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Viewing Art on a Tablet Computer: A Well-Being 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 well-being of people with dementia and their caregivers. This article explored whether such interventions can be delivered via a touchscreen tablet device displaying art images. **Method:** Twelve pairs of volunteers with dementia and informal caregivers were recruited (N = 24). A quasi-experimental mixed-methods within-subjects study evaluated the well-being 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 well-being from Session 1 to Session 5 but this became non-significant after the correction was applied. Well-being subdomains generally increased with number of sessions. Qualitative findings included changes in cognition, behavior, mood, and relationships. These changes tended to be

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viewed positively. **Conclusion:** The results suggest touchscreen-based art interventions could yield well-being benefits for this population. A larger-scale controlled study would help determine whether wider dementia care practice implications can be drawn.

Keywords
dementia, visual art, tablet computers, well-being, 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 behavior. 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 whereas 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 caregivers. Although standardized 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 while 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, and Chatterjee (2012) to propose that physical holding of objects during object handling sessions, while 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.

Well-Being

Well-being has been variously conceptualized and measured. The World Health Organization updated their definition of well-being in 2011 to be, "a positive state of well-being, one which allows individuals to fully engage with others, cope with the stresses of life and realise their abilities" (p. 1). This suggests that while a sense of well-being 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 well-being 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 well-being was connected to self-sufficiency, ability, and sociability. For the present study the definition of well-being as a dynamic phenomenon proposed by Dodge, Daly, Huyton, and Sanders (2012) was used. This conceptualizes well-being as "a state of equilibrium or balance that can be affected by life events or challenges." (p. 222), which in turn can be subjectively assessed.

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 whereas 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, and Gowans (2010a) 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 (Astell et al., 2010b). Leuty, Boger, 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 although 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 behaviors when people were using iPads as opposed to engaging in arts and crafts or cooking, and similar or enhanced levels of well-being, 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 well-being for people with dementia and their informal caregivers. The following hypotheses were tested:

Hypothesis 1 (H1): Subjective composite well-being will show significant improvement following art-viewing sessions.
Hypothesis 2 (H2): Subjective happiness will show significant improvement following art-viewing sessions.
Hypothesis 3 (H3): Subjective wellness will show significant improvement following art-viewing sessions.
Hypothesis 4 (H4): Subjective interestedness will show significant improvement following art-viewing sessions.
Hypothesis 5 (H5): Subjective well-being and quality of life (QoL) 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 well-being 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 well-being 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 were analyzed using thematic analysis.

Participants

This study was approved by an ethics panel in the Faculty of Social and Applied Sciences at Canterbury Christ Church 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 12 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 4 years.

A priori power analysis conducted using G*Power (Faul, Erdfelder, Buchner, & Lang, 2009) suggested that, 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 well-being. 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 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 well-being, such as physical health, relationships, pastimes and life overall, and each is rated on a four-point Likert-type 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 ($r \geq .6$), interrater reliability ($\kappa > .70$) and internal consistency ($\alpha > .82$). People with dementia also completed three visual analogue subscales (VAS; one subscale was adapted from EuroQol Group, 1990) measuring appraisals of their own levels of happiness, wellness and interestedness before and after each art-viewing session. The happiness and interestedness subscales were not a part of the EuroQol scales, which are all directly health-related. These were added to evaluate the level of art viewers' subjective level of happiness and 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 well-being. Visual analogue scales were selected as previous studies with older people (Thomson & Chatterjee, 2014) and people with dementia and their caregivers (Dementia Tool Kit, 2015; Johnson, Culverwell, Hulbert, Robertson, & Camic, 2015) have found it an easy to use and effective tool for rapidly gathering well-being information.

