Viewing art on a tablet computer: A wellbeing intervention for people with dementia and their caregivers

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Abstract

Background: Art-based interventions have been shown to be beneficial for the wellbeing of people with dementia and their caregivers. This paper explored whether such interventions can be delivered via a touchscreen tablet device displaying art images. **Methods**: Twelve pairs of volunteers with dementia and informal caregivers were recruited. A quasi-experimental mixed-methods within-subjects study evaluated the wellbeing impacts of art-viewing using visual analogue scales and explored participant experiences with thematic analysis. **Findings**: Quantitative results before Bonferroni correction showed a significant effect for change in composite wellbeing from session one to session five but this became non-significant after the correction was applied. Qualitative findings included changes in cognition, behaviour, mood and relationships. These changes tended to be viewed positively. **Conclusions**: The results suggest touchscreen-based art interventions could yield wellbeing benefits for this population. A larger-scale controlled study would help to determine whether wider dementia care practice implications can be drawn.

Keywords: dementia, visual art, tablet computers, wellbeing, caregivers, visual analogue scales

Introduction

Dementia is a progressive disease, mainly affecting older adults and is characterized by widespread impairment in mental functioning and cognitive decline accompanied by disturbances of mood, behavior, and personality (National Institute for Health and Care Excellence [NICE], 2012. It affects not only those diagnosed but also informal caregivers and other people close to them, and which can place significant emotional burden on relationships. The care associated with dementia is a growing worldwide concern with an estimated 44 million people living with it internationally, with that number possibly doubling by 2030. (Alzheimer's Disease International, 2014). Engagement in meaningful daytime activity has been cited by people with dementia and their caregivers as one of their most frequent unmet daytime needs (Miranda-Castillo, Woods, & Orrell, 2013). 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). In addition, relationships with caregivers 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).

Arts and Health Interventions

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 more be offered, citing benefits for people with dementia and their caregivers. MacPherson, Bird, Anderson, Davis and Blair (2009) found gallery-based interventions for people with dementia seemed to be beneficial at the time, reporting changes in cognition and social behaviour. A caregiver was quoted as saying, "You do it for the moment", suggesting that the benefits are valued despite their transience. Zeisel (2009) was one of the first to discuss the imaginative use of the arts in dementia for both care home and museum settings as tools to engage

people in the present. Eekelaar, Camic and Springham (2012) looked at the impact of structured art-viewing in a gallery followed by art-making. Their results revealed that episodic memory showed improvements while family members reported benefits in mood, confidence and a reduced sense of isolation during gallery sessions for those with dementia. In a mixed-methods study Camic, Tischler and Pearman (2014) explored the impact of art-viewing and art-making sessions in galleries on people with dementia and cargivers. Although standardised measures showed no significant change, a trend was seen in the reduction of caregiver burden; thematic analysis revealed cognitive improvements and enhanced quality of life. Young, Camic and Tischler (2015) systematically reviewed arts-based interventions for people with dementia and found that whilst different 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 may 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. This additional processing channel led Thomson, Ander, Menon, Lanceley & Chatterjee (2012) to propose that physical holding of objects during object handling sessions, whilst also viewing and talking about them, gave rise to “triple coding” potentially providing extra sensory information for coding which may be beneficial for people with dementia in engagement with activities.

Wellbeing

Wellbeing has been variously conceptualised and measured. 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. This conceptualises wellbeing as "a state of equilibrium or balance that can be affected by life events or challenges." (p. 222). On this basis, visual analogue measures of participants' appraisals of their own wellbeing were used (Johnson, Culverwell, Robertson, Hulbert & Camic, 2015).

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 technology might have a role in compensating for cognitive decline. Astell, Ellis, Alm, Dye, R. & Gowans (2010) reported on CIRCA, a touchscreen based system which acts as a cognitive prosthesis to facilitate people with dementia to engage in reminiscence with caregivers. They found people with dementia were able to use the device, and it allowed them to play a more equal role in interactions. Leuty, Boer, Young, Hoey and Mihailidis (2013) developed and evaluated ePAD, a touchscreen device that allows people with dementia to engage in art therapy. 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 iPad use in people with dementia. Lim and colleagues found that whilst they were mostly able to use the iPads independently, 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 beneficial alternative activities.

