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Age-Related Differences in Factors Contributing to Affective Experiences among Japanese Adults

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Abstract. People's needs for products and services providing affective experiences continue to grow. Previous studies have made initial attempts at clarifying affective factors contributing to the generation of affects among Japanese participants. However, those studies focused only on younger adults. Given that most products are designed for a wide range of users, it is important to determine whether results obtained among Japanese younger adults generalize to broader populations including older adults. The purpose of this study was to explore the difference in factor structures of affective factors among Japanese older and younger adults. This study also explored how people's affective responses toward stimuli may vary across ages. A questionnaire-based investigation was conducted with both younger and older adults in Japan. Results indicated that affective responses elicited by the same stimulus varied across age groups. Younger and older adults' affects were evoked in different ways while participants' perceptions toward the same stimulus also varied across age groups. The result of this study would help designers to design products or services that elicit target users' affects more effectively according to the characteristics of younger and older adults as target users.

Keywords: aging, affect, affective experiences, design, product, service.

1 Introduction

Recently, the design of products and services that provide affective experiences has been considered as an approach to delight users beyond the conventional ways (i.e., functionality, quality, and usability). In the field of psychology, the term affect is used to represent people's emotions, mood, and feelings. It is defined as "emotion or subjectively experienced feelings, such as happiness, sadness, fear, or anger" [1]. In this study, the term affective is defined as "being capable to evoke affects in people's mind" [2]. Affective experience has been studied from both theoretical [3, 4] and practical perspectives [5, 6, 7, 8]. However, few studies have focused on the elements that generate human affects until recently. The clarification of such elements

has gradually been recognized as a critical issue for affect-eliciting product design. Tang and Umemuro's studies [9] revealed eight factors contributing to the generation of human affects, which were named *affective factors*, among Japanese adults.

Japan is gradually stepping into the aging society. According to an investigation conducted by Japanese government, the percentage of the population over age 65 is estimated to be 33.4% by 2035 [10]. Concerns towards the aging of population are not confined in Japan, but also other developed countries. The percentage of the population over age 65 is expected to range from 17% to 29% within Asia by 2030, North America, and Europa [11]. Thus, how to design products for older adults to satisfy their needs and improve the quality of their lives has become an urgent issue for both researchers and industry. With regard to customers' affective experiences, how to design affective products and services for older adults is therefore considered as a fundamental issue.

People's affective responses are possibly moderated by age-related factors. The relationships between human affect and aging are attracting wide research interest in psychological domain [12-14]. After reviewing the results reported, it was noticed that the results are not in accordance. Given the situation that the differences in the affects elicited by stimuli across age groups were still not clear, it is critical to further compare younger adults and older adults' affects caused by stimuli. Beside the research conducted in the domain of psychology mentioned above, practical explorations have also been made to investigate age-related influences on older adults' affective responses gained via specific products or experiences in the field of product design [15]-[18]. Nonetheless, most of the practical studies emphasized certain products or services, there have been few studies concerning age-related influences on affective experiences in general.

The purpose of this study was to explore the difference in factor structures of affective factors among Japanese older and younger adults. This study also explored how people's affective responses toward affective experiences may vary across ages. A questionnaire-based investigation was conducted with both younger and older adults in Japan.

2   Method

In order to explore how Japanese participants' affective responses evoked by stimuli vary across younger and older adults, a questionnaire-based investigation was conducted with both younger and older adults in Japan.

2.1   Participants

Fifty-two younger adults (aged 18 to 25, $M = 21.85$, $SD = 1.74$) participated in this study. Male participants accounted for 51.92% of all the younger adults. Meanwhile, 86 older adults (aged 61 to 87, $M = 71.21$, $SD = 6.17$) participated in this study. Male accounted for 38.37% of all the older adults.

2.2   Procedure

The participants were at first guided to understand the purpose of this study and then asked to read the instructions carefully. Then they were asked to provide their demographic information. After that, they viewed each of the stimuli carefully, which were prepared to elicit participants' affects, and answered the questionnaire corresponding to each stimulus.

2.3   Stimuli

Twelve high-resolution pictures along with short descriptions (e.g.: cute animals, high quality famous-branded car, popular smartphone) printed on paper were presented to participants one at a time, which were used to evoke participants' affects. The set of stimuli were adapted from Tang and Umemuro's previous study [9].

2.4   Measurements

The first section of the questionnaire evaluated participants' affects evoked by each stimulus based on the *valence* and *arousal* dimensions. The following statements comprised this section: "I had positive affect", "I had negative affect", "I had strong affect" and "I had calm affect". Participants were asked to indicate to which extent each statement matched their affective status with a five-point Likert scale (from "strongly disagree with the statement" to "strongly agree with the statement"). The responses toward the four questionnaire items were referred to as *affect variables*.

The second section of the questionnaire consisted of 51 questionnaire items designed based on affective elements adapted from Tang and Umemuro's previous research [9]. Each question item corresponded to an element that was potentially capable to evoke human affects. Participants were asked to rate to what extent each item matched the presented stimulus using five-point Likert scale (from "totally not match" to "totally match").