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 well-being (Stone & Mackie, 2013); interview data were analyzed using thematic analysis (Braun & Clarke, 2006). Interview transcripts were thematically analyzed using an iterative six-stage approach (Braun & Clarke, 2006) 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 organized 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 to identify areas of possible bias and minimize 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 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 (four caregivers and two people with dementia). Feedback

was sought in relation to the type and variety of visual images, the usability of the app. Adjustments to color, 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 more than 100 images drawn, with permission, from three London museums (British Museum, Dulwich Picture Gallery, and 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 16th to 21st centuries (including painting, decorative arts, and sculpture), and photography of urban and rural scenes. Images were selected that were not likely to be easily recognized 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 2 weeks. 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 few 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.

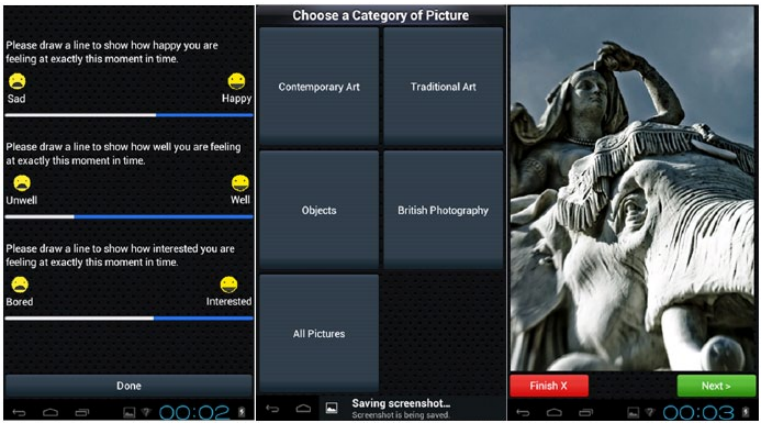

Figure 1. Screenshots from the art-viewing app.

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 5 times, per the suggested usage. Sessions tended to last about 20 min (M = 20.47, SD = 11.53), with about 30 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).

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 (Efron & Tibshirani, 1993). 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: α = .88, people with dementia: α = .90, caregivers: α = .81). All VAS also exceeded 0.7 (all: α = .73, people with dementia: α = .73, caregivers: α = .73).

H1: Composite well-being scores tended to drop when comparing pre- and post-values in Session 1, remained quite stable in Session 2, and in

Table 1. Art-Viewing Profiles of Each Pair of Participants.

Pair	Art-viewing sessions	Viewings span (days)	Session duration (min)		Images viewed		Seconds per image	*M*
			SD	*M*	*SD*	*M*	*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[a]	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
M	5.83	17.08	20.47		30.15		69.02	
SD	2.79	12.44	11.53		15.69		69.84	

[a]No measures recorded for final session (owing to tablet battery failure).

subsequent sessions the trend was toward 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 5 would however have been significant, $t(7) = -2.75$, $p = .029$ (bootstrapped $p = .073$), $d = 0.55$.

H2: Despite a clear trend, in all but session two, toward increased happiness at the end each session (Table 3), none of the five paired samples, two-tailed *t* tests revealed significant differences. Session 5 had the largest effect size ($d = 0.35$) and came closest to significance ($p = .13$, bootstrapped $p = .14$).

H3: Wellness scores tended to drop in the first two sessions, but from session three onwards there was a clear trend toward 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 5 had the largest effect size for improvement ($d = 0.47$, $p = .26$, bootstrapped $p = .31$).

H4: Interestedness scores tended to drop in Sessions 1 and 3, but in the other sessions the trend was toward increased reported interestedness (Table 5). None of the *t* test results reached significance, so it cannot be

Table 2. Pre- and Post-VAS Composite Well-being Scores.

	VAS score start		VAS score end		VAS change			
Session	*M*	*SD*	*M*	*SD*	*M*	*SD*	*t* test – start and end	(bootstrapped *p*)
1	225.38	44.67	214.75	40.52	−10.63	39.28	$t(7) = 0.77$, $p = .47$, $d = 0.25$	$p = .44$
2	225.00	47.65	225.63	42.66	0.63	44.68	$t(7) = -0.040$, $p = .97$, $d = 0.14$	$p = .98$
3	196.25	80.01	207.25	79.36	11.00	22.44	$t(7) = -1.39$, $p = .21$, $d = 0.14$	$p = .22$
4	209.88	62.91	223.88	62.31	14.00	38.66	$t(7) = -1.024$, $p = .34$, $d = 0.22$	$p = .34$
5	190.38	67.58	224.75	56.94	34.38	35.42	$t(7) = -2.75$, $p = .029$, $d = 0.55$	$p = .073$

Note. Bonferroni-corrected familywise error rate $p < .01$. VAS = visual analogue subscales.

