It Still Matters: Preference in Visual Appearance of Stimuli Among People in the Late Stages of Dementia

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Abstract. Introduction: This study aims to examine the emotional response towards visual stimuli in people with an advanced stage of dementia. **Methods:** One-to-one interview sessions were conducted with nineteen (17 females and two males) nursing home residents to investigate their response toward different visual stimuli. Fifteen positive images selected from the International Affective Picture System (IAPS) were used as visual stimuli. Participants' attitude and attention toward each stimulus was rated using the Observational Measurement of Engagement Tool (OME); their difficulty in recognising each stimulus was rated via a 3-point scale. **Results:** Stimuli contained children's faces received significantly higher attitude and attention scores than all the other stimuli ($p < 0.05$). Stimuli containing animals received the 2nd highest attitude and attention scores. Stimuli contained human faces or animals appeared to be more recognisable, especially the ones include children' faces. A strong, positive correlation between the attitude and recognisable ranking was identified, which was statistically significant ($p = 0.000$). The similar results have been found between the attention and recognisable ranking ($p = 0.002$). **Discussion:** The results of this study reveal that the people with moderate or severe stages of dementia still respond strongly to Kindchenschema (baby-schema). It provides designers with better insights into how to develop products/interventions for people with dementia, in particular for those in the advanced stage.

Keywords: Emotion design · Product appearance · Dementia care

1 Introduction

The rapid speed of global aging and the increasing prevalence of dementia have highlighted the importance of long-term care. Currently, around 46.8 million people worldwide are living with dementia. This number will almost triple by 2050 [1]. Improving the quality of and strategies for dementia care should be a central goal for researchers and clinical practitioners.

Empirical evidence shows that positive emotions are related to physical health, mental health and general well-being [2]. Higher ratios of positive to negative affect have been found in those who were mentally flourishing [3]. In response to the move of emotionally orientated and person-centered dementia care [4, 5], several design studies have been done to explore the design of personalized artifacts for people with dementia, in order to improve subjective well-being and maintain personhood. This form of personalized design project focuses on creating artifacts with a reminiscence function. It often starts with case studies and interviews to understand the life story of a person with dementia and creates personal items based on the life story [6, 7]. Although the results of this approach are positive, the effort required to create personalized artifacts limits its accessibility. It takes great effort to create personalized products for people with dementia. In one design project, for example, it required 30 volunteers, including designers, artists, caregivers, scientists, and therapists, to work a full day together to make three personalized dementia aprons [6]. This does not include the time that the research group spent on collecting life stories and preferences from the people with dementia.

So far, less attention has been paid to non-personalized products design in the dementia product design area. The effect of reminiscence approaches, such as using personal images/video and familiar music to improve mood and well-being people with dementia, has been well documented by many studies [8, 9] and therefore become predominate. The effect of non-personalized items in mood change is less addressed. It is unfortunate as non-personalized products can be produced on a large scale with less personal research work required.

According to Norman's model of emotion design, an individual's emotion experience toward products is affected by three design aspects: visceral, behavioral, and reflective [10]. Personalized items provide socio-pleasure and ideo-pleasure to people with dementia, and thus elicit positive emotion in respect of reflective design. Non-personalized products, on the other hand, are more likely to elicit positive emotion through visceral and behavioral aspects. Investigating the emotional response toward different product appearance can guide designers to create non-personalized products that people with dementia will likely prefer and engage with. This study, therefore, aims to examine the emotional response towards visual stimuli in people with an advanced stage of dementia.

2 Methods

2.1 Procedure and Measurements

One-to-one interview sessions were conducted with nineteen (17 females and two males) participants to investigate their response toward different visual stimuli. All the participants were nursing home residents with a moderate to advanced stage of dementia (CDR2-CDR3), all are white. The average ages of them is 90.7 ± 8.3 years old. Fifteen positive images selected from the International Affective Picture System (IAPS) [11] were used as visual stimuli. Those images were grouped in four groups, which are: (1) Portraits; (2) Landscapes; (3) Animals; (4) Food. Apart from these IAPS images, one neutral image was used as the control stimulus.

