all task measures improved. Psychometric	Some trained skills stayed improved – motoric and implicit memory

Authors, date	**Participants**	**Aim**	**Touchscreen Intervention**	**Design** ***(MMAT appraisal)***	**Measures**	**Psychological impact finding(s)**	**Important aspects of intervention**
	(SD 4.0).	cognitive training (ICT)	environment or town and social competence tasks	*(Quantitative checklist: 100%)*	Anecdotal info from carers.	measures not valid and no significant differences. Carers suggested people's abilities improved in real life.	might be preserved. Motor action during learning leads to improved cued recall.
Hofmann et al., 2003	9 PWD, 9 people with *depression*, MMSE 19.6 ±5.8 10 controls, age & sex matched	To evaluate effectiveness of interactive computer-based cognitive training (ICT)	ICT – an interactive simulation of the process of going shopping. 5 different programs.	Three experimental groups. Repeated quantitative measures *(Quantitative checklist: 100%)*	Quantitative - Training effectiveness - MMSE scores - Self-ratings of ICT impact	PWD – less errors. MMSE improved. Self-reported positive effect of training. All participants reported liking ICT.	Ergonomics - comfort via the easy-to-handle touchscreen function and desktops showing familiar items from the participants' environment. Exercising complex cognitive skills, not simple.
Imbeault et	2 PWD – both	See if PWD	AP@LZ	Multiple single	Neuropsych	Could learn to	Errorless

Authors, date	**Participants**	**Aim**	**Touchscreen Intervention**	**Design** ***(MMAT appraisal)***	**Measures**	**Psychological impact finding(s)**	**Important aspects of intervention**
al., 2013	male, aged 71 and 80, each with an informal carer	could use AP@LZ. Explore impact on memory. Explore impact on carer burden.	(agenda personnalisé pour des personnes avec maladie d'Alzheimer)	'ABA' case study, mixed methods *(mixed methods checklist: 25% - tiny sample, qualitative analysis unclear, integration consideration unclear)*	tests, performance measures, depression measure, burden measure.	use. Preserved ability on supported tasks. No significant impact on depression or burden.	learning style Three-step learning Stage of dementia Over five months needed to integrate AP@LZ in to daily life.
Leng et al., 2013	6 PWD with similar attributes at Singaporean day centre.	Investigate whether iPad apps could promote wellbeing like other meaningful activities	iPad apps "chosen with the characteristics of the PWD in mind"	Group sequential quasi-experimental design. Repeated measures of PWD using iPad vs Cooking vs Craft work.	Dementia care mapping	iPad activities promoted wellbeing and engagement. Wider range of behaviours with iPad.	Detailed planning and approach. Tailoring activities.

Authors, date	Participants	Aim	Touchscreen Intervention	Design ***(MMAT appraisal)***	Measures	Psychological impact finding(s)	Important aspects of intervention
				Quantitative checklist : 100% - but small sample)			
Leuty et al., 2013	6 PWD – art therapist (AT) dyads	Investigate 1. Usability for ATs 2. Usability for PWD 3. Improvements	Prototype ePad (Engaging Platform for Art Development) – artificially intelligent touch screen	Pragmatic mixed methods concurrent nested. *(Mixed methods checklist: 75% as integration consideration unclear)*	Mainly usability, but discussion includes psychological outcomes	PWD were “excited” by ePad, but frustrated by counterintuitive parts.	Improve intuitiveness – ATs did not like some aspects like brush running dry. Prompting. Ergonomics – screen position.
Lim et al., 2013	21 PWD (early stage) – carer dyads. Early-stage dementia. Living privately. Informal carer.	Explore usability of tablets by PWD	iPads with chosen apps.	7-day in-home pilot study. *(Quantitative checklist: 100%)*	Quantitative questionnaires with PWD and FC.	50% could use independently – suggested would reduce carer burden.	Case-by-case consideration of aptness. Simple interface. More helpful earlier in dementia.

Authors, date	Participants	Aim	Touchscreen Intervention	Design *(MMAT appraisal)*	Measures	Psychological impact finding(s)	Important aspects of intervention
Meiland et al., 2012	Test 1 - 16 PWD and their carers Test 2 - 14 PWD and their carers Test 3 - 12 PWD and their carers	Explore usability (tests 1-3) and effectiveness (test 3 only) of COGKNOW Day Navigator.	COGKNOW Day Navigator (CDN) – prototype 'daily life support'	3 mixed methods field tests. *(Mixed methods checklist: 50%)*	Semi-structured interviews, and outcome measures.	No effect from practical intervention. No effect on burden / autonomy.	Adaptations suggested such as including PWDs and ICs from beginning of development.
Nijhof et al., 2013	16 PWD and family carers. 11 professionals.	Study advantages & disadvantages of system from PWD, IC and professional perspectives.	PAL4 Dementia: Daily organiser, "PAL4 features", webcam	Mixed methods – qualitative interviews, logs, group meetings *(Mixed methods checklist: 75% as integration consideration unclear)*	Wellbeing and other measures	PWD seen laughing, stimulated, ++QOL, ++ independence Caregivers could speak remotely → ++ QoL	System in conspicuous place. Trouble-shooting service. Language of programs. All options on front page. Photos of contacts.
Riley et al., 2009	3 pilots – only 3rd with PWD	Provide and assess novel activity –	Evolution of CIRCA – ExPress Play.	Pilot studies building to 3rd	Observation and	All "appeared to enjoy". Laughing. If	Ergonomics – accidental

Authors, date	Participants	Aim	Touchscreen Intervention	Design *(MMAT appraisal)*	Measures	Psychological impact finding(s)	Important aspects of intervention
	(10)	creation of music	Chord-based music creator.	with PWD. *(Qualitative checklist: 25% as analysis and researcher position unclear)*	discussions.	carer present, + conversation. PWD avoided low-mood music.	button pushing Prompting system
Topo et al., 2004	28 PWD in UK, Norway, Ireland.	Part of ENABLE project which aims to find solutions to aid people living at home. This research was to assess usability and impact of jukebox-type program, and to find associations with wellbeing of participants.	The Picture Gramophone (PG) – a jukebox-type application which allows people to listen to music	Mixed methods pre-post and case studies. *(Mixed methods checklist: 75% as researchers' consideration of their impact unclear).*	Staff ratings of PWD PG usage. Staff ratings of health-related QoL measures. Staff ratings of sociability. Interviews with PWD after 2 weeks about their experiences with PG. Case studies.	52% had prob using. 91% benefited. 74% +ve mood impact. 70% +ve impact on social interaction Case studies: 1. 'Seemed pleased'. 'Cheered up'.	- Issues with touchscreen sensitivity – needs to be consistent. - Text should be as large as possible. - Stimuli (music) individualised to user beneficial

Authors, date	**Participants**	**Aim**	**Touchscreen Intervention**	**Design** ***(MMAT appraisal)***	**Measures**	**Psychological impact finding(s)**	**Important aspects of intervention**
						2. ‘Had a good time’. “It is inspiring and took my depression away”.	

Results

Interventions

There was a wide range of interventions that employed touch screen technology to engage people with dementia. These will be briefly described in chronological order, since as time progresses, the range and affordability of available touchscreen based technology has increased. The earliest reported intervention was interactive computer-based cognitive training (ICT) (Hofmann, Hock, Kühler & Müller-Spahn, 1996; Hofmann et al., 2003), running on a computer connected to a 21-inch touchscreen. ICT simulates various activities of daily living, such as shopping, and encourages the user to make decisions in relation to navigation, or answering questions. The simulations are tailored to each individual, via actual photographs of each person's social and local environments. The Picture Gramophone (Topo et al., 2004), which ran on computers connected to touchscreens, was designed as a pleasant pastime; it facilitates selection of artists, genres or themes of music to listen to, displays images and lyrics as the music plays, then facilitates further music selections.

A prototype 'cognitive prosthesis' (Cole, 1999) was developed by Alm et al. (2004) in order to support conversation. Cognitive prostheses were initially framed as devices providing compensatory support for people with cognitive impairments (Kirsh, Levine, Fallon-Krueger & Jarros, 1987); Arnott (1990) stated the importance of the person remaining in ultimate control of the system. The initial version ran on a computer connected to 20-inch touchscreen displaying a multimedia reminiscence package, which allowed people to view photos and videos, and listen to songs and music related to their local area, recreation and entertainment. The prototype was eventually developed into the Computer Interactive Reminiscence & Conversation Aid (CIRCA) (Alm et al., 2007; Alm et al., 2009; Astell et al., 2008; Astell et al., 2010). CIRCA runs on a computer connected to a 20-inch touchscreen monitor. The interface is designed to be “error-free” in that there are no wrong responses or dead-ends in possible decision trees. As a prosthesis, CIRCA is designed to augment the working memory of the user thereby supporting their conversations with others. A spinoff from the CIRCA project is ExPress Play (Alm et al., 2009; Riley, Alm & Newell, 2009). ExPress Play is a touchscreen interface that allows the user to generate chord-based music by touching the display, and to choose the emotional tone of the music output. ExPress Play aimed to build on evidence showing that people with dementia can maintain and also develop their creative skills (Miller, Boone, Cummings, Read & Mishkin, 2000); it also built on Hanneman’s (2006) theory that in this population, “art and creativity offer a path of opening up the windows to people’s emotional interiors”. A related project was ‘interactive entertainment’ activities (Alm et al., 2009). This comprised virtual environments such as botanical gardens, and virtual activities like football penalty shootouts that people could interact with via touchscreen interfaces.

Meiland et al. (2012) evaluated the prototype COGKNOW Day Navigator (CDN), an ‘integrated digital prosthetic’ designed to support people with dementia with daily activities. The system comprised a stationary touchscreen in the home and a mobile device. These devices were connected to various sensors around the home. The system offered support in the areas of memory, social contacts, daily activities and safety. Nijhof, van Gemert-Pijnen, Burns and Seydel (2013) evaluated PAL4-dementia, a similar touchscreen system installed in the home designed to act as a daily organiser, memory game console, diary keeper, information source, ‘life album’ and video link with family or professional caregivers. Imbeault et al. (2013) developed and evaluated an electronic organiser for people with dementia (*agenda personnalisé pour des personnes avec maladie d'Alzheimer* [AP@LZ]). AP@LZ is smartphone-based, and provides the user with information about current time and appointments, appointment scheduling, personal information, medical information, contact information and a notepad function.

The Engaging Platform for Art Development (ePAD) was developed and trialled by Leuty, Boger, Young, Hoey and Mihailidis (2013). This consists of a multi-touch display mounted on a wooden easel that can be used to create visual art via the client interface, and modified to meet specific clients' needs by art therapists on a separate interface. Artificial intelligence is employed by ePAD to evaluate the level of user engagement. Lim, Wallace, Luszcz and Reynolds (2013) assessed the usability of Apple iPads by people with dementia, both with their informal carers and independently. The eleven applications used were classified as “creative (art or music)” such as musical instrument simulators, “simple interactive games” such as spot-the-difference and “relaxation” such as a peaceful music and visual image player. Leng, Yeo, George and Barr (2013) also looked at iPad applications, but used to facilitate group activities. Applications were “chosen with the characteristics of the participants in mind”.

Study designs

The “design” column of Table 2 gives information about the design of each study, and a MMAT (Pluye et al., 2011) score and the checklist used where applicable. MMAT scores are provided with a brief explanation of why the study received its score. The score is a rough appraisal of a study's *methodological quality*, and does not measure *reporting quality*. For qualitative and quantitative studies, the percentage of criteria met is stated. For mixed-methods studies, the overall score cannot exceed the lowest score of a component, so if one part received 100% but the other 25%, the overall score would be 25%. This means it would be possible for a study to have a strong quantitative section and a weaker qualitative section, or vice-versa, but the overall score would be low, suggesting the study was less valuable than it might be to another researcher, especially if they were only interested in the stronger section. The MMAT is still under development and is necessarily reductive and therefore cannot capture study nuances; but it was used for this review as it can be applied to the full range of study types covered and give comparable ratings for each.

Eight of the studies employed mixed-methods approaches. Leuty et al. (2013) evaluated ePAD with six dyads of people with dementia and art therapists. They collected quantitative data using Likert scales related to usability of ePAD from both members of each dyad, and qualitative written comments, which gleaned information related to psychosocial outcomes. Content analysis was coded according to the quantitative data categories. Whilst both qualitative and quantitative components achieved maximum scores on the MMAT, it was unclear whether the limitations of their integration had been considered. Nijhof et al. (2013) reviewed the PAL4-dementia system with 16 people with dementia, their informal and professional carers over nine months. They looked at system logs, interviewed informal carers, held professional focus groups, observed group meetings and performed a cost analysis. People with dementia were sometimes present at the interviews with carers, and their comments were included in the transcripts. Transcripts were repeatedly read and discussed amongst researchers before coding according to research questions. The integration was not sufficiently clear to achieve a maximum MMAT score. Topo et al. (2004) explored the user-experience of the Picture Gramophone (PG) with 28 people (five of whom dropped out) and staff at five day centres across Europe. Qualitative measurements were taken of quality of life and dementia severity as well as information about carer burden and staff and qualitative information about the views of people with dementia on the PG. The interviews were content analysed in relation to use and usefulness of the PG. Whilst integration appeared to be well considered, the impact of researchers’ actions and beliefs on the findings was not explicitly taken into account.

Meiland et al. (2012) evaluated CDN using three mixed-methods field tests each lasting a year and with a mean of 14 people with dementia and their carers, and collected information through interviews, observations, questionnaires, software logging and diaries. Qualitative data was analysed via discussion between two researchers, although the qualitative methodology was not made clear. Whilst the quantitative components of this study met MMAT criteria, it was unclear whether the qualitative components and the integration of components did.

Imbeault et al. (2013) assessed AP@LZ via two in-depth ABA case studies with people with dementia and their informal carers. The proficiency of people with dementia at daily activities was measured pre-and-post training via AP@LZ, and carers completed questionnaires about their levels of burden. Comments and suggestions were collected in journals kept by carers. Whilst the quantitative methods seemed robust, the qualitative data analysis is not clearly described, nor how integration was considered. Alm et al. (2004) trialled their prototype cognitive prosthesis with a total of 15 people with dementia and their informal and professional carers. In the two study phases, they collected quantitative information about user experience using Likert scales, and qualitative information through interviews with people with dementia. The qualitative data analysis and consideration of the researchers' position was unclear, as was the consideration around integration. Alm et al. (2009) reviewed three interventions (including CIRCA, but this research was also included more comprehensively in Astell et al., 2010, so that part of this research was not reviewed). Twelve people with dementia tried interactive games and their views were collected by interview; Twenty-five people tried ExPressPlay whilst being videoed, their in-app activities were logged, and they were asked how they felt about the app afterwards. The qualitative analysis was unclear, and the thinking in relation to integration was not elaborated. It is worth noting that both Alm et al., studies included research also written up by Astell et al., (2006; 2010) for different journals which scored more highly on the MMAT, perhaps owing to being aimed at different groups of readers. Riley at al. (2008) assessed ExPressPlay with a range of users, including 10 people with dementia. Over the course of the study, they used mixed methods, but they only used qualitative observations with people with dementia. Their analysis and the observers' positions were unclear.

Seven studies used solely quantitative methods. Astell et al. (2010) explored the effect of CIRCA versus TRAD on 11 people with dementia in a repeated measures design where participants took part in both conditions. Incidences of both verbal (choosing and initiation of interactions) and nonverbal (musical, laughter, pointing and eye-gaze) were counted in each condition. Mean inter-rater count agreement was 100 percent. Hofmann et al. (1996) trialled ICT with 10 people with dementia (one of whose data was incomplete and was therefore excluded), and measured the number of mistakes they made, the time they needed to complete tasks and the amount of advice they needed before and after ICT. Participants and their carers were asked how effective they thought the training was. Hofmann et al. (2003) subsequently conducted a case-control study with ICT, gender and age-matching nine people with dementia with ten healthy controls and nine people experiencing major depressive episodes. Performance was measured through mistake count, time needed, correct answer count and need for instruction repetition on a shopping simulation task. Leng at al. (2014) explored the effect of iPad use compared to two traditional activities on six people with dementia and assessed the impact using Dementia Care Mapping (Brooker & Surr, 2005). Lim et al. (2013) explored the usability of iPads by 21 people with dementia over a 7-day period using questionnaires with the participants and their carers. These three studies all met all MMAT criteria for quantitative research.

Astell et al. (2008) compared use of CIRCA with traditional reminiscence (TRAD) 29 people with dementia took part, 18 of whom were in phase two, an RCT, with TRAD as control, and 11 of whom took part in phase two, where each participant tried both CIRCA and TRAD. Videos of sessions were coded for incidences of initiation of topics and decision making by the people with dementia, and of offering choice and leading the conversation by staff. Allocation concealment (if possible) was not made clear. Alm et al. (2007) reported on the informal prototyping of CIRCA with 40 people with dementia and the RCT component of Astell et al. (2008). The prototyping phase was excluded from MMAT appraisal for not having any explicit methodology, and the RCT phase methodology was very vague. Astell et al. (2008) reported the same study, which gave more useful information for this review owing to the focus of the report.

Outcomes – People with dementia

Mood and mental health (including behavioural evidence of mood changes)

Studies looking at CIRCA reported a range of outcomes related to mood and mental health. When Alm et al. (2004) explored the effects of the prototype cognitive prosthesis, staff reported that its prompting meant people with dementia interacted more than usual. Staff also reported that people with dementia appeared to remember new things. Alm et al. (2007) reported people with dementia seemed more interested and motivated and were more engaged even when informal carers were using CIRCA. One participant reported, “It takes you back and refreshes your memory”. Astell et al. (2008) reported that all people with dementia said that they had enjoyed using CIRCA.

Alm et al. (2009) found that there was a significant increase in the amount of time people with dementia spent using ExPress Play between the first and third sessions (*t*(M = 25, df = 24) = -2.89, p=0.008). There was a significant increase in the number of finger movements made during subsequent sessions, and an increase in the range of musical moods selected to play. This was taken as evidence that learning had occurred; in addition, 21 out of the 25 users said they enjoyed their first session, rising to 24 in the final session and after the final session, 22 indicated they would like to use it again. Riley et al. (2009) reported that “all participants appeared to enjoy using” ExPress Play. One participant “laughed animatedly” when she made music on the system and it was noted that those with dementia tended to become more communicative when they used the system, and also when they observed carers using it.

Topo et al. (2004) collected staff impressions of the impact that using Picture Gramophone had on people with dementia. In 74 percent of cases, the rating suggested a positive or very positive impact on mood. This seemed to happen in all countries except the UK; researchers attributed this difference to the people in the UK being “happy people already” with only one person reported to experience large positive and negative mood fluctuations; 87 percent of users were observed to sing along, dance or whistle, which suggested engagement and perhaps improved mood. A Spearman’s rho suggested a significant positive correlation (r_s = .46, p < .05) between age and impact of PG on user mood, suggesting older users more often benefited from use than younger ones. One case example in the paper concerns a woman who was described as depressed and staff reported that she had “cheered up with PG use”. Another client reported, “It is inspiring and takes my depression away.”