Table 3. Pre- and Post-VAS Happiness Scores.

	VAS score start		VAS score end		VAS change			
Session	*M*	*SD*	*M*	*SD*	*M*	*SD*	*t* test – start and end	(bootstrapped *p*)
1	69.88	23.52	74.00	14.26	4.13	22.22	$t(7) = -0.53$, $p = .62$ $d = 0.21$	$p = .62$
2	79.00	21.00	78.00	16.51	−1.00	24.00	$t(7) = 0.12$, $p = .91$ $d = 0.0067$	$p = .91$
3	67.13	33.18	68.63	30.05	1.50	9.65	$t(7) = -0.44$, $p = .67$ $d = 0.047$	$p = .70$
4	69.50	23.77	73.13	26.98	3.63	24.61	$t(7) = -0.42$, $p = .69$ $d = 0.14$	$p = .67$
5	60.75	28.30	70.75	28.42	10.00	16.21	$t(7) = -1.75$, $p = .13$ $d = 0.35$	$p = .14$

Note. Bonferroni-corrected familywise error rate $p < .01$. VAS = visual analogue subscales.

Table 4. Pre- and Post-VAS Wellness Scores.

	VAS score start		VAS score end		VAS change			
Session	*M*	*SD*	*M*	*SD*	*M*	*SD*	*t* test—start and end	Bootstrapped *p*
1	81.75	14.64	71.50	20.45	−10.25	17.49	$t(7) = 1.66$, $p = .14$, $d = 0.58$	$p = .13$
2	70.38	31.05	64.00	34.86	−6.38	15.36	$t(7) = 1.17$, $p = .28$, $d = 0.19$	$p = .36$
3	67.50	28.55	78.13	21.87	10.63	19.51	$t(7) = -1.54$, $p = .17$, $d = 0.42$	$p = .18$
4	73.88	18.57	79.25	17.37	5.38	16.15	$t(7) = -0.94$, $p = .38$, $d = 0.030$	$p = .44$
5	69.75	29.30	80.38	13.22	10.63	24.55	$t(7) = -1.22$, $p = .26$, $d = 0.47$	$p = .31$

Note. Bonferroni-corrected familywise error rate $p < .01$. VAS = visual analogue subscales.

Table 5. Pre- and Post-VAS Interestedness Scores.

	VAS score start		VAS score end		VAS change			
Session	*M*	*SD*	*M*	*SD*	*M*	*SD*	*t* test—start and end	(bootstrapped *p*)
1	73.75	14.17	69.25	23.30	−4.50	21.47	$t(7) = 0.60$, $p = .57$, $d = 0.23$	$p = .57$
2	75.63	18.76	83.63	23.42	8.00	17.30	$t(7) = -1.31$, $p = .23$, $d = 0.38$	$p = .26$
3	61.63	33.13	60.50	34.77	−1.13	18.70	$t(7) = 0.17$, $p = .87$, $d = 0.033$	$p = .85$
4	66.50	26.01	71.50	25.26	5.00	13.26	$t(7) = -1.07$, $p = .32$, $d = 0.20$	$p = .34$
5	59.88	30.32	73.63	25.34	13.75	22.24	$t(7) = -1.75$, $p = .12$, $d = 0.49$	$p = .15$

Note. Bonferroni-corrected familywise error rate $p < .01$. VAS = visual analogue subscales.