The participants' attitude and attention toward each stimulus was measured using the Observational Measurement of Engagement Tool (OME), a tool which was developed to record the response of individuals with dementia to the stimuli. The OME has shown a high degree of validity, inter–rater agreement (84%), and intra-class correlation (0.78) [12]. Residents' attention towards an image group was noted on a 4-point scale: *(1) not attentive, (2) somewhat attentive, (3) attentive*, and *(4) very attentive*. Residents' attitude towards an image group was noted in a 7-point Likert scale: *(1) very negative, (2) negative, (3) somewhat negative, (4) neutral, (5) somewhat positive, (6) positive,* and *(7) very positive* [13].

The residents' difficulty in recognizing the subject of the images was recorded based on a 3-point scale: *(0) Not difficult, (1) Somewhat difficult,* and *(2) Difficult/No response. Not difficult* means the resident recognized the main subject of the image quickly (in 5 s) without showing any difficulty. *Somewhat difficult* means the resident appeared to have some difficulty in response to the image but could recognize the main subject with the researchers' instruction. *Difficult/No response* means the resident showed no response or could not recognize the image even with the researcher's help.

The response was rated by a researcher during the interviews and two coders after the interviews (by listening audio recordings). These two coders had received the instruction of how to rate the events before they started. The researcher accompanied the coders while they were rating and played the audio files for them. Each audio file was only played once, to simulate the on-site rating situation.

2.2   Image Selection and Classification

This study used in 15 IAPS images and one control image (Table 1). These IAPS images are selected based on their emotion rating data provided in the manual [11]. IAPS provide ratings of three emotional dimensions for each image: pleasure, arousal, and dominance. The first two dimensions, pleasure and arousal, are known as core affect described in the circumplex model of emotion [14, 15], and therefore be chosen to be used in this study for image selection. Pleasure refers to the pleasure/misery of an emotion; arousal refers to the level of arousal/sleep induced by an emotion. All data was rated on a 9-point scale, with 9 referring to the highest rating and 1 referring to the lowest rating.

As the goal of this study is to elicit positive emotion, only images with high pleasure ratings were selected. These images were then classified into three groups based on their arousal level: (A) High levels of arousal; (B) Moderate levels of arousal; and (C) Low levels of arousal. The reprehensive emotion of these three groups, based on the circumplex model of emotion, are *excitement*, *pleasure*, and *relaxation*, respectively. Four subject groups were identified, based on the main subject of these images. The four groups are: *(1) Portraits*; *(2) Landscapes*; *(3) Animals*; and *(4) Food*. Group (1) contains six images and can be divided into two subgroups: *(1a) Images without children*; *(1b) Images including children*. Group (2) contains six images and can be divided into two subgroups: *(2a) Images without people*; *(2b) Images including people* (Fig. 1).