In an earlier study, Hofmann et al. (1996) found no significant impact on depressive symptoms (measured with Montgomery–Åsberg Depression Rating Scale, Montgomery & Åsberg, 1979), or on quality of life (measured by the interview for deterioration in daily living activities in dementia, Teunisse & Derix, 1991, as cited in Hofmann et al., 1996, p. 494). They questioned the validity of the scales as they were administered by the people giving the training, so bias on their part could not be ruled out. One participant was able to find their way to a location that they had been trained to find with ICT, but unable to find their way back, which had not been trained with ICT. One participant said that ICT was, “Quite different from the feeling of getting worse in every other aspect of life” (p. 500). Hofmann et al. (2003) found that the training seemed to lead to an average one point improvement on the mini mental state examination (MMSE; Folstein, Folstein & McHugh, 1975), which was significant (*F*(2,23) = 8.47, p < .008). It was also reported that people with dementia expressed the highest level of liking the training of the three groups who trialled ICT.

Leng et al. (2014) found that mood and engagement scores were highest for iPad activities, compared with traditional activities. The mood and engagement score for cooking was significantly less than for both iPad sessions, suggesting that iPad-based activities are more beneficial for mood and engagement than cooking. A wider range of behaviours (six compared to two) were recorded when people used iPads compared to cooking and craft work. With a wider range of behaviours, perhaps there are more possible ways that different people might become engaged with activities, and the greater engagement might mean more chance of improvement in mood.

Leuty et al. (2013) reported that whilst art therapists were unsure if they or their clients were satisfied with ePAD, people with dementia reported high levels of satisfaction with the intervention and its novelty. Some users were reported to engage in reminiscence as a result of using ePAD, an unexpected finding. Median responses from people with dementia suggested that they were happy with ePAD, enjoyed using it, were satisified with the art created and that creating art was fun. One user stated, “It’s miles ahead of anything I’ve ever seen to give you an ability to do something.”

Imbeault et al. (2013) found no significant change in either participant’s level of depression and both remained sub-threshold on the Geriatric Depression Scale (Bourque, Blanchard & Vézina, 1990) throughout their use of AP@LZ. The carer of one participant noticed that his ability to perform tasks targeted by AP@LZ (such as time and medication management) improved, whilst his functioning in other areas deteriorated.

Social life and quality of interaction

Alm et al. (2004) reported that the quality of time people spent together was improved when using the cognitive prosthesis, and that both parties were more equal participants in the interaction. Alm et al. (2007) reported that when using CIRCA rather than TRAD, people with dementia made more choices (U = 2.00, $p < .001$), and that more choices resulted in more sharing of memories ($r = 0.4$, $p < 0.05$). They also reported that the balance of conversations seemed to be more equal when using CIRCA: the facilitator did not predominate. Astell et al. (2008) reported that when using CIRCA, people with dementia initiated more interactions (RCT phase $p < .0005$; within subjects phase $p < 0.05$) and made more decisions (RCT phase $p < .001$; within subjects phase $p < 0.005$), suggesting more engagement and stimulation. Alm et al. (2009) reported that when people played interactive games in groups, “lots of comments and cheering” were observed, suggesting an improvement in the quality of the time people spent together whilst they were playing. One informal carer stated, “I have never had such a good reaction from Jim before”. Astell et al. (2010) also reported significantly more choices being offered to people with dementia by caregivers ($t(10) = 5.9$, $p < .0005$) and that they subsequently made more choices ($t(10) = 3.617$, $p < .005$) than during TRAD. People with dementia sang significantly more when using CIRCA ($t(10) = 2.191$, $p < .05$). Whilst there was no significant difference in the amount of laughter in CIRCA and TRAD sessions, it was observed that dyads tended to laugh together more with CIRCA, and separately during TRAD.

It was suggested that laughing together was a sign of enjoyment, whereas separate laughter indicated discomfort. This was corroborated by observations that solitary laughter tended to occur when the person with dementia was lost for words. Astell et al. (2010) analysed eye gaze and found that gaze patterns were significantly altered with CIRCA compared to TRAD, with a lot more attention being paid to the stimuli during CIRCA by both people with dementia and informal carers during CIRCA sessions. They suggested that since eye gaze is thought to be a reflection of engagement (Segrin and Abramson, 1994) and comfort (Nadel et al., 2000), this meant the dyads were better at establishing joint attention during CIRCA sessions, meaning interactions could be more equal. Carers were also observed to point a lot more during CIRCA sessions, and parallels could be drawn with research showing that mothers tend to point to cue their infants into attending to a point of shared focus to scaffold interactions (Pratt, Kerig, Cowan & Cowan, 1988), suggesting higher quality of interaction was taking place. A systematic review of attachment in people with dementia and their caregivers (Nelis, Clare & Whitaker, 2013) found that insecure attachment styles link with neuropsychiatric difficulties, and that attachment security also impacts on caregiver health. Interventions that promote attachment-enhancing behaviour are thus of great potential benefit within care dyads.

Topo et al. (2004) reported that in one of their case studies, a user with dementia's "enthusiasm about the PG [was] spreading to the others. They all had a good time." This suggests interventions could lift the mood of the individual, and then the people around them. Staff members reported that 70 percent of participants who used PG experienced a "positive or very positive" impact on their social interaction. Riley et al. (2008) reported that when people with dementia and a carer were present, "playing of the [ExPress Play] became more of a social activity. Communication was promoted.” This was reported to happen when the person with dementia or the carer used the device.

Lim et al. (2013) reported that participants who had sought and received support from a family member, such as a grandchild, had found the resultant interaction to be highly valuable. This suggests that by being intuitive enough to be learned by relative novices, touch screen technology might have the effect of bringing people from different generations closer together by giving them mutually enjoyable shared activities.

Independence

Whilst solitude might not be a beneficial outcome of an intervention, the capacity for a person to be more independent might be, as it could allow them to stay in their own home for longer, and reduce burden on carers and other sources of support. Meiland et al. (2004) concluded that whilst CDN was designed to support people living in the community, they found no evidence that it supported people with their daily functioning. Lim et al. (2013) reported that whilst 95 percent of participants with dementia were new to iPads, 52 percent were able to use them independently, and 24 percent could also charge and store them independently. Nijhof et al. (2013) found that PAL4-dementia promoted independence for people with dementia. The greatest positive impact on participants was on self-care as a result of improved daily scheduling. Imbeault et al. (2013) found that both of their participants were able to use AP@LZ sufficiently to support daily life: one of the participants surprised his wife when he reminded her of an appointment that she had not been aware of, and the other reported that it was more helpful than his calendar, and that his time-management had improved.

Sense of mastery

Some studies reported on participants' engagement with and mastery of the intervention. Imbeault et al. (2013) reported that one of their participants was “proud” to use AP@LZ, and that his wife noticed that he seemed to feel more empowered by it. As participants gained experience, their usage frequency of the devices tended to increase. Hofmann et al. (1996) found that following training, participants performance on ICT improved, with fewer mistakes, less time needed, and less advice needed. This pattern was also observed by Hofmann et al. in 2003, as well as an increase in the rate of correct answers. The group with dementias was also found to improve significantly more than the other groups in their level of mistakes ($F(4,15) = 2.95$, $p < .044$). Lim et al. (2013) reported that 48 percent of people with dementia said the iPad was moderately or extremely intuitive to use, despite under ten percent initially saying that they were confident using computers and technology. Topo et al. (2004) reported that one client initially said she would be unable to use the PG, but she spontaneously started touching the screen and interacting with the device. At a social event, people with dementia used the PG independently to choose songs to dance to.

Outcomes – Informal carers

Burden

Various studies reported an impact on the stress or burden of informal carers. Imbeault et al. (2013) reported that AP@LZ reduced informal carer stress as carers felt reassured that the people they cared for would be able to contact them if necessary. The Carer Burden Inventory (Hébert, Bravo & Girouard, 1993) indicated a trend towards increased burden over time in both cases, but without controls it is not possible to discern whether this rate increase might have been altered by AP@LZ. One carer reported she experienced less burden in relation to medication, as the reminder system prompted their spouse.

Carers reportedly enjoyed access to the video facility in PAL4-dementia (Nijhof et al., 2013), and whilst the study did not prove a reduction in carer burden, it was suggested that it might over a longer timeframe. Since Lim et al. (2013) reported that 90 percent of participants with dementia could use iPads independently, this might provide an activity that they could do whilst informal carers did other things, potentially reducing burden. Meiland et al., (2012) found no impact of CDN on carer burden, but the system was unstable, and carers found this frustrating. They suggested that with more development the CDN might be more beneficial for users.

Other areas

Other impacts included carers finding out new information about those they cared for (Alm et al., 2004) which might enrich their relationship and provide new conversation topics or activities. Astell et al. (2010) observed that carers sang (z = 2.33, $p < 0.05$) and moved to music more ($t(10) = 2.39$, $p < .05$) during CIRCA sessions. Thus, touch screen based interventions can have impacts on both members of care dyads, which might help to improve both members’ wellbeing.

Important aspects of interventions

Interface

Studies frequently highlighted important aspects of the interface. In relation to style, many studies underlined the importance of simplicity. Alm et al. (2004; 2007) stated that muted colours were helpful with CIRCA, and that there was no need to attempt to replicate the look of a traditional scrapbook. An animation of an audio player was found to be helpful, however. Leuty et al. (2013) found that their attempt to simulate an authentic painting experience by having the paint on the brush run out could confuse users, who thought they had accidentally changed the colour. They also found that using a bar to select brush-size was counterintuitive. Alm (2009) found that games were more engaging if they were “attractive” and colourful, so perhaps colour needs to be considered in relation to the media being displayed. Lim et al. (2013) suggested that the simplicity of the iPad interface contributes to its usability by people with dementia. Nijhof et al. (2013) stated that simple games were more suited than more complex ones. They also found that ‘layering’ the interface by nesting options beneath other screens seemed to impede usability: it is better to put all of the options on the main screen otherwise users are more likely to get lost in the options. Nijhof et al. found that positioning buttons at the top of the screen rather than the bottom minimised accidental button-pressing, which could deter users. They also found that adding photos of contacts aided in identifying them, increasing ease of use. Topo et al. (2004) found that larger text made the program easier to use, though this was limited by screen size and resolution. Hofmann et al. (2003) suggested that ergonomics played a key role in encouraging use of their apparatus, both via the ease-of-use of a touchscreen interface and via integration of familiar items from participants’ environments into the desktops.

A system of guidance built into the interface was recommended. Leuty et al. (2012) and Riley et al. (2009) found that prompting users was important, although Riley at al. found that written prompts needed to be clear, otherwise they could be confusing. Alm et al. (2009) found continual feedback was important, which comprised encouragement when people were experiencing difficulty, and praise of successes. They also found that making the next step as obvious as possible was key, via interface behaviour or specific prompts.

An error-free experience seems to be beneficial. Alm et al. (2004; 2007) and Astell et al. (2008; 2010) based their error-free interface on the “hypermedia effect” (McKerlie & Preece, 1992). This is a structure similar to the world-wide-web, where items are interconnected, without dead-ends, so that wherever the user may find themselves is fine, and it does not matter if they lose track of where they are. It also facilitates the interlinking of a range of different media formats, allowing the user to jump between them easily, hopefully enlivening the experience. By not having to keep track of their position, user working memory load is reduced, making it possible to “fit the human and machine components together in ways that exploit their respective strengths and mitigate their respective weaknesses” (Institute for Human Machine Cognition, 2015). Topo et al. (2004) also found that eliminating the intrusion of error messages into the user experience was key.

Interface factors relate to the “aesthetic-usability” effect (Norman, 2002), which can be neatly summed up in his phrase, “aesthetics matter: attractive things work better”.

Hardware

Nijhof et al. (2013) found that participants with little prior experience of computer-use tended to adapt to their touchscreen interface more easily, whilst those with prior computer experience tended to request keyboards and mice to facilitate their interactions. They also related this phenomenon to the “technology generation” theory (Docampo Rama, Ridder & Bouma, 2001) which suggests that experiences with technology in the first 25 years of life are more persistent than later ones. Nijhof et al. also found that placing the console in a conspicuous location in the home increased chances of adoption and usage by participants. Leuty et al. (2012) found that adjustability of the easel-mounted screen was important, but discovered this after they had been forced to fix the screen in place. Topo et al. (2004) found that ensuring uniformity of touchscreen sensitivity across devices was crucial, as there were noticeable differences between devices that sometimes compromised usability.

Content and personalisation

Alm et al. (2007) found that photos and music were generally appreciated more than videos. They attempted to incorporate personalised reminiscence media, such as family photographs. Unfortunately, this could lead to distress, “often to the point of tears”. People with dementia and informal carers found failures to remember events or people upsetting and this feature was abandoned. The researchers instead focussed on accumulating sufficient generic material that could be randomised, so that potentially activating personal material was not necessary. They found that with this approach, the material might lead people to engage in reminiscences that even their informal carers did not know about.

Other researchers found personalisation in different, less intimate ways to be helpful. Topo et al. (2004) found individualising music to users’ preferences beneficial. Leng et al. (2013) and Lim et al. (2013) both suggested tailoring iPad activities to individual preferences was helpful, but did not elaborate on how this was achieved. Nijhof et al. (2013) found the practical step of ensuring the ringtone of the system was different to users’ own ringtones was important.

The importance of elements of challenge or skill-mastery was raised by Alm et al. (2009) and Hofmann et al. (2003). Alm et al. identified there needs to be a goal to games, otherwise people tend not to engage. Hofmann et al. suggested that it is more beneficial for people with dementia to try and exercise complex cognitive skills as opposed to basic ones, suggesting that specifically targeted interventions had limited subjective wellbeing benefits.

Procedural

Various recommendations can be made in relation to the procedure of the intervention. Hofmann et al. (1996, 2003) suggested that touchscreen interventions automatically enhance the learning stage as motor action is necessary as well as mental effort. Motor and implicit procedural memory systems tend to be relatively preserved as dementia progresses (Eslinger & Damasio, 1986), and motor action during learning has been shown to have a positive impact on recall for people with dementia (Karlsson et al., 1989). Imbeault et al. (2013) employed an “errorless learning” method for their intervention (Laffan, Metzler-Baddeley, Walker & Jones, 2010). This approach limits the possibility of experiencing making errors, and is thus thought to enhance the learning process. This was augmented by a phase dedicated to “teaching transfer”, where the learned skills were consolidated via their employment in day-to-day events in line with a “three stage approach” to learning (Sohlberg & Mateer, 1989). Imbeault et al. found that it took about five months for AP@LZ to become integrated into participants’ daily lives.

Including potential users from the start of the development process was found to be useful by Meiland et al. (2012). Nijhof et al. (2013) stated that they did not do this, and that this may have contributed to the lack of user-friendliness of their system, with no users describing it as “intuitive”. They did provide support with their intervention, and this was adopted by users and reported to be helpful. Alm et al. (2004) found that the cognitive prosthesis could be employed with little preparation on the part of the staff, which seemed to increase the chance of its being used.

Progression of dementia

Various studies found the stage of dementia progression to be an important factor. Imbeault et al. (2013) found that of their two participants, the one at an earlier stage of dementia learned much faster. This is the minimum possible sample size for this comparison to be made, so wider conclusions can only be made very tentatively. Lim et al. (2013) suggested that their interventions was more helpful for people at earlier stages of dementia, and suggested matching iPad activities to the skill level of each user. Nijhof et al. (2013) reported that informal carers said they thought that the people they cared for would have learned to use PAL4-dementia more easily earlier in the progression of their dementias. They add the caution that the introduction of such a device earlier on might have been experienced as upsetting or stigmatising for people with dementia.

Discussion

This review has explored the diverse range of touchscreen based interventions for people with dementia that have been cited in published research. The diversity of the interventions is complemented by the relative qualities of the published papers. This diversity results from studies by researchers from different professional backgrounds, and in journals targeted at different audiences. The exploratory nature of the research often also led to idiosyncratic approaches to research and reporting. The robustness varied, and sample sizes tended to be small, therefore conclusions should be cautiously interpreted. Ethics and consent were often not clearly reported, and this is crucial in an area involving vulnerable people often with limited capacity to consent.

Whilst research has looked at the feasibility of touchscreen-based interventions, it is apparent that touchscreens are usable by those with dementia, and when well-designed they can be used with little training. As technology advances, hardware-related issues that arose in early studies such as inconsistent screen sensitivities are likely to diminish. These factors will hopefully allow more consideration to be given to the wellbeing outcomes of the interventions. According to this review, touchscreen based interventions can benefit the wellbeing of people with dementia in relation to their mood and mental health, their social lives and quality of interaction, their sense of independence and their sense of mastery of the intervention. Touch screen interventions can also benefit the wellbeing of informal carers in relation to their sense of burden, as well as enhancing the quality of their relationships and time spent with the people they care for.

Key aspects of the interventions’ interfaces were shown to be related to the interface being simple, intuitive, aesthetically pleasing, error free and providing guidance to the user. Important procedural aspects included provision of support, including potential users in the development process from the beginning, an errorless learning method for training, requiring motor-action during training and the ability to use the intervention with little preparation. Important aspects of content included tailoring content to the user where appropriate and an element of challenge, which might mean exercising complex cognitive skills rather than simpler ones. Hardware considerations included ergonomics, consistency and a conspicuous location. The progress of users’ dementia was also highlighted as a key aspect in several studies.

Recommendations for future research

Future research can strengthen and build on the foundation established so far in a range of ways:

- In order to improve the evidence base, research should be conducted with larger sample sizes and more rigorous methodological approaches. This could include the establishment of consensus on how wellbeing is to be measured, and adherence to reporting standards. Clinical psychologists could consult in relation to research methods.
- RCTs could be used to strengthen the quantitative evidence base and produce causal evidence likely to influence healthcare commissioners.
- Mixed-methods research could allow more in depth information about the user experience to be collected, especially in exploratory studies. It would be important to pay attention to the process of integration of quantitative and qualitative findings.
- Longer-term and longitudinal interventions could explore the effect of stage of dementia on the effectiveness of the interventions.
- Issues related to consent and ethics should be explicitly elaborated.
- Standardised hardware platforms such as specific models of tablet could be used in order to allow easy replication of research in other locations. This could also facilitate the exploration of impact across settings, such as at home, in daycare and in residential settings.

- Interventions that have been found to be useful in other areas, such as art-based interventions (e.g. Camic, Tischler & Pearman, 2013; Eekelaar, Camic & Springham, 2012; Rhoads, 2009) could be adapted to be delivered via touchscreen devices, and their effectiveness explored.

Clinical implications

A range of clinical implications can be cautiously suggested as a result of this review:

- Clinicians should be aware of possible touchscreen interventions that can be offered to people with dementia and their informal carers, and the potential benefits to wellbeing for people with dementia and other members of the systems around them they can offer.
- Clinicians should be prepared to highlight and challenge prevailing beliefs in relation to people with dementia being unable to use touchscreen technologies.
- People are more likely to be able to engage with interventions if they are initially offered earlier on in the progression of their dementia.
- Touchscreen based interventions might help people interact across generational gaps, potentially reducing their sense of isolation.

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Section B: Empirical Paper

Can viewing art on a touchscreen computer help the wellbeing of people with dementia and their carers?

7844 words

Abstract

Context: This project builds on the existing evidence that suggests that art-based interventions can be beneficial for the wellbeing of people with dementia and their carers, and explores whether such interventions can be delivered via a touchscreen tablet device using an application that allows them to view art images.

Participants: Twelve pairs of volunteers with dementia and their informal carers were recruited through Alzheimer's Society Dementia Cafés.

Method: A quasi-experimental mixed-methods within-subjects study evaluated the impact of art-viewing on wellbeing using visual analogue scales as well as exploring the experiences of participants qualitatively with thematic analysis.

Key findings: Quantitative results showed a trend towards improved composite wellbeing from viewing session one to session five. Wellbeing subdomain scores showed an impact on wellbeing which tended to increase with the number of sessions. Qualitative findings were reported in relation to shifts in cognition, changes in behaviour, mood and relationships between people with dementia and their carers. These changes tended to be viewed as positive by interviewees.