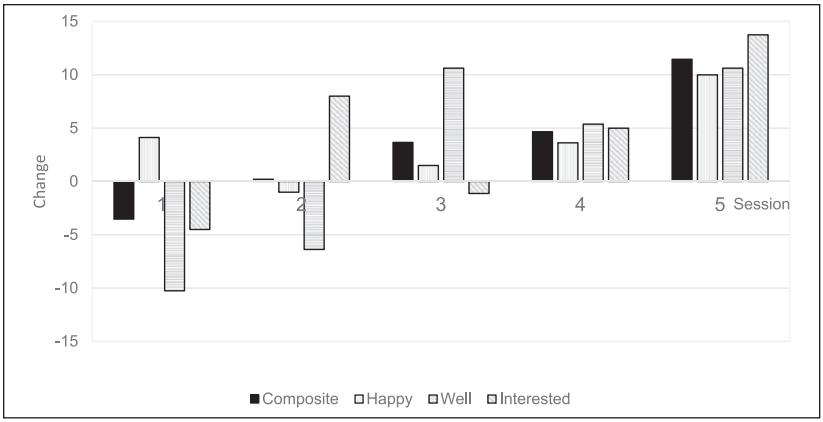

Figure 2. Percent changes in VAS scores across sessions for all participants.
Note. VAS = visual analogue subscales.

concluded that interestedness showed significant improvement following app sessions. Session 5 had the largest effect size ($d = 0.49$) and came closest to significance ($p = .12$, bootstrapped $p = .15$).

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

H6: Amount of well-being improvement will increase with number of sessions.

To explore whether the apparent increases in VAS changes were significant, we compared change scores of Sessions 1 and 5 for the composite well-being score as well as for each well-being 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 5 there was a trend toward all scores improving. There was an initially significant difference between the composite well-being change scores of Session 1 ($M = -10.63$, $SD = 39.28$) and Session 5 ($M = 34.38$, $SD = 35.42$); $t(7) = -2.394$, $p = .048$, $d = 1.20$ (bootstrapped $p = .092$) 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.

There was no significant difference between happiness change scores at Session 1 ($M = 4.13$, $SD = 22.22$) and Session 5 ($M = 10$, $SD = 16.21$); $t(7) = -.567$, $p = .589$ (bootstrapped $p = .580$), $d = 0.30$, between-wellness change scores at Session 1 ($M = -10.25$, $SD = 17.49$) and Session 5 ($M = 10.63$, $SD = 24.55$); $t(7) = -1.81$, $p = .11$ (bootstrapped $p = .12$), $d = 0.98$) and between-interestedness change scores at Session 1 ($M = -3.5$, $SD = 21.7$ and Session 5 ($M = 13.75$, $SD = 22.24$); $t(7) = -1.915$, $p = .097$ (bootstrapped $p = .125$) $d = 0.79$. These results suggest that with this sample size, there was no significant increase in the change in VAS subdomain scores from Sessions 1 to 5. There is, however, a consistent trend toward 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 well-being or quality of life across the intervention.

Summary of Quantitative Findings

Well-being 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 5, despite the small sample size. The well-being changes seem nuanced, as different well-being subdomains showed different patterns of change. In general, there seemed to be an increased beneficial effect on well-being as people completed more sessions.

Thematic Analysis

After initial coding of the 12 interview transcripts, 269 codes were identified. Five main themes and 25 subthemes were identified (Table 7). The findings are summarized below, in descending order of number of coded passages per theme and subtheme.

Cognitive. Reported impacts on cognition, relating to thoughts or attention.

Stimulating. Stimulating thoughts triggered through app use were the most commonly mentioned phenomenon for people with dementia and caregivers. The most frequent codes covered opinions about images. These could be aesthetic or thoughts in relation to image histories. People expressed prefer-

Table 6. Quality of Life and Visual Analogue Measures—Pre- and Post-Intervention.