The Present Study

The present study explored the impact of viewing visual art, with an installed art-app on a tablet-style computer on subjective wellbeing for people with dementia and their informal caregivers. The following hypotheses were tested:

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

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

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

H4: Subjective interestedness 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 caregivers' impressions of this activity's 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

The study adopted a mixed methodology. The quantitative data followed a quasi-experimental repeated measures design. Measures of wellbeing taken before and after each tablet use were compared. The design did not include the use of a control group. The qualitative data collected during interviews was analysed using thematic analysis

Participants

This study was approved by an ethics panel in the Faculty of [xxxx removed for blind review] at xxx University (approval number: V:/075/Ethics/2013). The research was also approved by the Research Engagement Section of the Alzheimer's Society. Participants were

recruited from Dementia Cafés with their caregivers in inner city London and rural locations in southeast England. All people with dementia attending Alzheimer's Society Dementia Cafés have a formal diagnosis of dementia. Twelve people with dementia and their twelve informal caregivers took part in the study; eight people with dementia were male, and two caregivers were male. All participants were white, with 11 people with dementia and 11 caregivers identifying as British or English, with one person with dementia and one caregiver identifying as Irish. The mean age of people with dementia was 75 years (range 64 - 90) and caregivers 66 years (range 48 - 77). All people with dementia had been diagnosed within the last four years.

A priori power analysis conducted using G*Power (Faul, Erdfelder, Buchner, & Lang, 2009) 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 to detect the impact of the intervention on wellbeing. As an exploratory study we accepted to settle for a lower number of participants hoping that the effect size of the change caused by the intervention was actually larger and also in order to allow us to collect qualitative data, which would enable exploration of user experiences and guide potential amendments to the intervention if it did not lead to change on the chosen measures.

Measures

Quantitative data. People with dementia and caregivers completed pen and paper versions of the Quality of Life-Alzheimer's Disease (QoL-AD) scale (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 scores are summed to give a total score ranging from 13 to 52. It was chosen because it can be self-administered by people with wide ranges of dementia severity, in addition to proxy scoring from caregivers, and it has good test-retest reliability ($r \geq 0.6$), interrater reliability (kappa >.70) and internal consistency ($\alpha > .82$). People with dementia also completed

three visual analogue sub-scales (VAS; two sub-scales were 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). Paper versions of the 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. After quantitative data collection was completed and the tablet computer collected, an audio recorded semi-structured interview was conducted to explore 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). 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 software and reviewed by all authors.
3. Themes identified and codes organised into themes.
4. Themes reviewed in relation to coded extracts and data set and reviewed by first and second authors peer-reviewed. Thematic map generated.
5. Themes clearly named and defined.

6. Report produced. Integrated with quantitative findings.

Quality Assurance. At the beginning of the project the first and second authors conducted bracketing interviews (Ahern, 1999) with two different colleagues in order to identify areas of possible bias and minimise their impact on the research. A research diary was also used throughout the project. All interviews were transcribed and coding was discussed with the second author 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

After ethics approval was granted a preliminary version of the app, on an Android-type tablet computer was first developed and then field-tested with volunteers (4 caregivers and 2 people with dementia). Feedback was sought in relation to the type and variety of visual images, 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 caregivers and two people with dementia. The final version of the app was divided into objects, paintings, and photography and consisted of over 100 images drawn, with permission, from three London museums (British Museum, Dulwich Picture Gallery, Hunterian Museum), and collections from a photographer and a painter. Images included early Greek and Egyptian objects (e.g. oil lamp, pottery), representational and abstract European art of the 16-21stth centuries (including painting, decorative arts and sculpture), and photography of urban and rural scenes. Images were selected that were not likely to be easily recognised so as to offer some degree of challenge and stimulation and not necessarily be a trigger for reminiscing about a specific time period or event. Participants were recruited following presentations about the study at Alzheimer's Society Dementia Cafés, venues which offer social activities and refreshments. An appointment was made with each dementia-caregiver dyad to discuss the study, experience a preliminary use of the app after a demonstration by one of the researchers, obtain consent and complete initial QOL-ADs and paper VAS. These were completed by both dyad members. 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 then left with participants and they were asked to use the tablet “at least five times” over the course of two weeks. In order to help generate conversation during app sessions a list of sample discussion questions were supplied. 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 from museums and area artists (‘Contemporary Art’, ‘Traditional Art’, ‘Objects’, ‘British Photography’ or ‘All Pictures’), and viewing commenced (Figure 1). There were two buttons beneath each image: one to skip to the next image, and one to end the session. When the latter button was pressed the ending VAS scales appeared for completion and once these were completed 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. The semi-structured interview was also completed at this time and the tablet computer collected.