Implications: The results suggest that touchscreen based art interventions have the potential to provide an activity people with dementia can engage in with their carers which can benefit their wellbeing. A larger-scale controlled study would help to further determine whether wider dementia care practice implications can be drawn for clinical psychologists and other healthcare providers.

Keywords: dementia, art, tablet computers, wellbeing, carers

Introduction

Dementia is a chronic, progressive syndrome which affects people with dementia, their informal carers and other people close to them, and which can place significant emotional burden on relationships. Dementia and its associated care is a growing worldwide concern with an estimated 44 million people living with dementia internationally, with that number possibly doubling by 2030. (Alzheimer's Disease International, 2014). According to Alzheimer's UK (2014), there are 850,000 people living with dementia in the UK, two thirds of whom live in the community, supported by 670,000 informal carers. Informal carers, who tend to be spouses and family members, are estimated to provide eleven billion pounds worth of unpaid care each year. Engagement in meaningful daytime activity has been cited by people with dementia and their carers as one of their most frequent unmet daytime needs (Miranda-Castillo, Woods, & Orrell, 2013). Relationships with carers can be essential as they provide opportunities for people with dementia to maintain their sense of identity and self-esteem (Livingston, Cooper, Woods, Milne & Katona, 2008). Social activity in older adults has been shown to correlate strongly with physical health (Cherry et al., 2013). These benefits can in turn allow a person who has a dementia to retain their personhood (Kitwood, 1997).

Arts and Health Interventions

Staricoff (2004) reviewed 385 studies and found evidence to suggest that the arts have important roles in relation to improved physiological and psychological outcomes as well as improving professional-client relationships. Clift et al. (2009) reviewed the state of arts and health in England and concluded that whilst there was good evidence for the benefits of arts in health interventions, further research and communication with central policy makers was necessary to boost their implementation. Kinney and Rentz (2005), Musella and colleagues (2009) and Rosenberg (2009) reported art-based interventions for people with dementia led to improved communication, engagement and attention. Rhoads (2009) explored museum-based projects for people with dementia, and recommended that more be offered, citing the benefits for people with dementia and their caregivers. MacPherson, Bird, Anderson, Davis and Blair (2009) found that gallery-based interventions for people with dementia seemed to be of benefit at the time of the intervention, with changes seen in cognition and social behaviour. A carer was quoted as saying, “You do it for the moment”, suggesting that the benefits are valued despite their transience.

Eekelaar, Camic and Springham (2012) looked at the impact of a structured art-viewing session in a gallery followed by an art-making session. Their results showed that episodic memory seemed to improve and family carers reported that the people with dementia had shown benefits in mood, confidence and a reduced sense of isolation during gallery sessions. In a mixed-methods study Camic, Tischler and Pearman (2014) explored the impact of a series of art-viewing and art-making sessions in galleries on people with dementia and carers. Although standardised measures showed no significant change, a trend was seen in the reduction of carer burden; thematic analysis revealed cognitive improvements as well as enhanced quality of life. Young, Camic and Tischler (2015) systematically reviewed arts-based interventions for people with dementia and found that whilst art interventions are helpful for people with dementia further research was necessary to determine how the utility of arts-based interventions might be of use across dementia stages.

The multisensory nature of engaging with art is thought to be related to the impact of art-based interventions. The “dual coding” theory of memory (Paivio, 1986) suggests that when verbal and visual inputs are encoded simultaneously, they are linked in the short-term memory and then combined with information retrieved from long-term memory. Clark and Paivio (1991) suggested the “contiguity” effect enhances memory performance when verbal and visual material is coordinated, as neural connection formation is improved. As the current study also involves the modality of touch, this opens another sensory channel to assist individuals experiencing sensory decline in their interactions with art and others, and memory encoding. This additional processing channel led Thomson et al. (2012) to propose that physical holding of objects during object handling sessions, whilst also viewing and talking about them, gave rise to “triple coding” which potentially provides extra sensory information for coding which may be beneficial for people with dementia in engagement with activities.

Wellbeing

Wellbeing has been conceptualised and measured in a wide range of ways. The World Health Organisation updated their definition of wellbeing in 2011 to be, “a positive state of wellbeing, one which allows individuals to fully engage with others, cope with the stresses of life and realise their abilities” (p.1). This suggests that whist a sense of wellbeing might be consciously experienced it is also dependent on physical and mental factors, as well as being related to social interactions. This is in line with Ryff (1989) who proposed that wellbeing was related to one’s relations with others, an existential sense of purpose, and opportunities for personal development. Deci and Ryan (2000) later proposed that wellbeing was connected to self-sufficiency, ability and sociability. For the present study the definition of wellbeing as a dynamic phenomenon proposed by Dodge, Daly, Huyton and Sanders (2012) was used (Figure 1). This conceptualises wellbeing as “a state of equilibrium or balance that can be affected by life events or challenges." (p. 222). On this basis, measures of participants' appraisals of their own wellbeing were used.

Figure 1. Definition of wellbeing (Dodge et al., 2012). Reprinted with permission.

Computer-Based Interventions

Age UK (2010) reviewed evidence relating to older adults using technology they were unlikely to have been previously familiar with, such as Internet-based media. They concluded that whilst older people tended to be less likely to have Internet access than other age groups, those who did tended to use it more. This report suggested that technology might have a role in compensating for cognitive decline. Astell et al. (2010) reported on CIRCA, a touchscreen based system which acts as a cognitive prosthesis to facilitate people with dementia to engage in reminiscence with their caregivers They found that people with dementia were able to use the device, and that it allowed them to play a more equal role in interactions. Leuty, Boer, Young, Hoey and Mihailidis (2013) developed and evaluated ePAD, a device that allows people with dementia to engage in art therapy via a touchscreen. Clients using ePAD reported high levels of satisfaction with it and its novelty, as well as that they enjoyed using it. Lim, Wallace, Luszcz and Reynolds (2013) and Leng, Yeo, George and Barr (2014) explored the use of iPads by people with dementia. Lim and colleagues found that whilst they were mostly able to use the iPads independently, computer applications (apps) should be tailored to individual levels of capability wherever possible. Leng and colleagues observed more varied behaviours when people were using iPads as opposed to engaging in arts and crafts or cooking, and similar or enhanced levels of wellbeing, suggesting iPads might provide a beneficial alternative activity.

The psychophysiological underpinnings of touch (Sherrick & Craig, 1982) appear to play a role in boosting the improvements in wellbeing and happiness compared to just looking at objects. If tablet-based art viewing is found to be of benefit, it could be beneficial in allowing therapeutic use of art to be made more accessible to a wider range of people, such as those whose mobility limits their access to public art resources. It could also be effective when people are having days of increased difficulty, and leaving their residence proves too difficult.

The Present Study

The present study explored the impact of viewing art, with an installed art-app on a tablet-style computer on subjective wellbeing for people with dementia and their informal carers. Potential benefits of tablet-based art-viewing compared to gallery visits include accessibility for people who have impaired mobility, as well as reducing travel and time costs, thus allowing it to be available to more people. In order to address this aim, the following hypotheses were tested:

H1: Subjective happiness will show significant improvement following art-viewing sessions.

H2: Subjective wellness will show significant improvement following art-viewing sessions.

H3: Subjective interestedness will show significant improvement following art-viewing sessions.

H4: Subjective composite wellbeing will show significant improvement following art-viewing sessions.

H5: Subjective wellbeing will not show significant change between the start and the end of the intervention.

The study also aimed to qualitatively explore the following questions:

1. How does viewing art on a tablet-style computer impact the wellbeing of people with dementia?
2. What are informal carers' impressions of the impact of viewing art on a tablet-style computer impact on the people with dementia they care for?
3. How does a person with dementia experience viewing art on a tablet-style computer?

Method

Design

A mixed-methods repeated measures design was used in this quasi-experimental exploratory study, integrating qualitative information from interviews with quantitative data from outcome measures.

Participants

This study was approved by an ethics panel in the Faculty of Social and Applied Sciences at Canterbury Christ Church University (Appendix B). The research was also approved by the Research Engagement section of the Alzheimer’s Society (Appendix C). Following ethical approval, people with dementia attending Dementia Cafés with their carers in inner city London and rural locations in southeast England were invited to take part. All people with dementia attending Alzheimer’s Society

Dementia Cafés have a formal diagnosis of dementia. Recruitment consisted of a brief presentation about the project and an invitation for people to look at a demonstration of the app to see how it worked. Information sheets (Appendix D) were also distributed to those who expressed interest. See Table 1 for participant demographics. All people with dementia had been diagnosed within the last four years.

A priori power analysis was conducted using G*Power (Faul, Erdfelder, Buchner, & Lang, 2009) which suggested that in order to detect a medium effect size (0.5) with a high level of power (0.8, Cohen, 1992) using a two-tailed t-test with alpha =.05, a minimum sample size of 34 participants with dementia would be necessary in order to reliably detect the impact of the intervention on wellbeing. It was accepted to settle for a lower number in the hope that the intervention effect size was larger and, since this was an exploratory study, to allow the collection of qualitative data, which would allow exploration of user experiences and guide potential amendments to the intervention in the event of it not leading to change on the chosen measures.

Table 1

Participant demographics (W = White)

	Person with a dementia				Informal carer		
Pair	Sex	Age	Ethnicity	Location	Relationship	Age	Ethnicity
1	M	71	W British	Urban	Wife	72	W British
2	M	64	W Irish	Rural	Ex-wife	66	W Irish
3	M	66	W English	Urban	Wife	63	W English
4	F	90	W British	Rural	Son	59	W British
5	M	74	W British	Rural	Wife	71	W English
6	M	67	W English	Rural	Wife	65	W British
7	M	76	W British	Rural	Wife	74	W British
8	M	86	W British	Urban	Wife	77	W English
9	F	80	W British	Urban	Daughter	48	W British
10	F	64	W English	Urban	Husband	66	W English
11	M	83	W British	Urban	Wife	73	W British
12	F	76	W British	Urban	Daughter	48	W English
	Mean	75			Mean	66	
	Range	64-90			Range	48-77	

Measures

Quantitative data. People with dementia and carers completed the Quality of Life-Alzheimer's Disease (QoL-AD) scale (Appendix E; Thorgrimsen et al., 2003) before art-viewing began and when the tablet was collected. The QoL-AD covers 13 questions exploring various aspects of wellbeing, such as physical health, relationships, pastimes and life overall, and each is rated on a 4-point Likert scale, ranging from poor (one point) to excellent (four points). The scored are summed to give a total score ranging from 13 to 52. It was chosen because it can be self-completed by people with wide ranges of dementia severity, in addition to proxy scoring from caregivers, and it has good test-retest reliability (r ≥ 0.6), interrater reliability (kappa >.70) and internal consistency (α > .82). People with dementia also completed three visual analogue sub-scales (VAS; Appendix F; two sub-scales adapted from EuroQol, 1990) measuring appraisals of their own levels of happiness, wellness and interestedness before and after each art-viewing session. The interestedness subscale was not a part of the EuroQol scales, which are all directly health-related. It was added in order to evaluate the level of art viewers' engagement with the app, as engagement is key to the effectiveness of interventions designed for people with dementia (Trahan, Kuo, Carlson & Gitlin, 2014; Weiner & Camic, 2014). VAS scales were also completed at the beginning of the intervention and at its conclusion. Each VAS subdomain yields a score out of 100, with 100 corresponding to the maximum and zero to the minimum possible levels of wellbeing. The VAS was selected as previous researchers have found it a simple, effective tool for rapidly gathering wellbeing information from participants in arts and health research (e.g Thomson, Ander, Menon, Lanceley & Chatterjee, 2011).

Qualitative data. When the tablet computer was collected, an audio recorded semi-structured interview (see Appendix G for interview schedule) was conducted to explore their positive and negative experiences of using the app and its impact on wellbeing (Stone & Mackie, 2013); interview data was analysed using thematic analysis (Braun & Clarke, 2006).

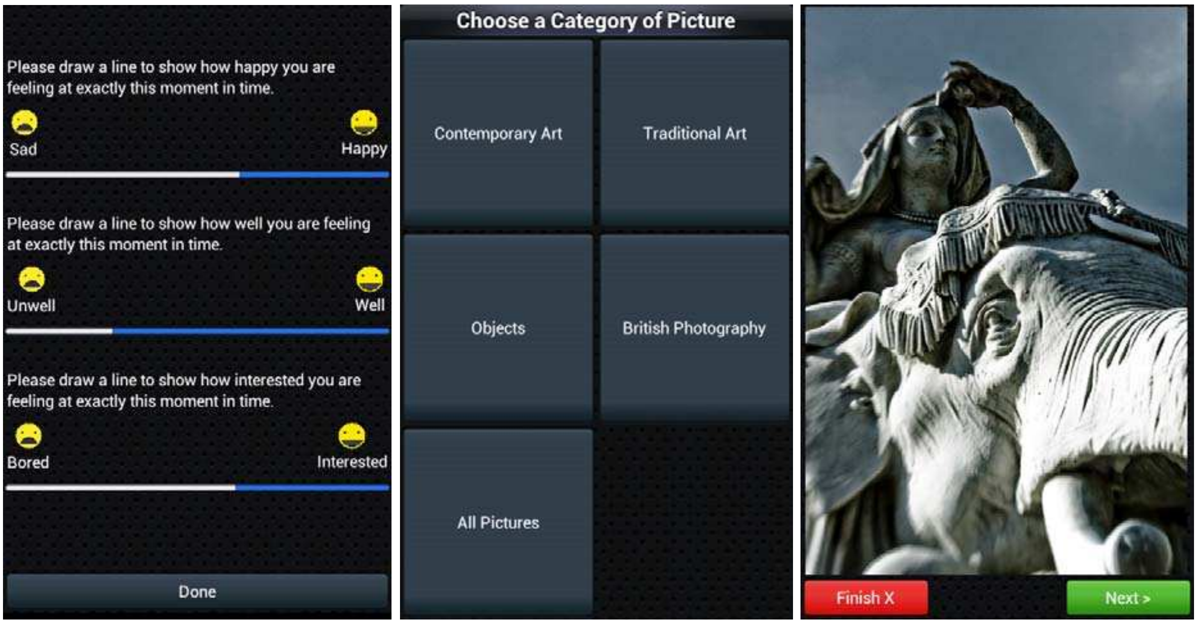
Quality Assurance

At the beginning of the project I conducted a bracketing interview (Ahern, 1999) with a colleague in order to identify areas of possible bias and minimise their impact on the research. Using a research diary, throughout the project I continuously attempted to keep in mind how my personal interest in the research yielding results, as well as how my beliefs might inadvertently influence responses from participants and the choices I made during analysis (Appendix H). All interviews were transcribed and coding was discussed with my lead supervisor in order to arrive at a consensus. Several codes were altered, expanded or combined during this process. Similarly, theme identification was reviewed and adjustments made as above.

Procedure

A preliminary version of the app was developed for the Android platform in partnership with Dr Michael Heron and field-tested with volunteers. Emphasis was placed on simplicity and clarity of the user interface (Figure 2). Feedback was sought in relation to the usability of the app. Adjustments to colour, font size, position of the VAS scales and other presentation aspects were made based on feedback from four carers and two people with dementia (Appendix I). Following presentations about the study at Alzheimer’s Society Dementia Cafés, an appointment was made with each dementia-carer dyad to meet at a location of their choice to discuss the study, experience a preliminary use of the app, obtain consent (Appendix J) and complete initial QOL-ADs and paper VAS. These were both completed by both dyad members where possible, but if one member of the dyad chose not to complete it, this was discussed and the process continued. Participants were encouraged to ask questions about anything they would like clarified, which confirmed understanding of what taking part would entail. The principles of process consent (Dewing, 2007) were applied throughout meetings with participants to monitor ongoing consent.

The tablet was left with participants and they were asked to use the tablet “at least five times” over the course of two weeks. Each time the person with a dementia used the app VAS scales were automatically presented at the beginning and end of viewing. Once the first VAS scales had been completed, participants were presented with a choice of art genres to view (‘Contemporary Art’, ‘Traditional Art’, ‘Objects’, ‘British Photography’ or ‘All Pictures’), and viewing commenced. Questions (Appendix K) were supplied on a printed sheet attached to the tablet case, in order to provide possible topics of conversation during app sessions. There were two buttons beneath each image: one to skip to the next image, and one to finish the session.



Please draw a line to show how happy you are feeling at exactly this moment in time.

Please draw a line to show how well you are feeling at exactly this moment in time.

Please draw a line to show how interested you are feeling at exactly this moment in time.

Figure 2. Screenshots from the art-viewing app. Photograph © Charlie Tyack 2015.

When the ‘finish’ button was pressed the ending VAS scales appeared for completion and once this was done the app closed. VAS scores and art-viewing information (category selected, duration of viewing, specific images viewed) were logged by the application. At the final meeting, the QOL-AD and paper VAS were completed by both participants where possible. The semi-structured interview was also completed at this time.

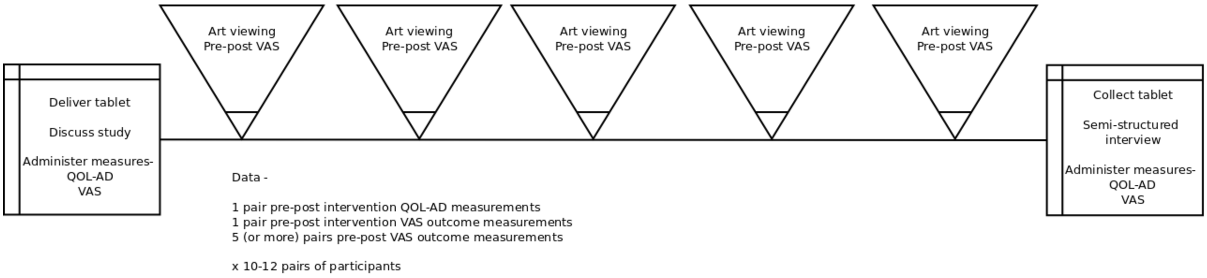


Figure 3. Experimental procedure.

Analysis

Descriptive statistics were generated using SPSS 21. Exploratory analyses were conducted to check VAS scores met parametric assumptions and QOL-AD scores showed internal consistency. Two way paired sample *t*-tests were conducted to compare the VAS score changes during each of the first five sessions. Changes in VAS scores before and after art-viewing were calculated by subtracting pre-session scores from post-session scores for each sub-scale and for the composite VAS score. The amounts of change in VAS score at session one and session five were compared using two way paired sample *t*-tests. VAS scores did not consistently meet parametric assumptions, therefore *t*-tests were carried out with bootstrapping (Efron & Tibishirani, 1993). This allows the shape of the sampling distribution to be estimated through resampling. Bootstrapping analyses were performed using 10,000 samples.

Interview transcripts were thematically analysed using an iterative six-stage approach (Braun & Clarke, 2006) in order to explore the views and experiences of participants, and allow themes within the data to be identified:

1. Data transcribed, read and re-read. Initial thinking noted.
2. Coding of data set conducted using QSR NVivo 10. Coding peer-reviewed.
3. Themes identified and codes organised into themes.
4. Themes reviewed in relation to coded extracts and data set and peer-reviewed. Thematic map generated.
5. Themes clearly named and defined.
6. Report produced. Integrated with quantitative findings.