	Measure	Score pre-intervention		Score post-intervention		*t* test	Bootstrapped *p*
		M	*SD*	*M*	*SD*		
People with dementia	QOL-AD	37.22	8.16	36.22	8.51	$t(8) = 0.68$, $p = .52$, $d = 0.12$	$p = .49$
	VAS-Happy	86.00	11.56	87.63	13.96	$t(7) = -0.23$, $p = .82$, $d = -0.13$	$p = .83$
	VAS-Well	90.00	13.93	89.00	13.61	$t(7) = 0.12$, $p = .91$, $d = 0.073$	$p = .91$
	VAS-Interested	80.50	24.63	82.00	32.13	$t(7) = -0.24$, $p = .82$, $d = -0.052$	$p = .83$
	VAS-Composite	256.50	38.49	258.53	50.62	$t(7) = -0.12$, $p = .91$, $d = -0.045$	$p = .90$
Informal carers	QOL-AD	32.82	3.76	32.27	4.05	$t(10) = 0.61$, $p = .55$, $d = 0.14$	$p = .55$
	VAS-Happy	78.78	16.20	77.11	12.50	$t(8) = 0.30$, $p = .77$, $d = 0.12$	$p = .77$
	VAS-Well	83.89	15.80	83.22	14.35	$t(8) = 0.14$, $p = .89$, $d = 0.044$	$p = .90$
	VAS-Interested	86.89	16.65	90.78	9.82	$t(8) = -0.94$, $p = .37$, $d = -0.28$	$p = .34$
	VAS-Composite	249.56	37.95	251.11	29.77	$t(8) = -0.12$, $p = .90$, $d = -0.045$	$p = .90$

Note. QOL-AD = Quality of Life-Alzheimer's Disease; VAS = visual analogue subscales.

Table 7. Thematic Analysis Findings.

Theme	Subtheme	Example quote (1 = Person with a dementia (PWD), 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	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
Impressions in relation to using the app	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

(continued)

Table 7. (continued)

Theme	Subtheme	Example quote (1 = Person with a dementia (PWD), 2 = Informal carer, I = Interviewer)	Dyads	Quotes
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
Behavior Impacts app had on behavior beyond dyad relationship	Use of time	"1—Yeah yeah, I 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

ences for specific genres. Seven people said the app was "interesting." Three people talked about considering where images could be displayed, suggesting engagement and cognitive stimulation.

Remembering. Remembering was described in relation to the person with dementia, but caregivers also described reminiscence, for example, in relation to family history. Some images seemed particularly evocative, such as the ice-cream van seemingly recalling pleasant childhood memories. One person with dementia suggested that viewers might find some memories unpleasant. One carer reported that their family member with dementia had reminisced about events unknown to them.

Attention. Effects on attention were reported in nine interviews. This related to the person with dementia's attention being app-focused, as reported by five interviewees. Changes in attention within sessions were reported, with attention reportedly progressively waning. Three interviewees reported noticing different things about the images each session. One person with dementia, for example, said the pace of life or watching television, meant "you pass by things," whereas the app's content and structure helped them concentrate.

The challenging nature of using the app. Raised in 11 interviews, this related to difficulties interpreting images and certain aspects of using the app. Eight pairs reported some of the images hard to understand, with four pairs reporting that the person with dementia made an effort to understand and "figure out" the images. All pairs described curiosity about certain images whereas three pairs reported brief moments of confusion, particularly in relation to abstract images or inapplicable questions. Two pairs reported overcoming difficulties either independently or with support.

Learning. Four pairs described events that evidenced learning. Two people with dementia reported increased ability with the app over time, and viewing sessions shortening as images became familiar. Two pairs reported initial apprehension, but then looked forward to sessions.

Reappraising. Half the interviews had references to people making reappraisals. 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 held, with family caregivers being surprised by things their family members with dementia noticed, or different viewing styles. Some realizations were difficult, such as one caregiver becoming aware of cognitive deterioration.

Experience of app. Comments relating to using the app.

Improvements. These included inclusion of information about the images, the possibility of new images, using the app in groups, enlarging images, and a system to highlight preferred images.

Issues. These included difficulties with the screen including over-sensitivity, glare, or viewing angle limitations inhibiting simultaneous viewing. Difficulties relating to VAS scales were mentioned, such as their discouraging independent app use, or health difficulties influencing scores. Two pairs had issues charging the tablet or turning it on, and one of those pairs also reported finding the app hard to use.