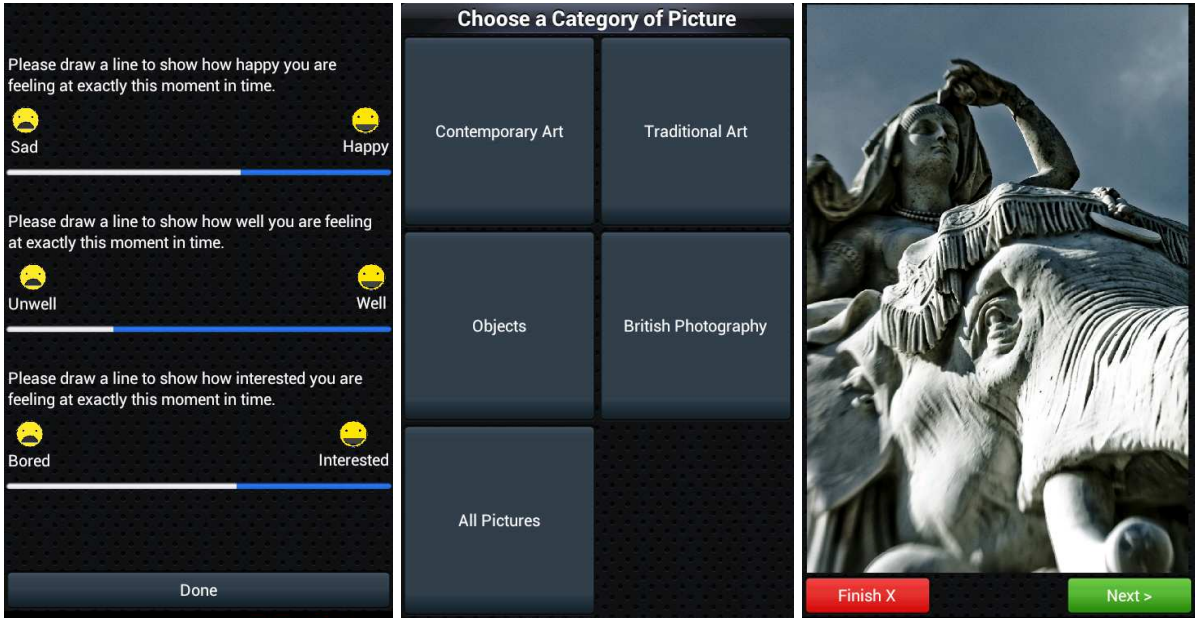

Figure 1. Screenshots from the art-viewing app.

Results

Quantitative analysis

App usage. App logs indicated that people used the app in different ways (Table 1). 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 under a minute per image, but this was highly varied (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 1

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 (owing to tablet battery failure).

Exploratory analyses. Kolmogorov-Smirnov tests, Skewness and Kurtosis statistics and inspection of histograms suggested that VAS scores did not always meet parametric assumptions. Therefore Bootstrapping was used on all paired samples *t*-tests as additional tests to our hypotheses. QOL-AD scores conformed to parametric assumptions and all QOL-AD revealed a Cronbach's alpha that exceeded the recommended threshold of .7 (Kline, 1999) that denotes high internal consistency (all: $\alpha = .88$, people with dementia: $\alpha = .90$, caregivers: $\alpha = .81$). All VAS also exceeded 0.7 (all: $\alpha = .73$, people with dementia: $\alpha = .73$, caregivers: $\alpha = .73$).