Results

Quantitative analysis

App usage. App logs indicated that people used the app in different ways (Table 2). Nine pairs used the app to view art at least five times, per the suggested usage. Sessions tended to last about twenty minutes (*M* = 20.47, *SD* = 11.53), with about thirty images viewed (*M* = 30.15, *SD* = 15.69) with people averaging just over a minute per image, but this varied a lot (*M* = 69.02, *SD* = 69.83). Session frequency ranged from averaging once per day to once per fortnight (*M* = one session every 3.56 days, *SD* = 3.74).

Table 2

Art viewing profiles of each pair of participants

Pair	*Art viewing sessions*	*Viewings span (days)*	*Session duration (mins)*		*Images viewed*		*Seconds per image*	
			Mean	*SD*	Mean	*SD*	Mean	*SD*
1	6	10	42.2	10.1	16.3	20.5	272.1	139.9
2	13	13	18.6	12.5	27.2	20.8	53.9	31.9
3	3	4	16.7	9.9	22.3	9.5	45.1	15.5
4	7	13	10.1	2.0	26.4	16.2	35.1	24.6
5	3	41	13.7	12.5	14.7	10.4	83.2	72.2
6	5	10	7.2	2.5	26.0	11.3	17.8	6.0
7	5	5	15.8	4.7	44.4	33.5	27.4	13.2
8	5*	20	12.4	10.1	26.6	14.6	26.6	14.7
9	5	9	18.0	17.4	73.6	53.9	19.5	19.8
10	5	12	17.8	8.8	30.6	18.5	64.9	84.0
11	9	36	33.2	11.6	31.9	20.9	73.6	28.4
12	4	32	40.0	19.1	21.8	9.3	109.1	24.1
Mean	5.83	17.08	20.47		30.15		69.02	
SD	2.79	12.44	11.53		15.69		69.84	

* No measures recorded for final session (perhaps owing to tablet battery failure).

Exploratory analyses. The VAS scales were assessed for conformity to parametric assumptions. According to the Kolmogorov-Smirnov test, the composite VAS scores met parametric assumptions on all but two out of fourteen administrations, when they were significantly abnormal. The subdomain scores breached normality on seventeen of 42 administrations. Since this meant parametric assumptions would be breached on some occasions, bootstrapping was used on all *t*-tests to check whether the scores were likely to be significantly different if part of a normal distribution. QOL-AD scores conformed to parametric assumptions at all administrations, according to Kolmogorov-Smirnov tests. Kolmogorov-Smirnov scores and *z* scores for kurtosis and skewness are in Appendix L. Cronbach’s alpha was used to estimate the internal consistency of the QOL-AD in the current study. An alpha value greater than or equal to 0.7 denotes adequate internal consistency (Kline, 1999). All QOL-AD exceeded this threshold (all: α = .88, people with dementia: α = .90, carers: α = .81). All VAS also exceeded 0.7 (all: α = .73, people with dementia: α = .73, carers: α = .73) Appendix M contains more detail.

Comparisons of means. VAS means from sessions one to five were compared to explore hypotheses one to four. Whilst nine sets of participants completed at least five sessions only eight had complete data sets.

Change in happiness VAS (H1) was explored by comparing pre and post app-use VAS scores with two-tailed within participant *t*-tests. See table 3 for *t*-test outcomes and effect sizes in relation to the happiness VAS subscale. There is a clear trend in all but session two towards increased happiness at the end of the app session. The Bonferroni-corrected *p* score would be < 0.01 as there were five pairwise comparisons in this hypothesis. None of the *t*-test results was significant, so it cannot be concluded that happiness showed significant improvement following art-viewing sessions. Session five had the largest effect size (*d* = 0.35) and came closest to significance, (*p* = 0.13, bootstrapped *p* = 0.14). A post-hoc power analysis was conducted which determined that 99 people would be needed at session five to detect a significant change, showing that p-levels are low due to the lack of power.

Table 3

Pre and post VAS happiness scores

Session	VAS Score	Mean	*SD*	*t*-test (bootstrapped *p*)
1	Start	69.88	23.52	*t*(7) = -0.53, *p* = 0.62 (0.62) *d* = 0.21
	End	74.00	14.26	
2	Start	79.00	21.00	*t*(7) = 0.12, *p* = 0.91 (0.91) *d* = 0.0067
	End	78.00	16.51	
3	Start	67.13	33.18	*t*(7) = -0.44, *p* = 0.67 (0.70) *d* = 0.047
	End	68.63	30.05	
4	Start	69.50	23.77	*t*(7) = -0.42, *p* = 0.69 (0.67) *d* = 0.14
	End	73.13	26.98	
5	Start	60.75	28.30	*t*(7) = -1.75, *p* = 0.13 (0.14) *d* = 0.35
	End	70.75	28.42	

Change in wellness VAS (H2) was explored by comparing pre and post app-use wellness VAS scores with two-tailed within participant *t*-tests. See table 4 for *t*-test outcomes and effect sizes in relation to the wellness VAS subscale. Scores tended to drop in sessions one and two, but from session three onwards there was a clear trend towards improved sense of wellness at the end of app sessions. The Bonferroni-corrected *p* score would be <0.01 as there were five pairwise comparisons in this hypothesis. None of the t-test results was significant, so it cannot be concluded that happiness showed significant improvement following art-viewing sessions. Session five had the largest effect size for improvement (*d* = 0.47) and came closest to significance, (*p* = 0.26, bootstrapped *p* = 0.31). A post-hoc power analysis was conducted which determined that 57 people would be needed at session five to detect a significant change, showing that *p*-levels are low due to the lack of power.

Table 4

Pre and post VAS wellness scores

Session	VAS Score	Mean	*SD*	*t*-test (bootstrapped *p*)
1	Start	81.75	14.64	*t*(7) = 1.66, *p* = 0.14 (0.13), *d* = 0.58
	End	71.50	20.45	
2	Start	70.38	31.05	*t*(7) = 1.17, *p* = 0.28 (0.36), *d* = 0.19
	End	64.00	34.86	
3	Start	67.50	28.55	*t*(7) = -1.54, *p* = 0.17 (0.18), *d* = 0.42
	End	78.13	21.87	
4	Start	73.88	18.57	*t*(7) = -0.94, *p* = 0.38 (0.44), *d* = 0.030
	End	79.25	17.37	
5	Start	69.75	29.30	*t*(7) = -1.22, *p* = 0.26 (0.31), *d* = 0.47
	End	80.38	13.22	

Change in interestedness VAS (H3) was explored by comparing pre and post app-use interestedness VAS scores with two-tailed within participant *t*-tests. See table 5 for *t*-test outcomes and effect sizes in relation to the interestedness VAS subscale. Scores tended to drop in sessions one and three, but in the other sessions the trend was towards increased reported interestedness. The Bonferroni-corrected *p* score would be < 0.01 as there were five pairwise comparisons in this hypothesis. None of the *t*-test results was significant, so it cannot be concluded that happiness showed significant improvement following art-viewing sessions. Session five had the largest effect size (*d* = 0.49) and came closest to significance, (*p* = 0.12, bootstrapped *p* = 0.15). A post-hoc power analysis was conducted which determined that 52 people would be needed at session five to detect a significant change (*p* < .01), showing that *p*-levels are low due to the lack of power.

Table 5

Pre and post VAS interestedness scores

Session	VAS Score	Mean	*SD*	*t*-test (bootstrapped *p*)
1	Start	73.75	14.17	$t(7) = 0.60$, $p = 0.57$ (0.57), $d = 0.23$
	End	69.25	23.30	
2	Start	75.63	18.76	$t(7) = -1.31$, $p = 0.23$ (0.26), $d = 0.38$
	End	83.63	23.42	
3	Start	61.63	33.13	$t(7) = 0.17$, $p = 0.87$ (0.85), $d = 0.033$
	End	60.50	34.77	
4	Start	66.50	26.01	$t(7) = -1.07$, $p = 0.32$ (0.34), $d = 0.20$
	End	71.50	25.26	
5	Start	59.88	30.32	$t(7) = -1.75$, $p = 0.12$ (0.15), $d = 0.49$
	End	73.63	25.34	

Change in composite VAS (H4) was explored by comparing pre and post app-use interestedness VAS scores with two-tailed within participant *t*-tests. See table 6 for *t*-test outcomes and effect sizes in relation to the interestedness VAS subscale. Scores tended to drop in session one, remained quite stable in session two, and in subsequent sessions the trend was towards increasing levels of improvement. The Bonferroni-corrected *p* score would be < 0.01 as there were five pairwise comparisons in this hypothesis. Before Bonferroni-correction, the *t*-test result for session five would have been significant ($t(7) = -2.75$, $p = 0.029$, (bootstrapped $p = 0.073$) $d = 0.55$). A post-hoc power analysis was conducted which determined that 52 people would be needed at session five to detect a significant change ($p < .01$), showing that *p*-levels are low due to the lack of power.

Table 6

Pre and post VAS composite wellbeing scores

Session	VAS Score	Mean	*SD*	*t*-test (bootstrapped *p*)
1	Start	225.38	44.67	*t*(7) = 0.77, *p* = 0.47 (0.44) *d* = 0.25
	End	214.75	40.52	
2	Start	225.00	47.65	*t*(7) = -0.040, *p* = 0.97 (0.98) *d* = 0.14
	End	225.63	42.66	
3	Start	196.25	80.01	*t*(7) = -1.39, *p* = 0.21 (0.22) *d* = 0.14
	End	207.25	79.36	
4	Start	209.88	62.91	*t*(7) = -1.024, *p* = 0.34 (0.34) *d* = 0.22
	End	223.88	62.31	
5	Start	190.38	67.58	*t*(7) = -2.75, *p* = 0.029, (0.073) *d* = 0.55
	End	224.75	56.94	

Further analysis. In light of the trend towards increasing beneficial impact on VAS scores at later sessions, it was decided to run further analyses on the changes VAS scores.

H6: Amount of wellbeing improvement will increase with number of sessions

In order to explore whether the apparent increased VAS changes were significant, two-way within participant *t*-tests were conducted on each of the VAS subdomains as well as the composite VAS scores, to compare the changes in score at session one with the changes as session five. Table 7 contains the computed change scores.

Table 7

Mean changes in VAS scores at each session

	Happy		Well		Interested		ALL		
Session	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	*N*
1	5.75	18.71	-2.25	18.54	-3.67	18.20	-0.17	36.50	12
2	1.08	19.63	-3.00	13.54	11.58	26.11	9.67	44.03	12
3	3.17	9.30	6.75	20.09	1.33	16.10	11.25	26.19	12
4	5.20	21.98	0.90	17.14	5.50	11.93	11.60	34.79	10
5	10.00	16.21	10.63	24.55	13.75	22.24	34.38	35.42	8

Paired-samples within participant *t*-tests were conducted to compare changes in individual VAS scores at session one and session five. Figure 4 shows that sessional VAS score changes tend to fluctuate initially but that by session five there was a trend towards all scores improving. There was no significant difference in the happiness score changes at session one (*M* = 4.13, *SD* = 22.22) and session five (*M* = 10.0, *SD* = 16.21); *t*(7) = -.567, *p* = 0.589 (bootstrapped *p* = 0.580), *d* = 0.30. There was no significant difference in the wellness score changes at session one (*M*=-10.25, *SD*=17.49) and session five (*M* = 10.63, *SD* = 24.55); *t*(7) = -1.81, *p* = 0.11 (bootstrapped *p* = 0.12), *d* = 0.98. There was no significant difference in the interestedness score changes at session one (*M* = -3.50, *SD* = 21.70 and session five (*M* = 13.75, *SD* = 22.24); *t*(7) = -1.915, *p* = 0.097 (bootstrapped *p* = 0.125) *d* = 0.79. These results suggest that with this sample size, there is no significant increase in the change in VAS subdomain scores from session one to session five. There is a consistent trend towards increased improvement at later sessions, backed up by the large effect sizes, especially for wellness and interestedness, which suggest the effect is powerful even with the small sample size.

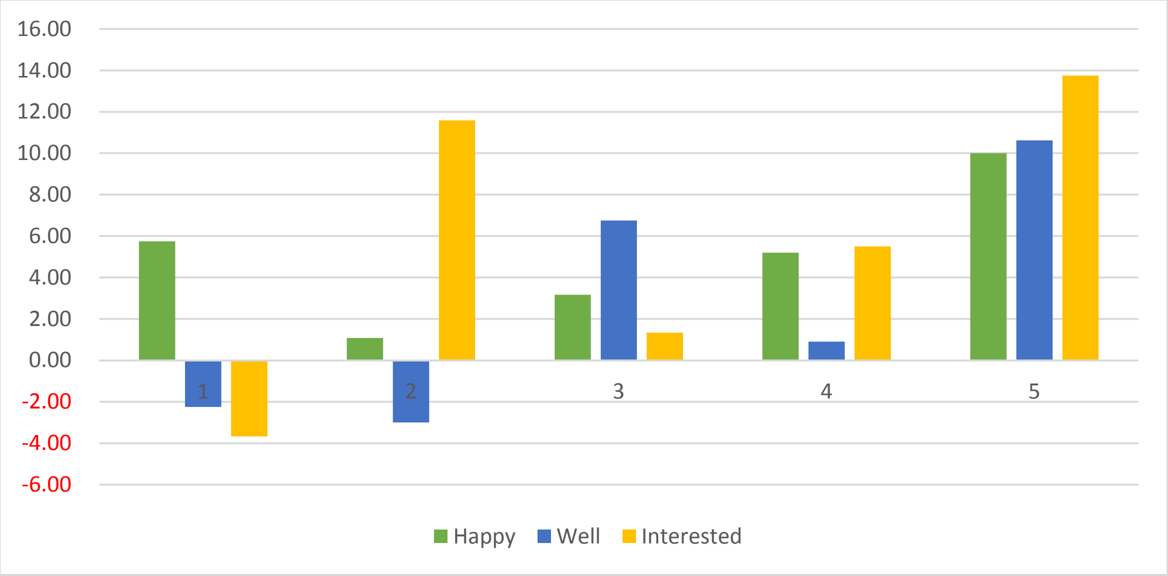


Figure 4. Changes in VAS subdomain scores across sessions for all participants

A paired-samples *t*-test was conducted to compare changes in composite VAS at session one and session five (Figure 5) which found that the beneficial effect of the intervention on reported composite wellbeing increased every session. There was a significant difference in the score changes at session one (*M* = -10.63, *SD* = 39.28) and session five (*M* = 34.38, SD = 35.42); *t*(7) = -2.394, *p* = 0.048, *d* = 1.20 (bootstrapped *p* = 0.092). Since four *t*-tests were run in this sub-hypothesis, the Bonferroni corrected alpha level was 0.0125. Thus whilst there is an apparent effect, more participants are needed for significance. The effect size is very large despite the small sample size.

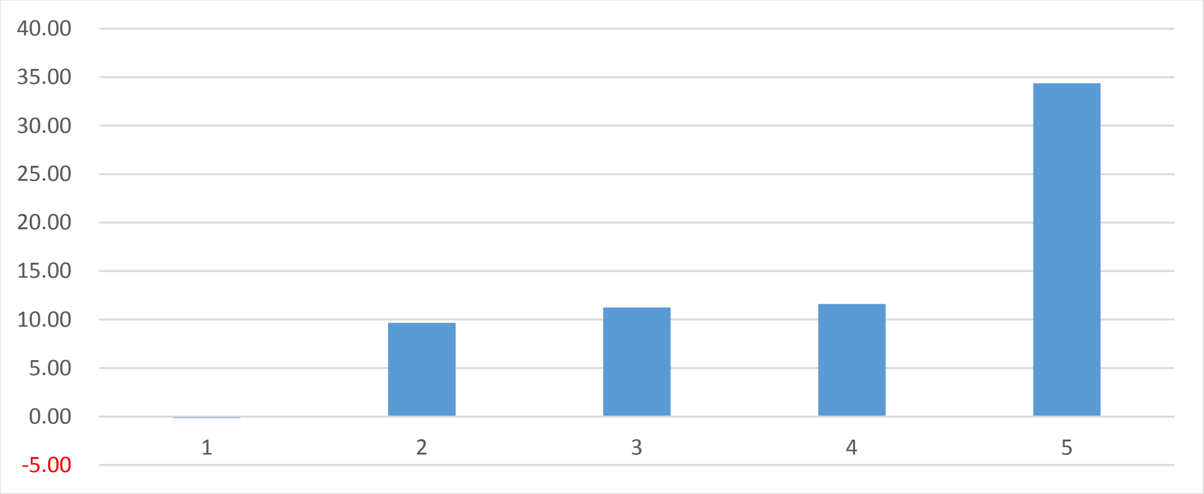


Figure 5. Changes in VAS composite scores across sessions for all participants

Pre-post-intervention differences (H5). Analysis was conducted to compare scores on QOL-AD and VAS measures prior to the intervention and at its conclusion approximately two weeks later. Table 8 details the changes in VAS and QOL-AD scores for both groups. In line with previous studies, there was no significant change in wellbeing on any scale across the intervention. Informal carers tended to rate the quality of life of the person they were caring for lower than they rated themselves.

Table 8

Measures – pre and post intervention

	Measure		Mean	SD	t-test (bootstrapped p)
People with dementia	QOL-AD	Pre	37.22	8.16	*t*(8) = 0.68, *p* = 0.52 (0.49), *d* = 0.12
		Post	36.22	8.51	
	VAS-Happy	Pre	86.00	11.56	*t*(7) = -0.23, *p* = 0.82 (0.83), *d* = -0.13
		Post	87.63	13.96	
	VAS-Well	Pre	90.00	13.93	*t*(7)=0.12, *p* = 0.91 (0.91), *d* = 0.073
		Post	89.00	13.61	
	VAS-Interested	Pre	80.50	24.63	*t*(7)=-0.24, *p* = 0.82 (0.83), *d* = -0.052
		Post	82.00	32.13	
	VAS-ALL	Pre	256.50	38.49	*t*(7)=-0.12, *p* = 0.91 (0.90), *d* = -0.045
		Post	258.53	50.62	
Informal carers	QOL-AD	Before	32.82	3.76	*t*(10) = 0.61, *p* = 0.55 (0.55), *d* = 0.14
		After	32.27	4.05	
	VAS-Happy	Before	78.78	16.20	*t*(8)=0.30, *p* = 0.77 (0.77), *d* = 0.12
		After	77.11	12.50	
	VAS-Well	Before	83.89	15.80	*t*(8)=0.14, *p* = 0.89 (0.90), *d* = 0.044
		After	83.22	14.35	
	VAS-Interested	Before	86.89	16.65	*t*(8)=-0.94, *p* = 0.37 (0.34), *d* = -0.28
		After	90.78	9.82	
	VAS-ALL	Before	249.56	37.95	*t*(8)=-0.12, *p* = 0.90 (0.90), *d* = -0.045
		After	251.11	29.77	

Summary of quantitative findings

Wellbeing appeared to show an improvement at the end of art viewing sessions, but none of the results achieved significance when familywise error rates had been corrected. The effect sizes tended to be quite large by session five, despite the small sample size. The changes in wellbeing seem to be nuanced, however, in that different wellbeing subdomains showed different patterns of change. In general, there seemed to be an increased beneficial effect on wellbeing as people completed more sessions.

Thematic analysis

After initial coding of the twelve interview transcripts, 269 codes were identified. See Appendix N for initial codes. Five main themes and 25 subthemes were identified (Table 9). See Appendix O for thematic maps. Appendix P contains theme definitions. The findings related to the research questions are summarised below, in descending order of number of coded passages per theme and sub-theme.