Good experiences. Good experiences included people reporting it was good to have something which brought their spouse into discussion. People also said the app was "amazing," that they liked it, and that it was a good idea.

Liked aspects. Liked aspects included four pairs finding it easy to use, two liked being able to skip pictures and one, being able to choose genres. One participant cited that the existence of the app implied acknowledgment that older people can use modern technology. People also reported that it was "comfortable" and "pleasant," and something that could be used despite limited mobility.

Familiarity. Familiarity with technology was mentioned by eight pairs, with one person with dementia saying that they were familiar with touchscreens. Six pairs said they found the technology novel.

Likened to. The app was likened to other activities, such as reading or talking to somebody.

Effect of timing. The *effect of timing* was covered: Two pairs found it better at certain times, or that their response depended on whether they were having a good day.

Dyad relationship. Impacts the app had on dyad relationship and interactions.

Conversations. Changes to the relationship included the app provoking conversations. Eleven pairs reported different images provoked different

amounts of conversation. Five pairs reported it changed their shared time. One pair said conversations sometimes replaced television.

Joint activity. Joint activity covers how for all pairs, app use became a generally favorably described shared activity. People collaborated to understand images. Five pairs reported the person with dementia required support using the app. Two pairs reported that this led to the app becoming a focus for joint attention.

Beneficial. Beneficial impacts of using the app were conveyed by seven pairs, soliciting such comments as it was "good for the partnership" and "this experience brought us closer." One caregiver reported the app helping her spouse to express his feelings, and how she subsequently felt she could help him more.

Mood. Impacts on emotional state.

Improved. Eleven pairs reported improved mood. This could be in relation to enjoying sessions, or certain images boosting mood, such as colorful ones. A third of informal caregivers reported enjoying seeing changes in the people they cared for. Two respondents reported happy memories being evoked. One caregiver reported that she successfully used the app to break negative emotional cycles that her spouse experienced: an unanticipated spontaneous intervention. 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. Another pair reported pride in relation to having an app.

Range of feelings. Likely not dissimilar to attending a museum or art gallery (Smith, 2014), there was a range of feelings being evoked in relation to different images. One respondent reported that it was "sometimes good to remember, but sometimes bad." Five pairs reported unchanged feelings in relation to some aspects of using the app, although two pairs added the caveat that this was due to the person with dementia having already been in a good mood. This was sometimes in relation to VAS scores, and sometimes in relation to specific images. Two pairs said they would miss the app.

Lowered. A third of interviews included reports of lowered mood; this related to specific images and not the overall art-viewing experience. Two people said some images could be upsetting. Another said duller images

could be "depressing." One participant said it was "annoying" not knowing what some of the images were.

Behavior. Changes in behavior reported outside the dyad relationship.

Use of time. Use of time related to changes people made to their routines including the app becoming a new pastime. One respondent said the person she cared for spent longer viewing images each time.

Activation. Five pairs reported behavioral activation, as art viewing stimulated other activities. Five pairs reported increased engagement with the arts. This included gallery trips, or obtaining images to enjoy together. One pair reported that it prompted them to review their photo albums.

Social. Social impacts were reported as people exhibited novel or thought-to-be-extinguished social behaviors. Four dyads reported demonstrating the app to other people. Two people with dementia reported using the app with other family members. One caregiver reported being surprised that her mother restarted using her phone.

In-app. In-app behaviors related to what people did while using the app. Four pairs reported the person with dementia had used the app alone, and two people with dementia reportedly made in-app choices.

Discussion

This was a mixed-methods exploratory study that examined the impact and experience of art viewing on a touchscreen tablet computer for people with a dementia and their informal caregivers. Taken as a whole, the results show promise. They are in line with previous research showing that people with dementia and their caregivers can benefit from arts-based interventions (Camic et al., 2014; Eekelaar et al., 2012; Kinney & Rentz, 2005; MacPherson et al., 2009; Musella et al., 2009; Rhoads, 2009; Rosenberg, 2009; Young et al., 2015) and that novel and generic stimuli "encourage the sharing of stories and social reminiscing." (Astell, Ellis, Alm, et al., 2010a, p. 177). Although there were insufficient participants in this study to reach statistical power, the quantitative data show a trend of increased well-being following art-viewing sessions, the magnitude of which tended to increase with the number of art-viewing sessions.