H1: Composite wellbeing scores tended to drop when comparing Pre and Post values in session one, remained quite stable in session two, and in subsequent sessions the trend was towards increasing levels of improvement (Table 2). Paired samples, two tailed t-tests revealed no significant effect of art-viewing in any session after Bonferroni-correction. Before Bonferroni-correction, the *t*-test result for session five would however have been significant ($t(7) = -2.75$, $p = 0.029$, (bootstrapped $p = 0.073$) $d = 0.55$).

Table 2

Pre and post VAS composite wellbeing scores

Session	VAS Score Start		VAS Score End		VAS Change		*t*-test – start and end	(bootstrapped *p*)
	Mean	SD	Mean	*SD*	*Mean*	*SD*		
1	225.38	44.67	214.75	40.52	-10.63	39.28	$t(7) = 0.77$, $p = 0.47$, $d = 0.25$	$p = 0.44$
2	225.00	47.65	225.63	42.66	0.63	44.68	$t(7) = -0.040$, $p = 0.97$, $d = 0.14$	$p = 0.98$
3	196.25	80.01	207.25	79.36	11.00	22.44	$t(7) = -1.39$, $p = 0.21$, $d = 0.14$	$p = 0.22$
4	209.88	62.91	223.88	62.31	14.00	38.66	$t(7) = -1.024$, $p = 0.34$, $d = 0.22$	$p = 0.34$
5	190.38	67.58	224.75	56.94	34.38	35.42	$t(7) = -2.75$, $p = 0.029$, $d = 0.55$	$p = 0.073$

Note. Bonferroni-corrected familywise error rate $p < 0.01$

H2: Despite a clear trend, in all but session two, towards increased happiness at the end each session (Table 3), none of the five paired samples, two tailed t-tests revealed significant differences. Session five had the largest effect size ($d = 0.35$) and came closest to significance, ($p = 0.13$, bootstrapped $p = 0.14$).

Table 3

Pre and post VAS happiness scores

Session	VAS Score Start		VAS Score End		VAS Change		*t*-test – start and end	(bootstrapped *p*)
	Mean	SD	Mean	*SD*	*Mean*	*SD*		
1	69.88	23.52	74.00	14.26	4.13	22.22	$t(7) = -0.53$, $p = 0.62$ $d = 0.21$	$p = 0.62$
2	79.00	21.00	78.00	16.51	-1.00	24.00	$t(7) = 0.12$, $p = 0.91$ $d = 0.0067$	$p = 0.91$
3	67.13	33.18	68.63	30.05	1.50	9.65	$t(7) = -0.44$, $p = 0.67$ $d = 0.047$	$p = 0.70$
4	69.50	23.77	73.13	26.98	3.63	24.61	$t(7) = -0.42$, $p = 0.69$ $d = 0.14$	$p = 0.67$

5	60.75	28.30	70.75	28.42	10.00	16.21	$t(7) = -1.75$, $p = 0.13$ $d = 0.35$	$p = 0.14$

Note. Bonferroni-corrected familywise error rate $p < 0.01$

H3: Wellness scores tended to drop in the first two sessions, but from session three onwards there was a clear trend towards improved sense of wellness at the end of app sessions (Table 4). None of the t-test results established significance, so it cannot be concluded that wellness showed significant improvement following sessions. Session five had the largest effect size for improvement ($d = 0.47$, $p = 0.26$, bootstrapped $p = 0.31$).

Table 4

Pre and post VAS wellness scores

Session	VAS Score Start		VAS Score End		VAS Change		*t*-test – start and end	Bootstrapped
	Mean	SD	Mean	*SD*	*Mean*	*SD*		*p*
1	81.75	14.64	71.50	20.45	-10.25	17.49	$t(7) = 1.66$, $p = 0.14$, $d = 0.58$	$p = 0.13$
2	70.38	31.05	64.00	34.86	-6.38	15.36	$t(7) = 1.17$, $p = 0.28$, $d = 0.19$	$p = 0.36$
3	67.50	28.55	78.13	21.87	10.63	19.51	$t(7) = -1.54$, $p = 0.17$, $d = 0.42$	$p = 0.18$
4	73.88	18.57	79.25	17.37	5.38	16.15	$t(7) = -0.94$, $p = 0.38$, $d = 0.030$	$p = 0.44$
5	69.75	29.30	80.38	13.22	10.63	24.55	$t(7) = -1.22$, $p = 0.26$, $d = 0.47$	$p = 0.31$