Cognitive. Theme covering comments people made that suggested the app had impacted on some aspect of cognition, in relation to specific thoughts or shifts in attention that using the app triggered.

Stimulating thoughts triggered by using the app were the most commonly mentioned phenomenon in this theme for both the person with a dementia and their carer. The most frequent codes related to opinions people had about images they viewed. These could be aesthetic responses to images, or thoughts people had in relation to the stories of images. People also expressed preferences for specific genres. Seven sources said the app was “interesting”. Three sources talked about thinking about where they might put the images in their homes following prompting from the questions provided, suggesting engagement not only with the art on screen but thinking related to practicalities.

Remembering was an often-cited subtheme. This was described in relation to the person with dementia, but carers also talked about how memories were evoked, such as those relating to family history. Some images seemed particularly evocative, such as the ice-cream van, which seemed to bring back pleasant childhood memories. One person with dementia raised the possibility that one might not want to revisit some memories as not all memories are pleasant. One carer reported that their family member with dementia had reminisced about events unknown to them. This recovery of unshared memories was an interesting phenomenon. Reminiscence was not a main aim of the app, and took place despite the lack of deliberately personalised images. This is a promising finding, as it suggests the app might be able to stimulate recollection without potentially traumatic experiences reported elsewhere for carers when they are aware of their relatives forgetting information about key people from their pasts (Alm, Dye, Gowans, Campbell, Astell, & Ellis, 2007; Woods et al., 2012).

Attention. Effects of art-viewing on attention were reported in nine interviews. This related to the person with dementia's attention being focussed on the app, as reported by five interviewees. Changes in attention within art-viewing sessions were reported, with viewers' attention reportedly waning towards the end. Some people with dementia discussed how the pace of everyday life, or television, was at a speed that meant "you pass by things", whereas the pace of the app meant that they could focus their mind on it. Several interviewees reported seeing different things every time.

The challenging nature of using the app. Raised in eleven interviews, this was related to difficulties interpreting images as well as to certain aspects of using the app or the tablet. Some people conveyed curiosity about certain images, which they may have eventually resolved. Others reported confusing aspects of the app, particularly in relation to abstract images, or questions that did not apply to some images. The challenges were viewed as positive experiences by some people, whilst others reported some aspects were "hard" or "tricky". Some respondents reported overcoming difficulties either on their own or with help, and some conveyed pride in relation to this.

Learning. Various respondents talked about events that suggested learning had taken place. Some people with dementia reportedly became more able to use the app over time and stated that their viewing sessions shortened as they became familiar with the images, which suggested learning was occurring. Other pairs reported how they were initially concerned about using the app, but that towards the end they looked forward to their sessions.

Reappraising. Half of the interviews had references to people reappraising certain things. These might have been in relation to their family members with dementia being more able to use the app than they had thought possible. Other references related to different perspectives people might have had, with family carers being surprised by things that their family members with dementia noticed, or different viewing styles. Some realisations were difficult, such as carers becoming aware of deterioration in family members' cognitive abilities.

Experience of app

This theme related to impressions interviewees raised in relation to using the app.

Improvements. These included inclusion of information about the images as an option after the first viewing rather than being immediately presented; the possibility of new sets of images; using the app to stimulate group activity; enlarging images and adding an image rating scale would be helpful, to keep track of preferred images.

Issues with the app. These were raised in relation to difficulties with the screen and included over-sensitivity resulting in unwanted button-presses, glare or viewing angle making it hard to find an optimum position for both viewers to look at images together. Difficulties relating to the VAS scales in the app were mentioned, such as their discouraging people with dementia viewing art alone, or physical difficulties influencing scores and respondents being unsure about how much impact they should have on the scores. Other issues related to difficulties charging the tablet or turning it on, but only one reported finding the app hard to use.

Good experiences included people reporting changes happening, such as how it was good to have something which brought their spouse into discussion. People also said the app was “amazing”, that they liked it, that it was a good idea, and that it was good when it worked. ***Liked aspects*** included people reporting finding it easy to use, being able to skip pictures and to choose the type of art. One participant reported liking the fact that the very existence of the app implied acknowledgement of the abilities of older people to use modern technology. People also reported that it was “comfortable” and “pleasant”, and something that could be used despite limited mobility. ***Familiarity*** with technology was mentioned by several participants, with some saying that they were familiar with touchscreen technology, which helped. Others said that the technology was relatively novel to them. The app was ***likened to*** other activities, like reading a book, or talking to somebody. The ***effect of timing*** was also referred to, as some people found it was better at certain times of day, or that their response depended on whether they were having a good day.

Dyad relationship

This theme related to references people made to impacts using the app had on their relationship and interactions.

Changes to the relationship included how the app provoked conversations. One pair said that the conversations replaced television viewing. Several pairs reported different images provoked different amounts of conversation. Several pairs reported it changed how they spent time together. ***Joint activity*** covers how app use became a generally favourably described shared activity. People worked together work out what images represented. Several pairs reported the person with dementia required support to use the app. Two pairs reported that in this process, the app became a focus for joint attention.

Beneficial impacts were covered in seven interviews. An example was that it was “good for the partnership”. Most of the participants reported that the app brought them closer. One carer reported that the app seemed to help her spouse to express his feelings in new ways, and how she saw this as positive as she felt she could help him more as a result. Five pairs said their interactions and the way they spent time together had been ***unchanged*** by the app.

Mood

This theme related to impacts that people reported on their own or their counterparts’ emotional state as a result of the app.

Eleven pairs reported ***improved*** mood. This could be in relation to their enjoying app sessions, or certain images boosting their mood, such as colourful ones. A third of informal carers reported enjoying seeing changes in the people they cared for. Two respondents reported that happy memories were evoked. One carer reported that she successfully used the app to break negative emotional cycles that her spouse could experience: an unanticipated spontaneous usage. Feelings related to mastery were also discussed: one person said it felt good to be able to use the app, a person with dementia reported that their confidence in their cognitive abilities was increased, and another pair reported pride in relation to having an app.

There were several reports of a ***range of feelings*** being evoked. This tended to be in relation to different images. One respondent reported that it was sometimes good to remember, but sometimes bad. Within this sub-theme, several pairs reported unchanged feelings. This was sometimes in relation to reflections about the VAS scores, and sometimes in relation to certain images not evoking strong feelings. Two pairs said they would miss the app. A third of interviews included reports of ***lowered*** mood. This tended to relate to specific images. Two people said some images could be upsetting. Another said duller images could be “depressing”. One participant reported that it was “annoying” to not know what some images were.

Behaviour

Changes in behaviour were reported outside the main carer-caree relationship.

Use of time related to changes people made to their routines including the app becoming a new pastime. Some pairs found that different image collections tended to be viewed at different speeds. One respondent said the person she cared for spent longer viewing images each time. Some pairs reported behavioural ***activation***, as art-viewing seemed to affect other activities. Five pairs reported increased engagement with the arts. This included gallery trips, or obtaining books of art images to enjoy together, which they would not have done previously. One pair reported that it prompted them to view their photo albums together.

Social impacts were reported as people exhibited novel or thought-to-be-extinguished social behaviours. Some people shared the art-viewing app with people beyond the dyad. People with dementia reported using the app with other family members. Perhaps their relative expertise with the app meant that they could participate more equally. One carer reported being surprised that her mother seemed to have regained the ability to use her phone.

In-app behaviours related to what people did whilst using the app. Four pairs reported that the person with dementia had used the app alone, and two people with dementia reportedly made in-app choices. One informal carer reported they had viewed different categories every time.

Summary of qualitative findings

People with dementia and carers reported a range of ways in which viewing art on a tablet computer impacted their wellbeing. Thematic analysis identified impacts on cognition, relationships, emotions and behaviour. Cognitive impacts included reports of stimulation, remembering both individually and jointly, attentional shifts, and evidence of the person with a dementia learning. Changes were reportedly transient. Relational impacts included changes in the dyad relationship, provision of a joint activity, and reports of improvement in some relationships, and of no change in others. All but one set of interviewees reported improved mood from app use, with a range of other feelings being described. Some aspects of the app were reportedly frustrating. Behavioural signs related to wellbeing included changes in use of time, behavioural activation, sociability and engagement with the app.

App experience was commented on in various ways. Ten sets of interviewees made suggestions in relation to possible app improvements, which suggested good engagement. All participants reported issues with the app, giving hope that future versions might be developed with user feedback. It is worth noting that despite these issues, all users continued to use the app on several occasions. All but one pair gave positive appraisals of the app experience, and ten pairs discussed aspects that they appreciated. Users reported differing levels of familiarity with this technology. Some reported it seemed to be more effective at different times of day.

Table 9

Thematic analysis results

Theme	Sub-themes	Example quotes (1 = Person with a dementia, 2 = Informal carer, I = Interviewer)	Total interviews	Coded passages
Cognitive - impacts the art-viewing app had on the cognitive processes of the users	Stimulating	“1 - They made you think, some of them made you think, and er, which is quite good.” “1 - I was, well, first of all, first of all, fascinated, at the fact that you can with this, do something which, um, actually, er, does challenge you to do something slightly more specific, um than perhaps something, um, wishy-washy.” “1 - [SIGH] There were some things that I thought, “Yes, I could live with that.” And then I looked at a few more, or a couple more, and I thought, “No I certainly wouldn’t, wouldn’t want anything to do with, with that.””	11	77
	Challenging	“1 - Well it challe- ... 2 - I mean that was, that was a positive. 1 - It challenged me to actually have a look...” “1 - Yeah. I - kind of a bit tricky to interpret, two or three of them but ... to you know to really appreciate them.” “1 - Um. A couple of the images were quite difficult to, try to work out what they were.”	11	31
	Remembering	“1 - In that sense, if you look at it like that, psychologically I suppose. It brought, you know, cos I didn’t, remember lots of things. Something. That brought back, you know, what a happy happy man you used to be, yeah.”	11	38

Theme	Sub-themes	Example quotes (1 = Person with a dementia, 2 = Informal carer, I = Interviewer)	Total interviews	Coded passages
		"1 - And it gives you, you remember, other things that have happened through your life with it. 2 - Yeah. 1 - You do! I - Hm. 1 - You do and it's like oh!" "2- Erm, what was lovely was that mum was able to share some experiences that I didn't know about, that was really nice."		
	Person with dementia's attention	"2- I mean he did attend, I mean he is a person that likes visual things you see so it is the sort of thing he would like to do … And he did. Yes he did sort of take an interest and attend to it." "2 -Towards the end, or if we did more than one category at a time ... She would have less answers to the pictures." "1 - Which in normal life, you know, you pass by things, er, without noticing it, I mean you ... Whereas this, this, you know focussing the mind on it ... With the questions."	9	28
	Learning	"1 - I did some on my own, and some with [2]." "2 - Well once [1] got used to it ... It became a lot easier." "2 - And, [1] found it a bit worrying to do the lines at first. And um, but as ti- as time went on, and we got used to it, we, we were sort of looking forward to it!"	9	15
	Reappraising	"2 - Yeah, cos I'd come down and I'd go, "We've gotta do that." He'd say, "I've already done it.". And I'd go, "Right okay!" [laughs]" "2 - Well it's quite funny because I see, I see it the way I see it, and	6	13

Theme	Sub-themes	Example quotes (1 = Person with a dementia, 2 = Informal carer, I = Interviewer)	Total interviews	Coded passages
		then mum would say something and I'm thinking, well where did you get that from?" "1 - Cos we, see things in a different way. 2 - Mmm. 1 - Especially the fruit business. 2 - Oh yeah. [LAUGHS] 1 - [LAUGHS]"		
	Temporary	"2 - I don't know whether it, it produced a long-term effect. … An immediate probably. I - Yeah, okay, so at the time, perhaps. Things felt different but then, outside that time ... 2 - Then after, you s- you start to concentrate, go back and concentrate on, pains and, what have, what have you. I - Yeah, okay. So maybe a brief, escape. 2 - A brief escape." "2 - Nothing long-term. Perhaps just while we were doing it … There was an interest there … But once we'd sort of sit up and ... back to normal."	2	2
Experience of app - impressions interviewees had in relation to using the app	Improvements	"2 - ... Would have been nice to have had a bit where you could have flicked on to see ... 1 - Who was what. 2 - ... that's from wherever, you know, and what, actually what it was, cos some of the um, the little statuette, objects, we weren't entirely sure. 1 - Yeah, we don't know what they were: there's nothing at the back of it." "2 - And I thought this would be good to do in a little group.	10	38

Theme	Sub-themes	Example quotes (1 = Person with a dementia, 2 = Informal carer, I = Interviewer)	Total interviews	Coded passages
		I - Yeah. 2 - Being able to see it and, sort of know what other people think.” “2 - I think the pictures could be bigger. 1 - Mm-hmm. 2 - Cos you didn’t, you know and I couldn’t see without putting my glasses on. 1 - Yeah. 2 - So I think that would be useful. 1 - Mm-hmm.”		
	Issues	“2 - I mean I’d sort of have to know but um. No. I mean I found the pictures difficult to look at really, because I, of the glare, and reflection ... I - Yeah. It is quite bright... 1 - It’s true.” “2 - Oh well you just, very, hardly touch it and you’ve missed a picture. [LAUGHS] I - Oh okay, so it’s quite sensitive. 1 - And it goes back. 2 - Yeah, yeah, it’s only because we’re not used to using technological.” “2 - I think that, er mum, as, you did attempt to use it on your own a few times didn’t you, but you used it getting through the first page of, “How do you feel?” … That and, and then getting to the done button, I think flummoxed you. So you didn’t actually get to visual, to see the pictures.”	12	33
	Good	“I - How did it make you feel? Using the app? 1 - Pleasant. Some-, something pleasant to do it’s not, imposing on ...	11	29

Theme	Sub-themes	Example quotes (1 = Person with a dementia, 2 = Informal carer, I = Interviewer)	Total interviews	Coded passages
		and just ... it's quite good." "2 - But when it worked you see and you were seeing it. Erm. It, it was good. 1 - Mm, yes good. When it goes it's good."		
	Liked aspects	"1 - Hmm. I think it was nice that you could skip, past the pictures that didn't really interest you. Um. It didn't, it didn't interrupt you, and make you sort of, uncomfortable." "2 - Yeah what was good about it is that you don't have to turn pages." "1 - You, you and more to the point? And you acknowledged the fact that older people don't have to be daft. I - Mm. 2 - Yeah, that's it."	10	29
	Familiarity	"1 - It was new technology to me. I - Yeah? 1 - [LAUGHS] Most technology is new to me, but yes." "2 - Yeah I'm glad we did it, cos we would never have, we would never experienced that for a start, would we at all? 1 - No. No. 2 - Wouldn't have experienced it." "I - Have you ever done anything like this before? 1 - No."	8	19
	Likened to	"1 - But it's like a book isn't it?"	2	3
	Effect of timing	"2 - It maybe depends slightly on the time of day. I - Yeah.	2	2

Theme	Sub-themes	Example quotes (1 = Person with a dementia, 2 = Informal carer, I = Interviewer)	Total interviews	Coded passages
		2 - Um. I mean I think now for instance it’s probably, particularly not very good, um cos he’s been asleep a lot, and you’re still in the, sort of half-world of reality and...”		
Dyad relationship - impact app had on relationship and interactions between person with dementia and carer	Changes	“I - Did you have any conversations about the app, or about looking at art? 1 - Um. We did. 2 - We did yeah. 1 - I think we did quite a lot.” “2 - I suppose it made us sit down together [1], and have a deeper conversation about something I suppose. Not just, not just everyday stuff really.” “1 - Made you talk more. 2 - Yeah it was useful, yeah. 1 - Made you talk more. 2 - You talked more, rather than putting that [TV] on and watching that.”	11	70
	Joint activity	“2 - It’s more a way of spending time together. I - Yeah. 2 - It helped. I - Yeah, okay. 2 - Because it gave you a focus: something to do.” “I - He helped you out. 1 - Yes. … 2 - I don’t, I don’t think Mum would have actually operated it, on her own, to be honest.”	12	43

Theme	Sub-themes	Example quotes (1 = Person with a dementia, 2 = Informal carer, I = Interviewer)	Total interviews	Coded passages
		“I - Okay. And, did you, did you always use it with Pat, or did you ever use it alone, Ian? 1 - We did it together didn’t we?”		
	Beneficial	“2 - It’s, it’s good for the partnership.” “2 - We were sharing something. 1 - Yeah. ... to see what you had to, to say. Yes. 2 - Rather than me instructing you or you saying, “where is this” or “what is that”? I - Mm. 2 - We were actually looking at the thing and yes I think from that point of view it’s a good thing isn’t it?” “2 - So, it had, it er, it has changed and I’ve got him to sort of talk about how he’s feeling more, not just with that. I - Yeah. 2 - But about other things as well, which is, is help, has been a great help.”	7	18
	Unchanged	“I - Did you find that it changed the way that you two, sort of, interacted and spent time together? 2 - Not really. 1 - Not really.” “2 - I wouldn’t say that that has, changed anything, or improved anything, or not improved anything. It was just something that we did.”	5	8
Mood - impacts app had on mood of users	Improved	“1 - Yeah, we had fun doing it actually I would say. And a laugh as well. Yeah, which was good. 2 - We did, yeah. As I said it was fun: it was quite enjoyable, and we could have a laugh about it.”	11	63

Theme	Sub-themes	Example quotes (1 = Person with a dementia, 2 = Informal carer, I = Interviewer)	Total interviews	Coded passages
		“2 - Partly cos it breaks the cycle of the ... sort of, low feeling. I - Okay so it, it was helpful when, things were difficult to have something to change the mood perhaps? 2 - Yes. Erm. But I did it intentionally at that moment because there was, it was specific, that it was, it was a sadness.” “2 - I think we enjoyed it. 1 - Yes we did. 2 - With the, if you if you say on a scale of one to ten, did we enjoy it, then it would be sort of, eight nine, up there nine and a half.”		
	Range of feelings	“I - Did any different pictures make you feel different things? 1 - Yeah course they do. I - Yeah? 1 - You like some and you don’t like others.” “2 - Umm. Your. Because [1]’s very positive anyway, and she feels well and, so, most of the time, she’s, there, you probably won’t see a great deal of difference between having looked at it in the beginning, and when she’d looked at it at the end, and if there is a difference, if it’s gone down, it will probably only be because her finger didn’t go!” “2- It really made a difference. We’ll miss it wont we? 1 - Yeah. 2 - Yeah, we’ll miss it.”	10	29
	Lowered	“2 - So would you like to see pictures of how, say, cos it’s the East End, how the East End used to look? 1 - No. We don’t want to go back to that. It wasn’t nice … Yeah that’s, that’s, that brings back memories, and sometimes, it’s not too good. I - Okay. 1 - To bring back too many memories.	4	15

Theme	Sub-themes	Example quotes (1 = Person with a dementia, 2 = Informal carer, I = Interviewer)	Total interviews	Coded passages
		I - Right. 1 - Cos, with memories also comes losses. I - Yeah. 1 - And remember: we have lived through two world wars." "I - Okay. And ... how does, how does it feel to not know? 1 - What it was? I - Yeah. 1 - Bloody annoying! 2 - [LAUGHS] I - [LAUGHS]"		
Behaviour - impacts app had on behaviour beyond dyad relationship	Use of time	"1 - Yeah yeah, I enjoyed enjoyed doing it. So, so it was part of- 2 - You did. It almost became a routine to him. Yeah." "I - Do you think you spent time differently, as a result of having this around? 2 - Well we did in the afternoons, yes." "2 - It took us w-, you know half about the first time we did it, it took about twenty minutes, and we got to about an hour at, uff, yesterday …Because he was taking longer and longer and longer."	10	27
	Activation	"I - And did that make a change to how you spent your time? 1 - Well yes in the sense that um, I would be, persuaded to go and see some of the- these things." "I - Whilst [1] is always interactive, and you're both, you both interact with each other, perhaps you interacted a little bit more in relation to art? 2 - Yes. I would say that yes. Definite, definitely, 1 - I would say that's a fact."	5	13

Theme	Sub-themes	Example quotes (1 = Person with a dementia, 2 = Informal carer, I = Interviewer)	Total interviews	Coded passages
		“2 - So, that’s sort of introduced us to doing that sort of thing, so, well I hope you can take those out of the library. They might just be for the reference. I - I think you probably can. 2 - But, but um, I th-, that’s, that wouldn’t have happened if we hadn’t had that.”		
	Social	“2 - I did notice that when you got to grips with that as well, because you hadn’t been using your phone, a lot at all had you? 1 - No. 2 - No, and suddenly you’re using your phone again, so I don’t know whether that’s tied into that but it’s like oh well I can play with that. I - Okay. 2 - And it. I - Started you using your phone a bit more. 2 - I’m not quite sure how you found my mobile number but well done! [LAUGHS] 1 - [LAUGHS]” “2 – [I USED THE APP] on one occasion with my niece, who was over from Australia. I - Yeah? Okay, wow. 2 - Mmm. I - And how was that? 1- It was lovely.”	7	13
	In-app	“1 - Well I looked at it with her. And then I looked at it by meself. I - Yeah. Okay. 1 - And you do, you look at things differently yeah, because then you go to a different realm.”	6	10

Theme	Sub-themes	Example quotes (1 = Person with a dementia, 2 = Informal carer, I = Interviewer)	Total interviews	Coded passages
		“1 - I, I looked at that on my self, on my own, and some with you didn’t I?” “1 - I did it, I did it alone quite a few times.”		