H1, H2, H3, and H4 cannot be supported at this sample size, as although effects were observed and tended to show improvement in composite

well-being, as well as on each of the three subscales, larger samples would be needed to reach significance. H5 is supported as there was no significant change in subjective well-being across the intervention, although a larger sample size would help verify the robustness of this finding. H6 was supported for composite well-being, prior to the application of Bonferroni correction. In light of the large effect sizes, larger sample sizes could determine whether this is a reliable outcome.

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 emotionally or in relation to well-being 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 well-being exerted by the intervention on participants increased with repeated sessions according to the well-being VAS data (see composite bars in Figure 2). 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. While reminiscence and cognitive stimulation were not deliberately aimed for, it seemed like these phenomena happened 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 caregivers (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 while 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 reminiscences evoked by the app catalyzed discussions but still allowed an error-free environment as there was no sense of people having to remember certain things. A striking outcome was that in one case someone remembered something that their caregiver 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 caregiver burden.

There was enthusiasm that using the app gave couples a new shared activity they could engage in and all caregivers told us they enjoyed seeing their spouse 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 these changes are likely to have contributed to a more stimulating environment for both members of the dyad, which could be beneficial for both their senses of well-being. Being challenged and overcoming challenges was raised 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 persevering with 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. It is, however, possible that with a smaller and different set of *a priori* planned comparisons, the effects of the intervention may have been generalizable. Several different statistical analyses were run increasing the possibility of Type-I errors. The lack of a control group makes it difficult to determine whether the impacts on well-being were directly related to the app or other factors. Participants in the study were self-selected members of perhaps a motivated group of people who attend Dementia Cafés. As they are run by an organization that requires people to have been formally diagnosed with 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. People volunteering, while ethically essential, also means participants might have tended to have more optimistic, resilient attitudes than average. It is also possible that the technology of using a tablet computer was an equivalent intervention to the art itself, although this was not evident in the thematic analysis of interview data.

Practice Implications

The outcomes of this research cautiously suggest that viewing art on a tablet computer might help some people with dementia to feel better. A clinical implication might be simply to suggest this as an activity for family members and friends to try out together. 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 art-viewing tablets to people with dementia and their caregivers might be a cost-effective way to provide people with activities that they can do together, especially when they are having difficult days or mobility difficulties. It might also help challenge prevailing ageist societal beliefs that relate to older adults being unable to engage with modern technology. As tablets can be used for other activities like video conferencing, podcasts, and shopping, people might find additional benefits once they become accustomed to using them.

Future Research

A larger-scale controlled study of the impact of tablet art viewing on well-being 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 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. Leng and colleagues (2014) compared tablet apps with non-tablet-based activities, which could provide a control condition. Larger-scale studies would also allow researchers to explore whether certain types of image are more beneficial than others.

Conclusion

This research cautiously suggests that art viewing on a touchscreen tablet computer can be beneficial for people with dementia and their caregivers. While the sample size was small and therefore wider generalization is not possible, findings suggest that people with dementia can engage with and experience benefits in well-being through viewing art on tablet-based computers at home or in convenient locations. It seems that the well-being improvements people experience tend to increase each time they use the app. The impacts on their well-being manifest in various ways: cognitively, behaviorally, emotionally, and in their relationships with their caregivers. There are

various ways in which the intervention might be improved, and further research with larger sample sizes and control groups would be beneficial to determine how effective this type of intervention can be, and with whom it might tend to be more beneficial.

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Michael James Heron is a lecturer in the School of Computing and Digital Media at Robert Gordon University. His primary research interests are accessibility, video games, accessibility within video games, and computer ethics. He has worked with

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