Note. Bonferroni-corrected familywise error rate $p < 0.01$

H4: Interestedness scores tended to drop in sessions one and three, but in the other sessions the trend was towards increased reported interestedness (Table 5). None of the *t*-test results reached significance, so it cannot be concluded that interestedness showed significant improvement following app sessions. Session five had the largest effect size ($d = 0.49$) and came closest to significance, ($p = 0.12$, bootstrapped $p = 0.15$).

Table 5

Pre and post VAS interestedness scores

Session	VAS Score Start		VAS Score End		VAS Change		*t*-test – start and end	(bootstrapped *p*)
	Mean	SD	Mean	*SD*	*Mean*	*SD*		
1	73.75	14.17	69.25	23.30	-4.50	21.47	$t(7) = 0.60$, $p = 0.57$, $d = 0.23$	$p = 0.57$
2	75.63	18.76	83.63	23.42	8.00	17.30	$t(7) = -1.31$, $p = 0.23$, $d = 0.38$	$p = 0.26$
3	61.63	33.13	60.50	34.77	-1.13	18.70	$t(7) = 0.17$, $p = 0.87$, $d = 0.033$	$p = 0.85$
4	66.50	26.01	71.50	25.26	5.00	13.26	$t(7) = -1.07$, $p = 0.32$, $d = 0.20$	$p = 0.34$
5	59.88	30.32	73.63	25.34	13.75	22.24	$t(7) = -1.75$, $p = 0.12$, $d = 0.49$	$p = 0.15$

Note. Bonferroni-corrected familywise error rate $p < 0.01$

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 VAS score changes.

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

In order to explore whether the apparent increases in VAS changes were significant, we compared change scores of sessions one and five for the composite wellbeing score as well as for each wellbeing subdomain using a series of four two-tailed paired samples *t*-tests (giving a Bonferroni-corrected familywise error rate of $p < .0125$).

Figure 2 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 an initially significant difference between the composite wellbeing change scores of 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 $p = 0.092$) which however disappeared if we use the corrected familywise error rate of .0125. It is however notable that the effect size is very large despite the small sample size.