Discussion

This was a mixed-methods exploratory study that examined the impact and experience of art-viewing on a touchscreen tablet for people with a dementia and their informal carers. Taken as a whole, the results show promise. They are in line with previous research showing that people with dementia and their carers can benefit from arts-based interventions (Camic et al., 2014; Eekelaar et al., 2012; Kinney and Rentz, 2005; MacPherson et al., 2009; Musella et al., 2009; Rhoads 2009; Rosenberg, 2009; Young et al., 2015). Whilst there were insufficient participants in this study to reach statistical power, the quantitative data show a trend of increased wellbeing following art-viewing sessions, the magnitude of which tended to increase with the number of art-viewing sessions.

This sense of improvement and change in the experience of art-viewing was captured by the thematic analysis. Participants described how their art-viewing changed over time, with some participants seeming to become more engrossed in the process, perhaps gleaning more as their familiarity with tablet-based technology increased, perhaps having a sense of familiarity or comfort with the images that meant they could explore different aspects to those they had on initial viewings. Either set of data would be somewhat less informative in isolation: users' qualitative reports that they felt better was supported by the quantitative data and gave some possible explanations of how and why this might have happened.

The strength of the effect on wellbeing exerted by the intervention on participants seemed to increase with repeated sessions. Perhaps in initial sessions, users were becoming accustomed to using the app, and it was only when this had happened that they were able to feel comfortable using it and get more enjoyment from looking at the art. As time passes, it is likely that greater numbers of people will be familiar with using this type of technology, perhaps allowing people to adapt to the app more rapidly. Some of the cognitive benefits identified in the thematic analysis were surprising. Whilst reminiscence and cognitive stimulation were not deliberately aimed for, it seemed like these phenomena tended to happen spontaneously as people looked at the images. This is similar to the spontaneous reminiscences observed by Leuty and colleagues (2013) when people used their ePAD system. The resultant conversations seem to have generally been enjoyable for users in the present study. This is promising, as previous research has shown that deliberate efforts to make people reminisce using stimuli that come from their actual histories can be traumatic when it does not work, especially for family carers (Woods et al., 2012). The dual- and triple-coding hypotheses (Paivio, 1986; Thomson et al., 2012) proposed to explain the benefits of arts based interventions might relate to this, and the fact that whilst some people might feel reticent about touching actual pieces of art, the fact that touchscreens need to be touched might mean that the touch-channel of perception is invoked more readily than with some arts-based interventions.

It seems that the unforced nature of the reminiscences evoked by viewing images in the app acted as a catalyst for discussions but still allowed an error-free environment in that there was no sense of people having to remember certain things. A striking outcome was that in one case someone remembered something that their carer did not know previously. Another example of stimulation and remembering was when a user began to use her phone again to the surprise of her daughter. A potential benefit of these impacts might be that people with dementia could remain independent for longer, helping them retain their personhood (Kitwood, 1997) and reducing carer burden.

Some people said that having the app gave them a new shared activity they could enjoy. There were reports that using the app inspired other art-related activities, when they observed the person they cared for apparently enjoying becoming absorbed in viewing images. This led to excursions to view art, or trips to the library to find images to view together at home. All of these changes are likely to have contributed to a more stimulating environment for both members of the dyad, which could be beneficial for both of their senses of wellbeing. Being challenged and overcoming challenges was brought up by several participants. It seemed that being challenged by the app was not a negative phenomenon for users per se, as long as they managed to overcome the difficulty. Several users reported experiencing difficulties but they persevered with using the app and some expressed pride at having mastered aspects of the app.

Limitations

The study was conducted on a small sample size for pragmatic reasons and it is therefore underpowered, and the findings cannot be generalised. It is however most likely that with a smaller and different set of a-priori planned comparisons, the effects of the intervention would have been generalisable. Several different statistical analyses were run increasing the possibility of Type-I errors. The lack of a control group means that it is hard to tell whether the impacts on wellbeing were directly related to the app or some other aspect of what was happening when people were taking time to use the app to view art.

Five sessions seems to be insufficient to determine at what point the increases in wellbeing might level out or start to diminish. Despite asking people to use the tablets at least five times, not all pairs did so, limiting the power of the results. Whilst the portability of the app meant that it could be used by people at home or another location of their choosing, beyond the app logs, it was not possible to know how the tablets were being used: whether people with dementia were using them alone or with a carer, and whether they always used the app with the same carer, which would be useful information. One way to find this information out would be to add questions to the app, but this would add to the complexity of the user experience and might deter users. People were encouraged to contact the researcher if they had any queries, but this was rare. More pro-active prompting of participants, either by the researcher directly or some aspect of the app itself might have boosted app use and yielded more data.

The participants in the study were self-selected members of perhaps an exceptionally motivated group of people who attend Dementia Cafés. Since they are run by an organisation that requires people to have been formally diagnosed with a dementia, this suggests that people attending might be more accepting of the diagnosis than the full range of people that might meet the criteria for diagnosis. The fact that people volunteered, whilst essential from an ethical perspective, also means that participants might have tended to have more optimistic, resilient attitudes than average.

Practice implications

The outcomes of this research cautiously suggest that viewing art on a tablet-computer might help people with dementia to feel better, a clinical implication might be simply to suggest this as an activity for dyads to try out. Some participants reported that they intended to obtain tablets to continue viewing art in this way after the research, which suggests that it was something they valued sufficiently to invest money in continuing doing. Provision of tablets to people with dementia and their carers might be a cost-effective way to provide people with activities that they can do together, especially when they are having difficult days or have difficulties with mobility. It might also help to challenge prevailing ageist societal beliefs that relate to older adults not being able to engage with modern technology. Since tablets can be used for other activities like video conferencing, podcasts and shopping, people might find other benefits once they become accustomed to using them.

Future research

A larger-scale controlled study of the impact of tablet art-viewing on wellbeing would allow more rigorous testing of the hypotheses used in the present study. Asking people to use the app without specifying number of viewing sessions would help to determine whether there is a ceiling on the benefit that people experience from using the app, and if so after how many sessions this tends to be reached. Determining an appropriate control condition would be a potential challenge. Simply using other tablet-based apps could be an option, and since some users said they found the pacing of the app comfortable and easier to follow than television, apps with similar pacing might be useful for controls. Examples of this might be an app for reading electronic books or to view news stories and images. Leng and colleagues (2014) compared tablet apps with non-tablet-based activities, which might also provide a potential control condition. One possibility might be to view art images in books or on a television screen (both suggestions made by participants). Another might be for the participants to do something somewhat different, like having a cup of tea and a chat with their carer. Participants could take part in both the app and control conditions, or a separate control group could be used if there were sufficient participants. Larger-scale studies would also allow researchers to explore whether certain types of image are more beneficial than others.

Further qualitative research could be conducted in order to put forward a theory of the mechanisms by which tablet-based art viewing might be beneficial for the wellbeing of people with dementia and their carers. Case studies might help to explore the idiosyncratic ways in which people incorporated tablet-use into their routines. The issues and potential improvements identified by users in this study could be incorporated into future versions of the application, in order to refine it and maintain user-involvement throughout the process. With more software development, the interface could be enhanced, perhaps even allowing interaction with three dimensional versions of museum objects and images; this might help to boost the triple-coding related benefits.

Conclusion

This research cautiously suggests that art viewing on a touchscreen tablet device can be beneficial for people with dementia and their carers. Whilst the sample size was small and therefore wider generalisation is not possible, findings suggest that people with dementia can engage with and experience benefits in wellbeing through viewing art on tablet-based computers at home or in convenient locations. It seems that the wellbeing improvements that people experience tend to increase each time they use the app to view art. The impacts on their wellbeing manifest in various ways: cognitively, behaviourally, emotionally and in their relationships with their carers. There are various ways in which the intervention might be improved, and further research with larger sample sizes and control groups would be beneficial in order to determine how effective this type of intervention can be, and with whom it might tend to be more beneficial.

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Section C – Appendices

Appendix A: Mixed Methods Appraisal Tool

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Appendix B: Ethical approval

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Appendix C: Alzheimer’s Society research approval

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Appendix D: Participant information sheet

ART VIEWING AT HOME ON A TABLET COMPUTER

Hello. My name is ___ and I am a trainee clinical psychologist at Canterbury Christ Church University. I would like to invite you to take part in a research study that involves looking at art on a tablet-style computer. Before you decide it is important that you understand why the research is being done and what it would involve for you.

Part 1:

What is the purpose of the study?

The purpose of this study is to find out if viewing and talking about art on a tablet-style computer (like an iPad) in your home can help you and a family member (or close friend) in some way.

Why have I been invited?

We have approached your Alzheimer's Society Centre and asked if they could recommend members of the Centre we could invite to take part in this study.

Do I have to take part?

It is up to you to decide to join the study. If you agree to take part, I will then ask you and your family member to sign a consent form. You are free to withdraw at any time, without giving a reason. This would not affect the standard of support you receive.

What will happen to me if I take part?

First of all, I shall visit you for about an hour to take your consent and to deliver the art-viewing tablet that you will be able to use over the next few weeks. I shall demonstrate it to you and there will be lots of time for any questions you may have. I shall ask both of you to describe how well you feel by marking lines on two simple pictures, and ask you and your family member some questions about your quality of life. I shall leave the tablet with you for about 2-3 weeks. You can call me any time if you need any further information on _____.

After I drop off the tablet, a few days later, I shall call you to see how things are going with the art viewing and tablet, and answer any questions you may have.

Each time you look at art on the tablet computer, the computer will first ask you how well you feel using the two diagrams we used at the start. After this occurs, you can view the art. When you are finished viewing the art, the computer will ask you how well you feel using the same diagrams. This is to see if viewing the art makes any difference to how you feel.

I hope you will be able to view the art up to five times, or more if you like, over the 2-3 weeks you have the tablet. You can view the art for as long or short a time as you'd like.

Finally, I shall visit you again for about an hour to collect the tablet, and find out how things went. I shall talk to you and your family member and ask you both a few questions and gather your opinions about viewing art on a computer. I shall ask you and your family member similar questions to the ones I asked you at the beginning about your wellbeing. I shall also ask you to tell me how you feel using the diagrams one more time at this final session.

When we finish the study, you will be welcome to have a copy of the art-viewing program if you like for no cost. I will also give you a brief report that summarises the results.

Will my taking part in the study be kept confidential?

Information will be collected by me when I visit you, and by the art viewing system on the tablet.

All information which is collected about you during the course of the research will be kept strictly confidential, and any information about you that leaves your home will have your name and address removed.

Expenses and payments

You will be given up to £10.00 to share to help cover costs if I meet you somewhere other than your home. I am happy to come to your home if that is more convenient for you.

What are the possible disadvantages and risks of taking part

It is possible that you may not like some of the art that you will view. If this is the case and you wish to skip that picture, there is a button that will allow you to skip it. I shall demonstrate this when I visit you for the first time.

If you find that you want to stop participating in the study for any reason, you are free to withdraw at any time. If this is the case, please call me and I will come by and pick up the tablet computer.

What are the possible benefits of taking part?

We hope that viewing the art on the tablet computer will be enjoyable. Looking at art may be interesting for you and your family member. It will give you something you can do together and talk about.

We can also offer you a copy of the art viewing system afterwards if you like. We can discuss this when we meet.

Part 2:

What will happen if I don't want to carry on with the study?

If you pull out of the study, you are under no further obligation to us. We hope that we could keep any information that we have already gathered, and it would be kept anonymously so it could not be linked to you. If you wish us to dispose of the information, this is also possible.

You will be under no obligation to continue and it will not affect your opportunities to take part in any further research projects we run.

What will happen to the results of the research study?

The information used will contribute to the broad scientific results of the study, and used in the final report write-up. We hope that this will be published in a journal so that the results can be shared and any helpful findings can be used to help people more widely.

We may use anonymous quotes from our conversations during my visits. If we did this, it would be with your consent.

Who is organising and funding the research?

Canterbury Christ Church University.

Who has reviewed the study?

This study has been reviewed and given favourable opinion by Canterbury Christ Church University Research Ethics Committee.

What if there is a problem?

If you have any concerns about taking part in the study, want to make a complaint or anything else arise, you are welcome to call or email me. If I am not able to resolve it then please contact my supervisor on _________ or ________.

Further information and contact details

If you would like to speak to me and find out more about the study or have questions about it answered, you can call me on _________, or leave a message for me on a 24-hour voicemail phone line at ______. Please say that the message is for __________ and leave a contact number so that I can get back to you. You can also send me an email at _____________.

Appendix E: Quality of Life in Alzheimer's Disease measure

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Appendix F: Wellbeing visual analogue scales

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Appendix G: Semi-structured interview schedule

Directed primarily at PWD		
Main questions	**Additional questions**	**Clarifying questions**
What was it like to use the app?		What was good about it? What was not so good?
Did looking at the art make you remember anything from the past?	What was it like to remember that?	
How did it make you feel?	Did different pictures make you feel differently?	Was it good to feel like that?
Any suggestions for improvements?		What would make it better for other people?
Did you use the app alone or with [NAME OF FC]?	What was that like? Did it change the way you two interact with each other in any way?	How did it change? Did you spend time differently?
What differences did it make to your day-to-day life?		
Directed primarily at FC		
Did it make any difference to how you spend time together?	What was different? Was this a good change?	
Did you notice any changes in [PWD]'s attentiveness?	What made you notice those changes?	What did you notice? How did it feel to see those changes?
Did you notice any changes in [PWD]'s interaction levels?	What made you notice those changes?	What did you notice? How did it feel to see those changes?
Did [NAME OF PWD] use the app alone or with you?	What was that like? Did it change the way you two interact with each other in any way?	How did it change? Did you spend time differently?
Did you have conversations about the app and art viewing?	How often?	What did you talk about? Did you enjoy talking about ____?
Thank you both very much for your time. I hope you enjoyed taking part in this research and we will share our findings with you. If you have any questions you are welcome to call me or send me an email. We will also give you a copy of the art viewing app if you like. Do you have any concerns you would like to discuss with me at the moment? If not, thank you again.		

Appendix H: Reflective diary extracts

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Appendix I: App development feedback

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Appendix J: Consent form

Participant Identification Number:

CONSENT FORM
Title of Project: Wellbeing in people with dementia and their carers – the impact of virtual art viewing
Name of Researcher:

Please initial each box if you agree

1. I confirm that I have read and understand the information sheet dated................ (version...........) for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.	
2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason.	
3. I understand that relevant sections of the data collected during the study may be looked at by my lead supervisor. I give permission for this individual to have access to my data.	
4. There will be brief interviews at the beginning and end of the art viewing that will be audio recorded. I give my permission for this.	
5. I agree that anonymous quotes from my interview may be used in published reports of the study findings [if applicable]	
6. I agree to take part in the above study.	

Name of First Participant ________________________________

Date_________________ Signature ________________________________

Name of Second Participant _____________________________

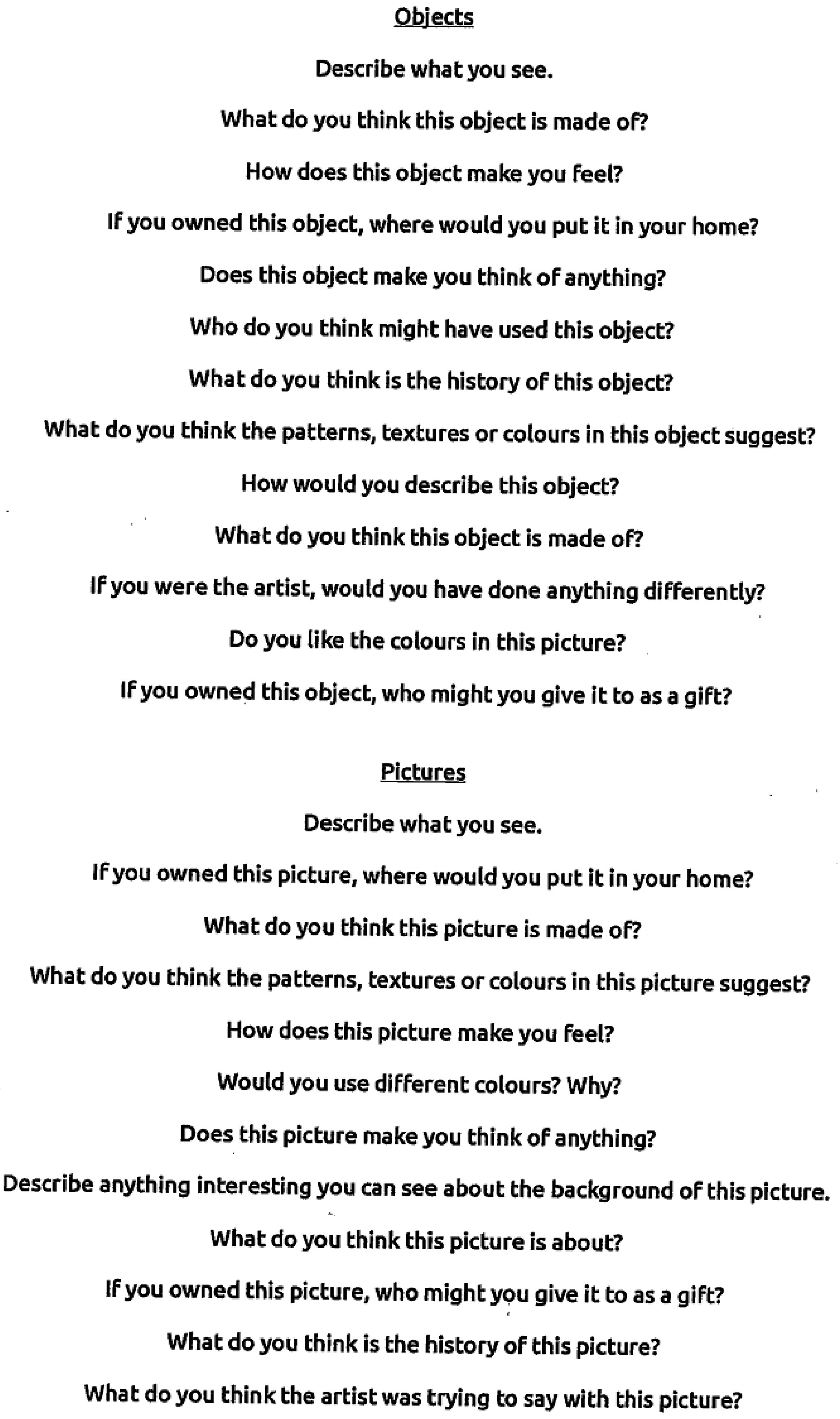
Date_________________ Signature ________________________________

Name of Person taking consent _____________________________

Date_________________ Signature ________________________________

Date______________ Signature ________________________________

Appendix K: Questions presented with the app



Objects

Describe what you see.