Table 1. The details of images used in this study

| Image description (IAPS No.)	Arousal (SD)	Valence (SD)	Emotional groups	Subject groups
Hang glider (5626)	6.10 (2.19)	6.71 (2.06)	(A)	2b
Hiker (5629)	6.55 (2.11)	7.03 (1.55)	(A)	2b
Sailboat (8173)	6.12 (2.30)	7.63 (1.34)	(A)	2a
Skier (8190)	6.28 (2.57)	8.1 (1.39)	(A)	2b
Water skier (8200)	6.35 (1.98)	7.54 (1.37)	(A)	1a
Baby (2071)	5.00 (2.34)	7.86 (1.32)	(B)	1b
Family (2340)	4.9 (2.20)	8.03 (1.26)	(B)	1b
Romance (4601)	5.08 (2.01)	6.82 (1.22)	(B)	1a
Mountains (5660)	5.07 (2.62)	7.27 (1.59)	(B)	2a
Ice cream (7330)	5.14 (2.58)	7.69 (1.84)	(B)	4
Cow (1670)	3.05 (1.91)	6.81 (1.76)	(C)	3
Bunnies (1750)	4.10 (2.31)	8.28 (1.07)	(C)	3
Couple (4700)	4.05 (1.90)	6.91 (1.94)	(C)	1a
Sky (5594)	4.15 (2.76)	7.39 (1.45)	(C)	2a
Winner (8330)	4.06 (2.28)	6.65 (1.52)	(C)	1a
Control (-)	-	-	-	-
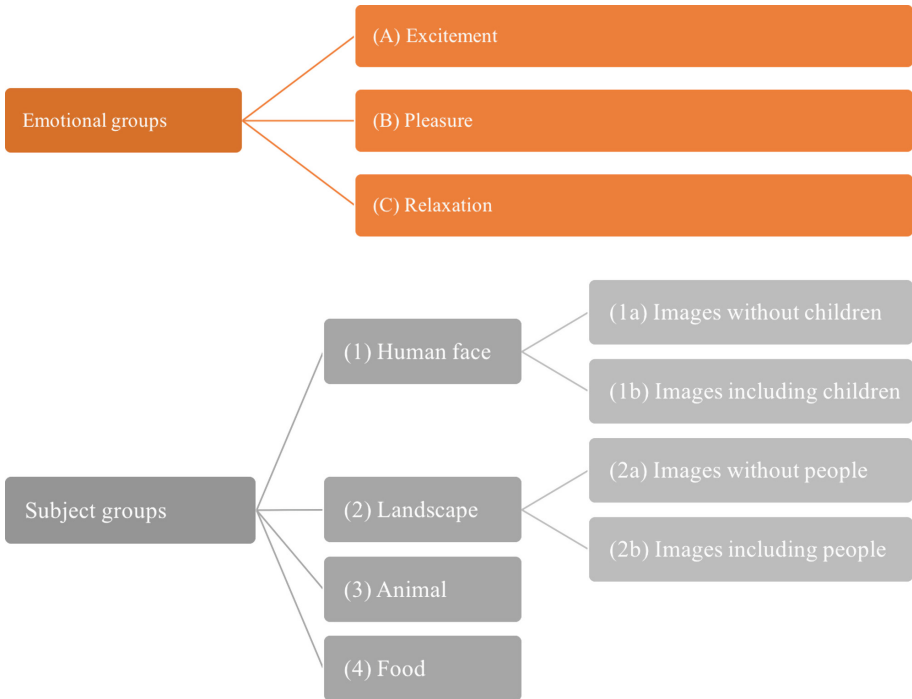
Fig. 1. The 15 IAPS images were classified into three emotional groups and four subject groups.

2.3   Data Analysis

All statistical analyses were performed by using IBM SPSS Statistics version 20. The OME were treated as interval data, in the assumption that the distances between each of the scale elements are equal. The results of recognizing ratings were analyzed as ordinal data. The ranks of OME and recognizing have been made to clarify which stimuli have better results. Friedman's test was used to examine the difference of OME scores between the image groups. Wilcoxon signed rank test was used as the post hoc test. To clarify whether the residents' emotional response to an image was affected by their ability to recognize it, the Spearman's rank-order correlation was run to determine the relationship between these variables. Inter-rater reliability of the researcher and the two coders was assessed using a two-way mixed, consistency, average-measures Intraclass Correlation (ICC) [16, 17].

3   Results

Among these 19 residents, four of them were excluded as they responded with indifference to the images. With the 15 residents, only one resident could recognize all the images without any difficulty. In the worst case, a resident could only recognize two images without any difficulty. Table 2 lists the reconcilability ranking of the 16 images. Generally, images in the emotional group (B) and (C), and those that contained human faces or animals (subject group (1) and (3)) appeared to be more recognizable, especially the ones include children' faces. The landscape pictures seemed to be less recognizable.