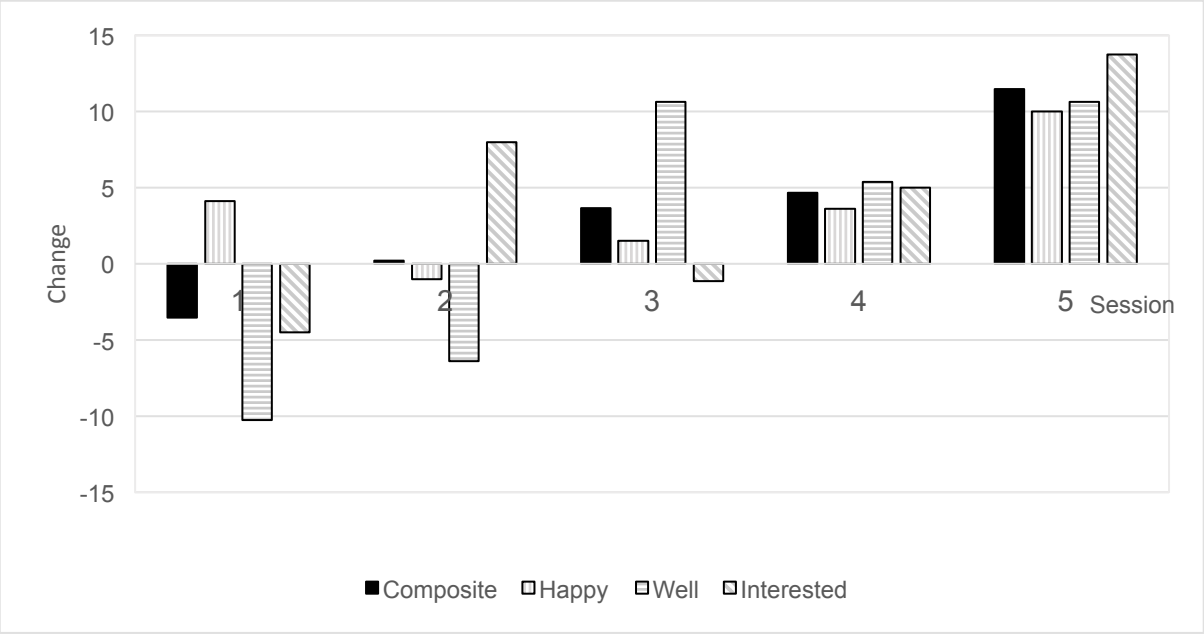

Figure 2. Percent changes in VAS scores across sessions for all participants

There was no significant difference between happiness change scores 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, between wellness change scores 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) and between interestedness change scores 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 was no significant increase in the change in VAS subdomain scores from session one to session five. There is, however, a consistent trend towards increased improvement at later sessions, supported by large effect sizes, especially for wellness and interestedness, which suggest powerful effect despite the small sample.

H5: Table 6 details the scores of VAS and QOL-AD that both groups of participants completed at the beginning and at the end of the overall study. There was no significant change in wellbeing or quality of life across the intervention.

Table 6

Quality of Life and Visual Analogue Measures – pre and post intervention

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

Summary of quantitative findings

Wellbeing appeared to show improvement at the end of app sessions, but none of the results achieved significance when corrected familywise error rates were considered. Effect sizes became quite large by session five, despite the small sample size. The wellbeing changes seem nuanced, as 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. Five main themes and 25 subthemes were identified (Table 7). The findings are summarised below, in descending order of number of coded passages per theme and sub-theme.

Table 7

Thematic analysis findings

Theme	Sub-theme	Example quote (1 = Person with a dementia, 2 = Informal carer, I = Interviewer)	Dyads	Quotes
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."	11	77
	Challenging	"1 - Yeah. I - kind of a bit tricky to interpret, two or three of them but ... to you know to really appreciate them."	11	31
	Remembering	"2- Mum was able to share experiences I didn't know about, that was really nice."	11	38
	PWD attention	"2 -Towards the end ... she would have less answers to the pictures."	9	28
	Learning	"2 - Well once [1] got used to it ... It became a lot easier."	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]"	6	13
	Temporary	"2 - Nothing long-term. Perhaps just while we were doing it."	2	2
Experience of app - impressions in relation to using the app	Improvements	"2 - I think the pictures could be bigger."	10	38
	Issues	"2 - Oh well you just, very, hardly touch it and you've missed a picture. [LAUGHS]	12	33
	Good	1 – "Pleasant to do, it's not, imposing on ... and just ... it's quite good."	11	29
	Liked aspects	"2 - Yeah what was good about it is that you don't have to turn pages."	10	29
	Familiarity	"1 - It was new technology to me."	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."	2	2
Dyad relationship - impact app had on relationship	Changes	"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."	11	70
	Joint activity	"2 - It's more a way of spending time together … it helped … because it gave you a focus: something to do."	12	43
	Beneficial	"2 - It's, it's good for the partnership."	7	18
	Unchanged	"2 - I wouldn't say that that has, changed anything, or improved anything, or not improved anything."	5	8
Mood - app impacts on mood	Improved	"1 - Yeah, we had fun doing it ... And a laugh as well. Yeah, which was good."	11	63
	Range of feelings	"1 - You like some and you don't like others."	10	29
	Lowered	"I - Okay. And ... how does, how does it feel to not know? … 1 - Bloody annoying!"	4	15
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."	10	27
	Activation	"I - And did that make a change to how you spent your time? 1 - Well … I would be, persuaded to go and see some of the- these things."	5	13
	Social	"2 – [I USED THE APP] on one occasion with my niece, who was over from Australia. … I - And how was that? 1- It was lovely."	7	13
	In-app	"1 - I, I looked at that … on my own, and some with you didn't I?"	6	10