What do you think this object is made of?

How does this object make you feel?

If you owned this object, where would you put it in your home?

Does this object make you think of anything?

Who do you think might have used this object?

What do you think is the history of this object?

What do you think the patterns, textures or colours in this object suggest?

How would you describe this object?

What do you think this object is made of?

If you were the artist, would you have done anything differently?

Do you like the colours in this picture?

If you owned this object, who might you give it to as a gift?

Pictures

Describe what you see.

If you owned this picture, where would you put it in your home?

What do you think this picture is made of?

What do you think the patterns, textures or colours in this picture suggest?

How does this picture make you feel?

Would you use different colours? Why?

Does this picture make you think of anything?

Describe anything interesting you can see about the background of this picture.

What do you think this picture is about?

If you owned this picture, who might you give it to as a gift?

What do you think is the history of this picture?

What do you think the artist was trying to say with this picture?

Appendix L: Normality tests

Skewness and Kurtosis for Sessional VAS Scores (n = 8)

		Statistic	Std. Error
session_1_VAS_start_happy	Mean	69.88	8.314
	Skewness	.066	.752
	Kurtosis	-1.989	1.481
session_1_VAS_start_well	Mean	81.75	5.175
	Skewness	-2.148	.752
	Kurtosis	5.080	1.481
session_1_VAS_start_interested	Mean	73.75	5.010
	Skewness	.580	.752
	Kurtosis	-.192	1.481
session_1_VAS_start_ALL	Mean	225.38	15.793
	Skewness	-.231	.752
	Kurtosis	-.269	1.481
session_1_VAS_end_happy	Mean	74.00	5.043
	Skewness	-.036	.752
	Kurtosis	.393	1.481
session_1_VAS_end_well	Mean	71.50	7.231
	Skewness	-.289	.752
	Kurtosis	-1.963	1.481
session_1_VAS_end_interested	Mean	69.25	8.237
	Skewness	-2.168	.752
	Kurtosis	5.553	1.481
session_1_VAS_end_ALL	Mean	214.7500	14.32624
	Skewness	.430	.752
	Kurtosis	.374	1.481
session_2_VAS_start_happy	Mean	79.00	7.423
	Skewness	-2.044	.752
	Kurtosis	4.772	1.481
session_2_VAS_start_well	Mean	70.38	10.979
	Skewness	-1.779	.752
	Kurtosis	3.117	1.481
session_2_VAS_start_interested	Mean	75.63	6.633
	Skewness	-.647	.752
	Kurtosis	-1.692	1.481
session_2_VAS_start_ALL	Mean	225.00	16.846

	Skewness	-.993	.752
	Kurtosis	.580	1.481
session_2_VAS_end_happy	Mean	78.00	5.837
	Skewness	-.194	.752
	Kurtosis	-1.185	1.481
session_2_VAS_end_well	Mean	64.00	12.323
	Skewness	-.879	.752
	Kurtosis	-.317	1.481
session_2_VAS_end_interested	Mean	83.63	8.278
	Skewness	-2.258	.752
	Kurtosis	5.427	1.481
session_2_VAS_end_ALL	Mean	225.63	15.082
	Skewness	.884	.752
	Kurtosis	-.810	1.481
session_3_VAS_start_happy	Mean	67.13	11.730
	Skewness	-.990	.752
	Kurtosis	-.590	1.481
session_3_VAS_start_well	Mean	67.50	10.092
	Skewness	-.239	.752
	Kurtosis	-1.788	1.481
session_3_VAS_start_interested	Mean	61.63	11.714
	Skewness	-.474	.752
	Kurtosis	-1.817	1.481
session_3_VAS_start_ALL	Mean	196.25	28.288
	Skewness	-.248	.752
	Kurtosis	-1.101	1.481
session_3_VAS_end_happy	Mean	68.63	10.623
	Skewness	-1.183	.752
	Kurtosis	-.305	1.481
session_3_VAS_end_well	Mean	78.13	7.731
	Skewness	-2.267	.752
	Kurtosis	5.579	1.481
session_3_VAS_end_interested	Mean	60.50	12.293
	Skewness	-.407	.752
	Kurtosis	-1.282	1.481
session_3_VAS_end_ALL	Mean	207.25	28.057
	Skewness	-1.038	.752

	Kurtosis	.206	1.481
session_4_VAS_start_happy	Mean	69.50	8.403
	Skewness	-.724	.752
	Kurtosis	-1.220	1.481
session_4_VAS_start_well	Mean	73.88	6.564
	Skewness	-.713	.752
	Kurtosis	-1.186	1.481
session_4_VAS_start_interested	Mean	66.50	9.196
	Skewness	-1.134	.752
	Kurtosis	.262	1.481
session_4_VAS_start_ALL	Mean	209.88	22.242
	Skewness	-1.140	.752
	Kurtosis	.163	1.481
session_4_VAS_end_happy	Mean	73.13	9.538
	Skewness	-.902	.752
	Kurtosis	.281	1.481
session_4_VAS_end_well	Mean	79.25	6.140
	Skewness	-.250	.752
	Kurtosis	-1.587	1.481
session_4_VAS_end_interested	Mean	71.50	8.930
	Skewness	-.701	.752
	Kurtosis	.091	1.481
session_4_VAS_end_ALL	Mean	223.88	22.030
	Skewness	-.164	.752
	Kurtosis	-1.191	1.481
session_5_VAS_start_happy	Mean	60.75	10.005
	Skewness	-.855	.752
	Kurtosis	.139	1.481
session_5_VAS_start_well	Mean	69.75	10.359
	Skewness	-1.101	.752
	Kurtosis	.267	1.481
session_5_VAS_start_interested	Mean	59.88	10.721
	Skewness	-.623	.752
	Kurtosis	-.744	1.481
session_5_VAS_start_ALL	Mean	190.38	23.894
	Skewness	.297	.752
	Kurtosis	-1.961	1.481

session_5_VAS_end_happy	Mean	70.75	10.049
	Skewness	-1.481	.752
	Kurtosis	2.392	1.481
session_5_VAS_end_well	Mean	80.38	4.675
	Skewness	-.453	.752
	Kurtosis	-1.197	1.481
session_5_VAS_end_interested	Mean	73.63	8.958
	Skewness	-1.991	.752
	Kurtosis	4.675	1.481
session_5_VAS_end_ALL	Mean	224.75	20.132
	Skewness	-1.048	.752
	Kurtosis	1.463	1.481

Kolmogorov-Smirnov Scores for VAS sessional measures

	Kolmogorov-Smirnov[b]	
	Statistic	Significance
session_1_VAS_start_happy	.223	.200*
session_1_VAS_start_well	.338	.008
session_1_VAS_start_interested	.215	.200*
session_1_VAS_start_ALL	.182	.200*
session_1_VAS_end_happy	.181	.200*
session_1_VAS_end_well	.239	.198
session_1_VAS_end_interested	.337	.008
session_1_VAS_end_ALL	.172	.200*
session_2_VAS_start_happy	.299	.033
session_2_VAS_start_well	.309	.023
session_2_VAS_start_interested	.297	.036
session_2_VAS_start_ALL	.183	.200*
session_2_VAS_end_happy	.148	.200*
session_2_VAS_end_well	.270	.088
session_2_VAS_end_interested	.297	.037
session_2_VAS_end_ALL	.259	.122
session_3_VAS_start_happy	.224	.200*
session_3_VAS_start_well	.253	.142
session_3_VAS_start_interested	.241	.193
session_3_VAS_start_ALL	.151	.200*

session_3_VAS_end_happy	.321	.015
session_3_VAS_end_well	.356	.004
session_3_VAS_end_interested	.193	.200*
session_3_VAS_end_ALL	.204	.200*
session_4_VAS_start_happy	.229	.200*
session_4_VAS_start_well	.225	.200*
session_4_VAS_start_interested	.319	.016
session_4_VAS_start_ALL	.289	.048
session_4_VAS_end_happy	.222	.200*
session_4_VAS_end_well	.222	.200*
session_4_VAS_end_interested	.188	.200*
session_4_VAS_end_ALL	.223	.200*
session_5_VAS_start_happy	.197	.200*
session_5_VAS_start_well	.233	.200*
session_5_VAS_start_interested	.212	.200*
session_5_VAS_start_ALL	.220	.200*
session_5_VAS_end_happy	.254	.139
session_5_VAS_end_well	.164	.200*
session_5_VAS_end_interested	.287	.051
session_5_VAS_end_ALL	.194	.200*

Skewness, Kurtosis and Kolmogorov-Smirnov scores for people with dementia VAS Scores administered at initial and final meetings by main researcher

Descriptives – People with dementia				Kolmogorov - Smirnov	
		Statistic	Std. Error	Statistic	Significance
paper_VAS_start_happy	Mean	82.8	3.867	0.29	0.02
	Skewness	0.555	0.687		
	Kurtosis	-1.32	1.334		
paper_VAS_start_well	Mean	84	5.772	0.23	0.15
	Skewness	-0.925	0.687		
	Kurtosis	-0.524	1.334		
paper_VAS_start_interested	Mean	76.4	7.543	0.19	.200*
	Skewness	-0.806	0.687		
	Kurtosis	-0.184	1.334		
paper_VAS_start_ALL	Mean	243.2	14.239	0.22	0.17
	Skewness	-0.538	0.687		

	Kurtosis	-1.083	1.334		
paper_VAS_end_happy	Mean	84.1	4.547	0.17	.200*
	Skewness	-0.339	0.687		
	Kurtosis	-1.21	1.334		
paper_VAS_end_well	Mean	87.2	4.25	0.28	0.023
	Skewness	-1.094	0.687		
	Kurtosis	0.47	1.334		
paper_VAS_end_interested	Mean	82.6	8.999	0.30	0.010
	Skewness	-2.229	0.687		
	Kurtosis	5.128	1.334		
paper_VAS_end_ALL	Mean	253.9	14.635	0.17	.200*
	Skewness	-0.689	0.687		
	Kurtosis	-0.904	1.334		

* This is a lower bound of the true significance.

Skewness, Kurtosis and Kolmogorov-Smirnov Scores for informal carer VAS Scores administered at initial and final meetings by main researcher

Descriptives – Informal carers				Kolmogorov - Smirnov	
		Statistic	Std. Error	Statistic	Significance
paper_VAS_start_happy	Mean	79.90	4.96	0.16	.200*
	Skewness	-0.41	0.69		
	Kurtosis	-0.10	1.33		
paper_VAS_start_well	Mean	84.50	4.75	0.21	.200*
	Skewness	-1.29	0.69		
	Kurtosis	2.40	1.33		
paper_VAS_start_interested	Mean	88.20	5.13	0.34	0.0014
	Skewness	-1.79	0.69		
	Kurtosis	2.94	1.33		
paper_VAS_start_ALL	Mean	252.60	11.72	0.17	.200*
	Skewness	-1.20	0.69		
	Kurtosis	1.93	1.33		
paper_VAS_end_happy	Mean	79.40	4.38	0.29	0.018
	Skewness	-0.91	0.69		
	Kurtosis	1.59	1.33		
paper_VAS_end_well	Mean	84.90	4.60	0.34	0.0020
	Skewness	-1.15	0.69		
	Kurtosis	0.27	1.33		
paper_VAS_end_interested	Mean	91.70	3.07	0.30	0.0095
	Skewness	-0.58	0.69		
	Kurtosis	-1.48	1.33		
paper_VAS_end_ALL	Mean	256.00	10.13	0.25	0.077
	Skewness	-0.64	0.69		
	Kurtosis	-0.68	1.33		

* This is a lower bound of the true significance.

Skewness, Kurtosis and Kolmogorov-Smirnov Scores for people with dementia QOL-AD Scores administered at initial and final meetings by main researcher

Descriptives - PWD				Kolmogorov - Smirnov	
		Statistic	Std. Error	Statistic	Significance
QOL_AD score initial	Mean	37.22	2.722	0.13	.200*
	Skewness	0.145	0.717		
	Kurtosis	-1.328	1.4		
QOL_AD score final	Mean	36.22	2.837	0.18	.200*
	Skewness	0.281	0.717		
	Kurtosis	-1.324	1.4		

* This is a lower bound of the true significance.

Skewness, Kurtosis and Kolmogorov-Smirnov Scores for informal carer QOL-AD Scores administered at initial and final meetings by main researcher

Descriptives - IC				Kolmogorov - Smirnov	
		Statistic	Std. Error	Statistic	Significance
QOL_AD score initial	Mean	32.82	1.135	0.23	0.10
	Skewness	0.283	0.661		
	Kurtosis	-1.283	1.279		
QOL_AD score final	Mean	32.27	1.222	0.13	.200*
	Skewness	-0.352	0.661		
	Kurtosis	-0.6	1.279		

* This is a lower bound of the true significance.

Appendix M: Cronbach’s alpha

QOL-AD – All forms

Case Processing Summary

		N	%
Cases	Valid	42	100.0
	Excluded[a]	0	.0
	Total	42	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.878	.875	13

tem Statistics

	Mean	Std. Deviation	N
Q1_Physical_health	2.52	1.018	42
Q2_Energy	2.33	.979	42
Q3_Mood	2.71	.673	42
Q4_Living_situation	3.21	.565	42
Q5_Memory	1.57	.703	42
Q6_Family	3.45	.593	42
Q7_Marriage	3.50	.741	42
Q8_Friends	2.67	.874	42
Q9_Self_as_whole	2.74	.828	42
Q10_Chores_ability	2.07	1.022	42
Q11_Fun_ability	2.33	1.004	42
Q12_Money	2.69	.950	42
Q13_Life_as_whole	2.79	.750	42

Inter-Item Correlation Matrix

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13
Q1_Phys._health	1.000	.726	.402	.139	.457	-.200	-.194	.420	.572	.456	.589	.172	.470
Q2_Energy	.726	1.000	.333	.132	.637	.028	-.202	.475	.621	.561	.703	.402	.697
Q3_Mood	.402	.333	1.000	.358	.456	.087	.098	.622	.563	.208	.614	.087	.407
Q4_Living_sit.	.139	.132	.358	1.000	.237	.359	.671	.346	.175	.142	.301	-.010	.457
Q5_Memory	.457	.637	.456	.237	1.000	.067	-.140	.397	.431	.417	.587	.198	.515
Q6_Family	-.200	.028	.087	.359	.067	1.000	.528	.345	.247	.106	.232	.125	.388
Q7_Marriage	-.194	-.202	.098	.671	-.140	.528	1.000	.151	.099	.048	.066	-.017	.154
Q8_Friends	.420	.475	.622	.346	.397	.345	.151	1.000	.550	.300	.713	.225	.558
Q9_Whole_self	.572	.621	.563	.175	.431	.247	.099	.550	1.000	.542	.782	.422	.732
Q10_Chores	.456	.561	.208	.142	.417	.106	.048	.300	.542	1.000	.642	.300	.530
Q11_Fun_ability	.589	.703	.614	.301	.587	.232	.066	.713	.782	.642	1.000	.392	.680
Q12_Money	.172	.402	.087	-.010	.198	.125	-.017	.225	.422	.300	.392	1.000	.418
Q13_Whole_life	.470	.697	.407	.457	.515	.388	.154	.558	.732	.530	.680	.418	1.000

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Q1_Physical_health	32.07	39.922	.559	.690	.870
Q2_Energy	32.26	38.442	.720	.797	.859
Q3_Mood	31.88	42.839	.551	.636	.870
Q4_Living_situation	31.38	44.876	.391	.764	.877
Q5_Memory	33.02	42.365	.578	.541	.869
Q6_Family	31.14	45.686	.264	.548	.881
Q7_Marriage	31.10	46.576	.101	.725	.890
Q8_Friends	31.93	40.019	.666	.654	.863
Q9_Self_as_whole	31.86	39.247	.792	.819	.856
Q10_Chores_ability	32.52	39.621	.582	.545	.868
Q11_Fun_ability	32.26	36.539	.873	.842	.848
Q12_Money	31.90	42.722	.364	.315	.881
Q13_Life_as_whole	31.81	39.914	.809	.818	.857

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
34.60	48.149	6.939	13

Broken down into people with dementia and informal carers

Case Processing Summary

Member			N	%
PWD	Cases	Valid	19	100.0
		Excluded[a]	0	.0
		Total	19	100.0
IC	Cases	Valid	23	100.0
		Excluded[a]	0	.0
		Total	23	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Member	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
PWD	**.899**	.891	13
IC	**.812**	.827	13

Inter-Item Correlation Matrix

Item Statistics

Member		Mean	Std. Deviation	N
PWD	Q1_Physical_health	2.68	1.204	19
	Q2_Energy	2.58	1.071	19
	Q3_Mood	2.74	.653	19
	Q4_Living_situation	3.26	.562	19
	Q5_Memory	1.74	.733	19
	Q6_Family	3.68	.478	19
	Q7_Marriage	3.63	.684	19
	Q8_Friends	2.89	.937	19
	Q9_Self_as_whole	3.00	1.000	19
	Q10_Chores_ability	2.47	1.073	19
	Q11_Fun_ability	2.79	1.032	19
	Q12_Money	2.79	.918	19
	Q13_Life_as_whole	2.89	.875	19
IC	Q1_Physical_health	2.39	.839	23
	Q2_Energy	2.13	.869	23
	Q3_Mood	2.70	.703	23
	Q4_Living_situation	3.17	.576	23
	Q5_Memory	1.43	.662	23
	Q6_Family	3.26	.619	23
	Q7_Marriage	3.39	.783	23
	Q8_Friends	2.48	.790	23
	Q9_Self_as_whole	2.52	.593	23
	Q10_Chores_ability	1.74	.864	23
	Q11_Fun_ability	1.96	.825	23
	Q12_Money	2.61	.988	23
	Q13_Life_as_whole	2.70	.635	23