Images containing children's faces (group 1b) received significantly higher attitude and attention scores than all the other groups (Tables 3 and 4). Images containing animals (group 3) received the 2nd highest attitude and attention scores, although there are still significant differences between these and group (1b). No significant difference was found between group 1 and group 3. Those results indicate that compared with the images of landscapes and objects, images of human faces and animals are the better materials to elicit positive emotions in people with dementia, with the images containing children' faces producing the best results. The image of object (group 4) appear to have the lowest attitude score, compared with other IAPS images.

To clarify whether the residents' emotional response to an image was affected by their ability to recognize it, the Spearman's rank-order correlation was run to determine the relationship between these variables. A strong, positive correlation between the attitude and recognizable ranking was identified, which was statistically significant (rs (16) = 0.902, p = 0.000). Similar results were found between the attention and recognizable ranking (rs (16) = 0.705, p = 0.002). Table 5 presents the ranking of the three variables measured in this study: attitude, attention, and recognizing. It appears that the images containing children's faces had the highest ranking in all the three aspects. Images with human faces were more easily recognized by the residents and had higher ranking of attitude and attention. Landscape images were generally less favorable. Stimuli contained human faces or animals appeared to be more recognizable, especially the ones include children' faces. A strong, positive correlation between the

Table 2. The recognisable ranking of the 16 images.

Image (IAPS no.)	Emotional groups	Subject groups	Difficult in recognizing (%)*	Somewhat difficult in recognizing (%)*	No Difficult in Recognizing (%)*	Recognizable ranking
Baby (2071)	(B) Moderate	(1b) Human face, including children	0.0	0.0	100.0	1
Family (2340)	(B) Moderate	(1b) Human face, including children	0.0	0.0	100.0	1
Romance (4601)	(B) Moderate	(1a) Human face, without children	15.6	0.0	84.4	3
Couple (4700)	(C) Low	(1a) Human face, without children	13.3	4.4	82.2	4
Winner (8330)	(C) Low	(1a) Human face, without children	2.2	17.8	80.0	5
Cow (1670)	(C) Low	(3) Animal	8.9	11.1	80.0	6
Bunnies (1750)	(C) Low	(3) Animal	11.1	11.1	77.8	7
Skier (8190)	(A) High	(2b) Landscape, including people	4.4	28.9	66.7	8
Water skier (8200)	(A) High	(1a) Human face, without children	2.2	33.3	64.4	9
Mountains (5660)	(B) Moderate	(2a) Landscape, without people	22.2	33.3	44.4	10
Sailboat (8173)	(A) High	(2a) Landscape, without people	17.8	40.0	42.2	11
Hiker (5629)	(A) High	(2a) Landscape, including people	6.7	60.0	33.3	12
Control image	–	–	24.4	46.7	28.9	13
Hang glider (5626)	(A) High	(2b) Landscape, including people	6.7	71.1	22.2	14
Ice cream (7330)	(B) Moderate	(4) Food	44.4	33.3	22.2	15
Sky (5594)	(C) Low	(2a) Landscape, without people	35.6	44.4	20.0	16

*Coders voted how much difficulty (difficult, somewhat difficult, no difficult) a resident showed in recognizing an image. The results were divided by 45 (the total votes of each image) to get the percentage.

attitude and recognizable ranking was identified, which was statistically significant (p = 0.000). The similar results have been found between the attention and recognizable ranking (p = 0.002).

Table 3. The post hoc results of the attitude scores

p value		(1) Human face			(2) Landscape			(3) Animal	(4) Food	(5) Control
		(1) Total	(1a) Without children	(1b) Including children	(2) Total	(2a) Without people	(2b) Including people			
(1) Human face	(1) Total	0.001*	0.001*	0.001*	0.001*	0.003*	0.932	0.002*	0.001*
	(1a) Without children		0.001*	0.009*	0.011*	0.061	0.088	0.014*	0.001*
	(1b) Including children			0.001*	0.001*	0.001*	0.001*	0.001*	0.001*
(2) Landscape	(2) Total				0.798	0.776	0.005*	0.088	0.012*
	(2a) Without people					0.798	0.005*	0.201	0.013*
	(2b) Including people						0.010*	0.059	0.041*
(3) Animal								0.002*	0.001*
(4) Food									0.656

Table 4. The post hoc results of the attention scores

p value		(1) Human face			(2) Landscape			(3) Animal	(4) Food	(5) Control
		(1) Total	(1a) Without children	(1b) Including children	(2) Total	(2a) Without people	(2b) Including people			
(1) Human face	(1) Total	0.001*	0.001*	0.001*	0.001*	0.001*	0.95	0.073	0.001*
	(1a) Without children		0.001*	0.084	0.069	0.272	0.051	0.972	0.006*
	(1b) Including children			0.001*	0.001*	0.001*	0.002*	0.001*	0.001*
(2) Landscape	(2) Total				0.421	0.363	0.002*	0.379	0.022*
	(2a) Without people					0.382	0.002*	0.221	0.123
	(2b) Including people						0.004*	0.382	0.020*
(3) Animal								0.033*	0.001*
(4) Food									0.024*

Table 5. Overall responsiveness to 16 picture stimuli: Ranking of different aspects of variables. Ordered by attitude ratings.

	Emotional groups	Subject groups	Ranking: Attitude	Ranking: Attention	Ranking: Recognizing
Baby (2071)	(B) Moderate	(1b) Human face, including children	1	1	1
Family (2340)	(B) Moderate	(1b) Human face, including children	2	2	1
Bunnies (1750)	(B) Low	(3) Animals	3	3	6
Cow (1670)	(C) Low	(3) Animals	4	4	5
Winner (8330)	(C) Low	(1a) Human face, without children	5	10	4
Romance (4601)	(B) Moderate	(1a) Human face, without children	6	11	2
Couple (4700)	(C) Low	(1a) Human face, without children	7	5	3
Water skier (8200)	(A) High	(1a) Human face, without children	8	6	8
Sailboat (8173)	(A) High	(2a) Landscape, without people	9	9	10
Skier (8190)	(A) High	(2b) Landscape, including people	10	8	7
Mountains (5660)	(B) Moderate	(2a) Landscape, without people	11	12	9
Hang glider (5626)	(A) High	(2b) Landscape, including people	12	13	13
Hiker (5629)	(A) High	(2b) Landscape, including people	13	14	11
Sky (5594)	(C) Low	(2a) Landscape, without people	14	16	15
Ice cream (7330)	(B) Moderate	(4) Food	15	7	14
Control image	–	–	16	15	12

The averaged ICC = 0.82 (range 0.62–1) for the three rating variables (attention, attitude, and difficulty in recognizing), suggests an excellent agreement between the three coders. The averaged ICC for each variable was reported as follows: attitude: 0.85 (range 0.67–0.93); attention: 0.74 (range 0.63–0.89); difficulty in recognizing: 0.88 (range 0.62–1).

4   Discussion

The visual appearance of products plays a vital
role in how people respond to them [18]. The results of this study revealed that this
phenomenon can still be found in people in the late stages of dementia. Compared to
images of animals, landscape, and food, the research participates tend to have less
difficulty in recognizing portraits. A clear preference of images of children and animals
has also been identified. In addition, the results suggested a positive correlation
between the attitude and reconcilability rankings, which means images that were easily
recognized tend to receive better responses from people with dementia.