Member		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13
PWD	Q1_Physical_health	1.000	.753	.453	.130	.404	-.280	-.149	.461	.646	.595	.748	.389	.546
	Q2_Energy	.753	1.000	.468	.379	.559	.051	.004	.618	.623	.618	.821	.414	.839
	Q3_Mood	.453	.468	1.000	.502	.427	.075	.144	.588	.595	.029	.655	.366	.435
	Q4_Living_situation	.130	.379	.502	1.000	.312	.534	.555	.478	.297	.058	.484	.437	.624
	Q5_Memory	.404	.559	.427	.312	1.000	-.092	-.315	.443	.227	.097	.510	.243	.474
	Q6_Family	-.280	.051	.075	.534	-.092	1.000	.645	.170	.116	-.125	-.030	.093	.315
	Q7_Marriage	-.149	.004	.144	.555	-.315	.645	1.000	.110	.244	-.052	-.037	.224	.303
	Q8_Friends	.461	.618	.588	.478	.443	.170	.110	1.000	.593	.384	.838	.555	.663
	Q9_Self_as_whole	.646	.623	.595	.297	.227	.116	.244	.593	1.000	.414	.754	.545	.698
	Q10_Chores_ability	.595	.618	.029	.058	.097	-.125	-.052	.384	.414	1.000	.547	.445	.529
	Q11_Fun_ability	.748	.821	.655	.484	.510	-.030	-.037	.838	.754	.547	1.000	.537	.774
	Q12_Money	.389	.414	.366	.437	.243	.093	.224	.555	.545	.445	.537	1.000	.663
	Q13_Life_as_whole	.546	.839	.435	.624	.474	.315	.303	.663	.698	.529	.774	.663	1.000
IC	Q1_Physical_health	1.000	.675	.365	.135	.498	-.293	-.313	.322	.393	.210	.354	-.081	.319
	Q2_Energy	.675	1.000	.217	-.138	.687	-.151	-.479	.236	.568	.411	.516	.380	.487
	Q3_Mood	.365	.217	1.000	.249	.492	.086	.061	.683	.616	.387	.682	-.114	.394
	Q4_Living_situation	.135	-.138	.249	1.000	.150	.249	.749	.208	-.012	.187	.112	-.354	.275
	Q5_Memory	.498	.687	.492	.150	1.000	.043	-.080	.279	.669	.684	.619	.133	.545
	Q6_Family	-.293	-.151	.086	.249	.043	1.000	.436	.384	.231	.048	.201	.100	.442
	Q7_Marriage	-.313	-.479	.061	.749	-.080	.436	1.000	.125	-.166	.023	.028	-.204	-.024
	Q8_Friends	.322	.236	.683	.208	.279	.384	.125	1.000	.413	.058	.522	-.099	.394
	Q9_Self_as_whole	.393	.568	.616	-.012	.669	.231	-.166	.413	1.000	.632	.792	.287	.803
	Q10_Chores_ability	.210	.411	.387	.187	.684	.048	.023	.058	.632	1.000	.621	.141	.511
	Q11_Fun_ability	.354	.516	.682	.112	.619	.201	.028	.522	.792	.621	1.000	.257	.581
	Q12_Money	-.081	.380	-.114	-.354	.133	.100	-.204	-.099	.287	.141	.257	1.000	.164
	Q13_Life_as_whole	.319	.487	.394	.275	.545	.442	-.024	.394	.803	.511	.581	.164	1.000

Item-Total Statistics

Member		Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
PWD	Q1_Physical_health	34.47	47.930	.659	.806	.890
	Q2_Energy	34.58	47.035	.830	.923	.879
	Q3_Mood	34.42	54.257	.590	.738	.893
	Q4_Living_situation	33.89	55.544	.538	.918	.895
	Q5_Memory	35.42	55.146	.429	.735	.898
	Q6_Family	33.47	59.263	.119	.717	.906
	Q7_Marriage	33.53	58.485	.135	.875	.908
	Q8_Friends	34.26	49.538	.755	.902	.884
	Q9_Self_as_whole	34.16	48.807	.755	.900	.884
	Q10_Chores_ability	34.68	51.450	.504	.691	.897
	Q11_Fun_ability	34.37	46.690	.894	.979	.876
	Q12_Money	34.37	51.357	.621	.736	.891
	Q13_Life_as_whole	34.26	48.760	.887	.942	.878
IC	Q1_Physical_health	30.09	26.083	.374	.728	.807
	Q2_Energy	30.35	24.692	.526	.879	.793
	Q3_Mood	29.78	25.269	.598	.865	.788
	Q4_Living_situation	29.30	28.221	.234	.909	.814
	Q5_Memory	31.04	24.771	.725	.782	.780
	Q6_Family	29.22	28.087	.231	.669	.814
	Q7_Marriage	29.09	29.628	-.030	.902	.837
	Q8_Friends	30.00	25.455	.490	.767	.796
	Q9_Self_as_whole	29.96	24.862	.807	.926	.777
	Q10_Chores_ability	30.74	24.383	.569	.687	.789
	Q11_Fun_ability	30.52	22.897	.812	.802	.766
	Q12_Money	29.87	28.028	.094	.518	.837
	Q13_Life_as_whole	29.78	24.996	.723	.902	.781

Scale Statistics

Member	Mean	Variance	Std. Deviation	N of Items
PWD	37.16	60.363	7.769	13
IC	32.48	29.988	5.476	13

VAS - All

Case Processing Summary

		N	%
Cases	Valid	182	100.0
	Excluded[a]	0	.0
	Total	182	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.734	.735	3

Item Statistics

	Mean	Std. Deviation	N
happy	75.3077	21.73151	182
well	76.5385	22.56840	182
interested	76.5055	23.29246	182

Inter-Item Correlation Matrix

	happy	well	interested
happy	1.000	.451	.649
well	.451	1.000	.342
interested	.649	.342	1.000

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
happy	153.0440	1411.412	.673	.480	.509
well	151.8132	1671.744	.434	.207	.786
interested	151.8462	1423.822	.578	.424	.621

VAS – People with dementia

Case Processing Summary

		N	%
Cases	Valid	162	100.0
	Excluded[a]	0	.0
	Total	162	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.729	.730	3

Item Statistics

	Mean	Std. Deviation	N
happy	74.7716	22.44642	162
well	75.5309	23.21388	162
interested	74.8457	23.75563	162

Inter-Item Correlation Matrix

	happy	well	interested
happy	1.000	.456	.654
well	.456	1.000	.313
interested	.654	.313	1.000

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
happy	150.3765	1448.808	.686	.497	.477
well	149.6173	1765.679	.420	.208	.790
interested	150.3025	1517.479	.564	.428	.626

VAS – Carers

Case Processing Summary

		N	%
Cases	Valid	20	100.0
	Excluded[a]	0	.0
	Total	20	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.728	.734	3

Item Statistics

	Mean	Std. Deviation	N
happy	79.6500	14.39399	20
well	84.7000	14.38603	20
interested	89.9500	13.14084	20

Inter-Item Correlation Matrix

	happy	well	interested
happy	1.000	.256	.554
well	.256	1.000	.627
interested	.554	.627	1.000

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
happy	174.6500	616.766	.442	.321	.769
well	169.6000	589.621	.491	.405	.711
interested	164.3500	520.239	.745	.559	.408

Appendix N – Initial codes

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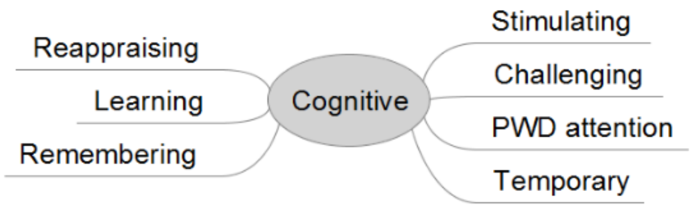
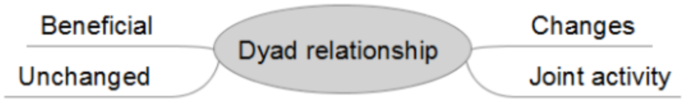
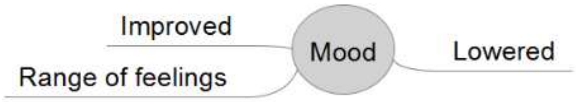
Appendix O – Thematic maps







Appendix P: Theme definitions

1. Cognitive – impacts the art-viewing app reportedly had on the cognitive processes of users.

Stimulating – interviewees describing how using the app stimulated thoughts. This could be on the part of a person with a dementia or their family carer, or jointly. This could have been in relation to opinions that they expressed about the images. Opinions could be positive, negative or more neutral: al suggested that some thinking had been provoked by art-viewing. Another possibility was discussing where they thought the image should go, which arose in three interviews. General comments about the app being interesting were expressed in seven interviews. Expression of interest was taken as evidence of cognitive stimulation in this context.

Challenging – references people made to how the app was challenging to use, from a mental perspective. This could be in relation to how the images themselves were hard to understand, and subsequent efforts that were made to reach understanding. People expressed a sense of curiosity in relation to this. They also expressed confusion arising from some images, in relation to there being too much colour in some images. Some users found the questions confusing, particularly when they seemed not to apply to certain images. Some interviewees talked about overcoming challenges. One pair talked about how the app was more challenging at certain times of day for the person with a dementia.

Remembering – how memories were evoked through the use of the program. This included memories from the life of the person with a dementia that seemed to be evoked through the process of art viewing. Some participants reported joint reminiscences about events from family history, such as bicycles they had when they were growing up. Some informal carers reported that the person with a dementia they were caring for talked about events in their past that they did not know about.

PWD Attention – impact of art-viewing on the attention patterns of the person with a dementia. This included references to how the person with a dementia focussing on the images, showed more sustained concentration than usual, and saw different things on different occasions. It also included references to how the informal carer thought the person with dementia’s relatively short attention span might have had a detrimental impact on their art-viewing.

Learning – evidence of learning taking place in relation to the use of the tablet and the art-viewing application. This included reports that the person with a dementia had become more proficient at using the app over time. This included reports that the person with a dementia had been able to use the tablet alone, since they would have had to have learned to use it in order to do this. It also included reports of a lack of learning, such as the person with a dementia not recalling the use of the app. Evidence of learning resulting in the person with a dementia regaining an ability believed to be lost was also included in this sub-theme.

Reappraising – adjustments people reported having to make as a result of using the app. A common example was participants becoming aware of the different ways in which they used the app to view images. Two informal carers reported a sense of surprise when they saw that their carees were able to use the app. Two coded sections related to people becoming more aware of the progression of the dementia of the person that they cared for. This also includes interviewees changing their opinions of the subject matter of certain images.

Temporary – expressions of the transient nature of the changes brought on by the app: a sense that there were changes at the time, but that afterwards the cognitive changes tended to revert to their original states.

2. Experience of app – impressions stated by users about the experience of using the app, divided into the sub-themes below.

Improvements – these were suggestions made by interviewees about ways the app itself and the usage protocol could be modified for potential improvements. This include suggestions to include information about the images or about particular images to include. It also included a rating scale for images, and the option to enlarge images. It also included suggestions to make art-viewing a group activity.

Issues – issues that users reported with using the app. Some were related to the software, such as finding the app hard to use, or the VAS scales difficult. Others were related to the tablet hardware itself, such as having difficulty charging it up, trouble turning it on, or difficulties with the screen.

Good – positive appraisals of the app. This could be people saying that the app was enjoyable to use, that it was a good idea, or that they liked the app.

Liked aspects – particular elements of the app that people expressed a liking for. This included its ease of use, the accessibility of the art, a sense that it was comfortable to use, that it provided a stimulus for the person with a dementia, and that it was good not to have to turn pages.

Familiarity – expressions of the level of familiarity the interviewees had with similar technology. Some expressed a level of technical awareness prior to using the app. Others said that the technology was relatively novel to them.

Likened to – participants sometimes said the app was like another form of technology, like a book, or said that it was unlike other things, such as viewing art in a gallery setting.

Effect of timing – a sense that the app had different levels of effectiveness at different times of day.

3. Dyad relationship – impacts that art viewing had on the carer-caree relationship as expressed by the interviewees.

Changes – changes in the relationship fed back by interviewees. This includes stimulation of conversations that they might not otherwise have had. It also covers changes in the way that they spent time together. Some carers talked about how they had to take a more active role in instigating sessions, and one carer reported that it meant that their relative positions in the relationship shifted, as they felt more like their parent than their child, as was actually the case.

Joint activity – passages that suggest that the app gave the dyad something that they could do together. This included using the app itself, and working together to work out the subject matter of some of the images. The person with dementia being described as needing support to use the app was also coded here.

Beneficial – examples of the interviewees saying that using the app had the effect of improving their relationship. This includes respondents saying that the app promoted closeness. One carer also said they felt they were helping their caree more since using the app.

Unchanged – a sense that the relationship between carer and caree was unaffected by the use of the app.

4. Mood – expressions of the impact that using the app had on the moods of the interviewees.

Improved – participants reporting a sense of improved mood as a result of using the app. This could be from self-report, or from one member of the pair observing what they believed to be an improved mood in the other. It could be a direct result of using the app, or perhaps at other times, for example some users reporting a sense of pride in having an app, or when overcoming difficulties they had experienced with the app.

Range of feelings – reports of a variety of feelings being evoked by the app. This included different images evoking different emotions, suggestions that people might miss having access to the app, having mixed feelings about memories brought back by art-viewing, and having similar feelings evoked by different images. A sense of lack of impact on feelings was also covered by this sub-theme.

Lowered – a sense that interviewees' moods worsened as a result of using the app. This was mainly in relation to some images lowering the mood of the viewer owing to the subject matter or the difficulty experienced in understanding the images.

5. Behaviour – impacts that the app reportedly had on behaviours of members of the dyad beyond the dyad relationship itself.

Use of time – changes in the way that members of the pair used time. This could be changes in daily routine. It could also be app-use replacing other activities. Comments about the length of individual viewing sessions and changes in their lengths were also covered by this theme.

Activation – reports of increased activity levels were covered by this theme. This might be participants engaging more with the arts in general, or seeking out other activities as a result of being inspired by the effects of the app.

Social – behaviours reported that related to interactions with others. This might be the person with a dementia using the app with other people outside the interviewed dyad, or informing other people about the app. It also covered an instance where the person with dementia started using her telephone again.

In-app – behaviours reported whilst using the app. This includes the person with a dementia exercising choice within the app, and their image viewing patterns. It also includes occasions where the person with a dementia was reported to have used the app on their own.

Appendix Q: Journal style guidelines

This has been removed from the electronic copy.

Appendix R: Participant thank you letter

[Participants]
[Street Address]
[Town]
[County]
[Postcode]

[Date]

Dear [Participants],

This is a letter to say thank you for generously giving your time to take part in my research project earlier this year. Your participation helped us to explore whether looking at art on a tablet computer can be helpful for people. I am in the process of writing up the research. When I am able to summarise my findings, I will send you information about them.

If you have any questions for me, please let me know either at the address above, via email, or by telephone.

Thanks again for taking part.

Yours sincerely,

Trainee Clinical Psychologist
Canterbury Christ Church University

Appendix S: Participant findings summary letter

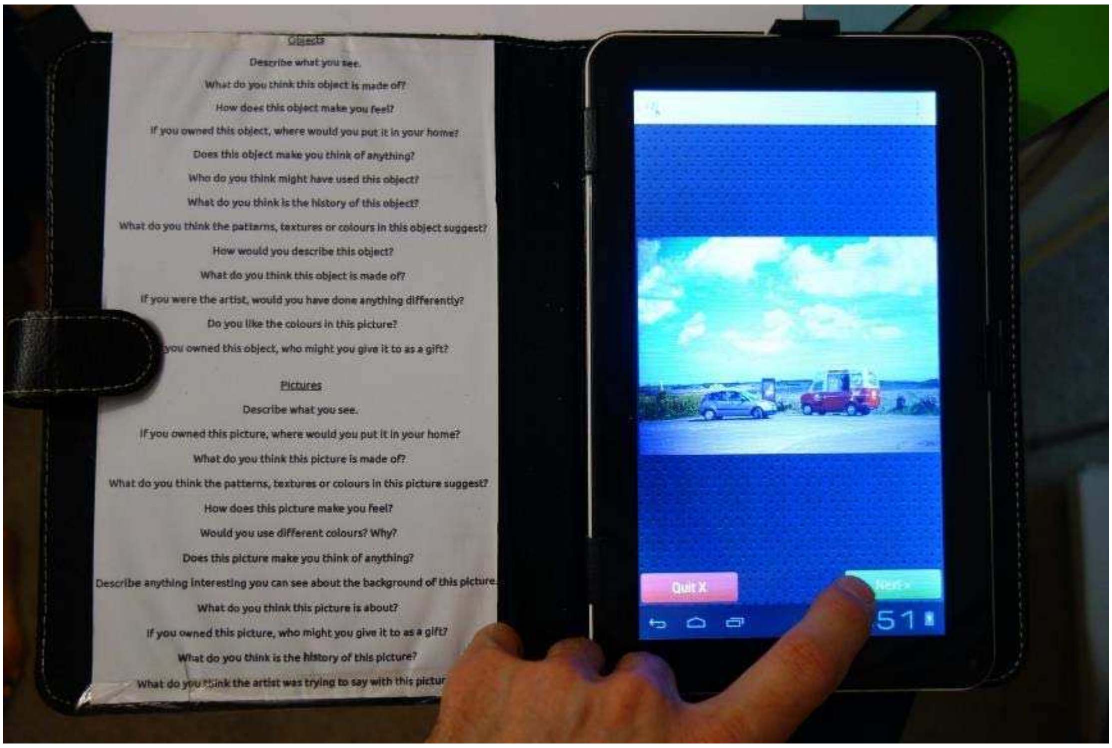
[Participants]
[Address]

[Date]

RE: Art-viewing app research

Dear [Names of people],

This is a letter to summarise the findings of the art-viewing research you took part in after we met at your local Dementia Café. This is the project where we gave you a tablet hand held computer for 2 weeks to look at works of art. Your participation helped us to collect data which suggests that art viewing on a tablet computer can be helpful for people.



Objects
Describe what you see.
What do you think this object is made of?
How does this object make you feel?
If you owned this object, where would you put it in your home?
Does this object make you think of anything?
Who do you think might have used this object?
What do you think is the history of this object?
What do you think the patterns, textures or colours in this object suggest?
How would you describe this object?
What do you think this object is made of?
If you were the artist, would you have done anything differently?
Do you like the colours in this picture?
you owned this object, who might you give it to as a gift?

Pictures
Describe what you see.
If you owned this picture, where would you put it in your home?
What do you think this picture is made of?
What do you think the patterns, textures or colours in this picture suggest?
How does this picture make you feel?
Would you use different colours? Why?
Does this picture make you think of anything?
Describe anything interesting you can see about the background of this picture.
What do you think this picture is about?
If you owned this picture, who might you give it to as a gift?
What do you think is the history of this picture?
What do you think the artist was trying to say with this pictur

The questions about happiness, wellness and interestedness that you completed at the start and end of each time you viewed the art work on the computer showed that after a few art-viewing sessions, people tended to feel better. The power of art-viewing to increase feeling better (wellbeing) seemed to increase each time people did it. We need to do more research with more people to know for sure, but the responses that you provided suggest that this is so.

The interviews I had with you provided very valuable information. I transcribed all of the interviews, and identified themes that related to the experience of using the app, and its potential impacts. The themes suggest that people often found the app stimulating, and that it brought back memories, which could lead to enjoyable discussions. Some people said that the app had inspired them to do other things related to art, like visiting art galleries.

Several people said that using the computer to look at art was a comfortable experience. Some people found certain aspects it challenging, but when difficulties were overcome, this led to a sense of achievement. A lot of people made suggestions about ways the app could be improved, and we hope to build a better version of it based on those suggestions.

The research suggests that we can suggest that other people with memory problems and their carers might benefit from using tablet computers to view art together. **It is thanks to your generously volunteering to take part in the research that we are able to make progress in this area.**

If you have any questions for me, please let me know either at the address above, via email, or by telephone.

Thanks again for taking part.

Yours sincerely,

Trainee Clinical Psychologist

Canterbury Christ Church University