As the dementia progresses, many people experience difficulties in recognizing
familiar objects or surroundings. People in the advanced dementia often lose their ability to
interact with stimuli but still reserve some ability to response to human interaction. This
phenomenon was reflected by this study. Most of the research participates, even those in
the late stages of dementia, were able to appreciate portrait images. In fact, while some
participants experienced difficulties in understanding the three adult portraits, none of
them showed difficulties in appreciating the images of baby and small children. This result
suggests that portrait images are the better choice to provide visual stimulation for people
in the late stages of dementia. Lack of spatial awareness is often found in people with
dementia. Pictures taken from a view of a long shot (for example, "hiker (5629)") or a
detail shot (for example, "ice cream (7330)") might make it difficult for the people with
dementia to recognize them, which could limit their enjoyment of these images. The
results of this study also suggest a positive correlation between the attitude and recog-
nizably ranking. It once again emphasizes the importance of "product appearance." As a
stimulus evokes people's emotional response though its aesthetic impression, semantic
interpretation, and symbolic association [18], it is predicable that limitations to inter-
preting a stimulus affect the individual's emotional response toward it. It is not unusual,
however, to see long shot and detail shot images are displayed on nursing homes walls.
These images could serve a role to entertain the staffs and visitors, but less likely to be
effective visual stimuli for people in the late stages of dementia.

According to the ethologist Konrad Lorenz [19], baby-schema, such as a round
face, large eyes, a small nose, a high forehead (see Fig. 2), evoke positive emotions and
motivate caretaking behavior in human beings. This theory has been confirmed by
several behavioral studies, which indicated that faces with high baby-schema were
found to be more attractive and elicited stronger motivation of caretaking [20, 21]. In
real life practice, some kindergartens arrange children to visit nursing homes, sug-
gesting it encourages social engagement and promote physical activity of nursing home
residents [22]; Pet therapy is adopted by many nursing homes as a regular activity, with
positive effects demonstrated by many research papers [23]. In addition, given the
benefits of interacting with little children and pets, baby dolls and robotic animals have
been developed for people with dementia for therapeutic purpose. Although the evi-
dence is still weak (no large-scale study have been conducted so far), some studies
suggested doll therapy and robot therapy might improve communication and reduce
behavioral symptoms [24–27]. Besides, although they are not real babies and animals,
it has been found that products with a physical appearance of baby-schema can elicit

caretaking behavior in people with dementia. For example, in one case study, a research participate with dementia apologized to Paro, the baby harp seal robot with clear baby-schema appearance (Fig. 3), before he had to leave [27].
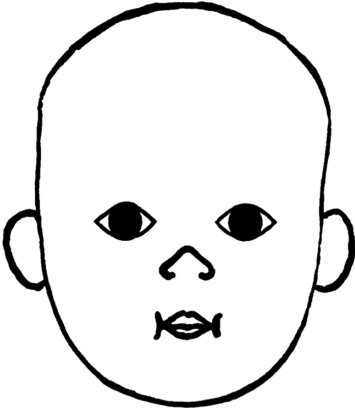

Fig. 2. The ideal face that contains all the features of baby-schema. Source: [21]

Fig. 3. Paro, the baby harp seal robot comes with a round face, large eyes, and a small nose. Source: [27]

Despite doll therapy and robotic therapy being adopted by more and more nursing homes, they are still seen as controversial interventions. Some family members were upset to see their loved ones being "treated as child" [28]. Besides, it raises ethical concerns of not telling people with dementia that what they are holding in arms are not real creatures but dolls and robotics [29].

The integration of baby-schema into daily products without having the products mimic the behaviors of babies and animals might be a more preferable approach. In fact, baby-schema has been applied in everyday products as an approach of emotional design. For example, it has been found that people had a more positive response toward cars with baby-schema features, and no habituation has been found after repeated exposures [30]. Our study has shown that the research participates manifested a more positive response towards the images of little children and animals. It could be explained that these types of images are simply more preferable, as they all contain the characteristics of baby-schema. Further research might work on how to effectively integrate baby-schema into product design and investigate its effect of eliciting positive emotions in people with dementia.

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