3   Result

3.1   Extraction and Validation of Affective Factors among Japanese Younger and Older Adults

To investigate whether there was any difference in the factor structures of younger and older participants, a series of factor analyses was conducted for each age group. Responses of younger and older adults for the 51 questionnaire items were analyzed respectively. The principal component method and varimax rotation were employed. The number of factors was determined by eigenvalue. Only the factors with eigenvalue greater than 1.0 were accepted.

The factor analysis revealed similar factor structures among younger and older adults. Consequently, a factor analysis was conducted with younger and older adult data combined, using the principal component method and varimax rotation. Only the

factors with eigenvalue greater than 1.0 were accepted. As a result, a five-factor struc-ture was extracted from Japanese participants (cumulative contribution: 56.7%). Five factors extracted were referred to as affective factors, including *social connection and relaxation* (Factor 1), *product satisfaction* (Factor 2), *risky and unpleasant* (Factor 3)*, achievement* (Factor 4), as well as *ethics* (Factor 5) factor.

To validate the affective factors extracted, the correlation coefficients between fac-tor scores of affective factors and affect variables were calculated (see **Table 1**) shows the result of correlation analysis between factor scores and affect variables. All the affective factors showed significant correlations with positive or negative affect, or with both. Except for the "product satisfaction" (Factor 2) and "ethics" (Factor 5) factor, all the factors showed significant correlations with strong or calm affect, or with both. This pattern validated the affective factors extracted.

3.2   Age-Related Influences on Participants' Affects Elicited

Table 2 shows the means and standard deviations of the four affect variables for each age group. Two-way analyses of variance were conducted to confirm the effects of age on participants' positive, negative, strong and calm affect evoked. The four affect variables were subjected to two-way ANOVA having two levels of generation (younger and older adults) and 12 levels of stimulus (12 items).

Tables 3 and **4** show the results of ANOVA on positive and negative affect va-riables. The effects of generation on positive affect and negative affect were not ob-served in this study whereas the interaction effect between generation and stimulus was significant. Table 5 shows the result of ANOVA on strong affect variable. There was a main effect of generation on strong affect F (1, 1426) = 36.864 (p < 0.01). Along with the results shown in Table 2, this result indicated that the mean value of

Table 1. Correlations between affect variables and factor scores of affective factors

	Factor 1 Social Connection and Relaxation	**Factor 2** Product Satisfaction	**Factor 3** Risky and Unpleasant
Positive	.60**	.19**	-.54**
Negative	-.40**	-.19**	.67**
Strong	.14**	-.01	.39**
Calm	.71**	.02	-.39**
	Factor 4 Achievement	**Factor 5** Ethics	
Positive	.16**	.01	
Negative	-.16**	.12**	
Strong	.21**	.03	
Calm	-.00	.04	

N = 1450; ** p < 0.01

strong affect was significantly greater for older adults than for younger adults. The main effect of stimulus was also significant as was the interaction effect between generation and stimulus. **Table 6**, showed that, as for calm affect, the main effect of the generation was significant, $F(1, 1426) = 93.01$ ($p < 0.01$). Along with **Table 2**, this result suggested that the calm affects elicited by stimuli was significantly greater for older adults than for younger adults. Besides, the main effect of stimulus was also significant, as well as the interaction effect between generation and stimulus.

Table 2. Descriptive statistics of the four affect variables

	Positive		Negative		Strong		Calm	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
YA	.48	1.36	-.94	1.28	-.23	1.27	-.31	1.40
OA	.52	1.41	-.99	1.36	.16	1.24	.14	1.39

YA represents younger adults; OA represents older adults
n (younger adults) = 618, *n* (older adults) = 832

Table 3. Results of ANOVA to positive affect: Generation and stimuli as factors

	Sum of Squares	df	Mean Square	F
Corrected Model	1752.15	23	76.18	104.22**
Intercept	350.51	1	350.51	479.52**
Stimulus	1640.69	11	149.15	204.05**
G	.30	1	.30	.41
Stimulus * G	37.48	11	3.41	4.66**
Error	1042.35	1426	.73	
Total	3159.00	1450		

Table 4. Results of ANOVA to negative affect: Generation and stimuli as factors

	Sum of Squares	df	Mean Square	F	
Corrected Model	1601.92	23	69.65	104.22	**
Intercept	1330.71	1	1330.71	1991.22	**
Stimulus	1509.25	11	137.20	205.31	**
G	.84	1	.84	1.25	
Stimulus * G	21.33	11	1.94	2.90	**
Error	952.98	1426	.67		
Total	3926.00	1450			

** $p < .01$

Table 5. Results of ANOVA to strong affect: Generation and stimuli as factors

	Sum of Squares	df	Mean Square	F	
Corrected Model	372.73	23	16.21	11.84	**
Intercept	1.97	1	1.97	1.44	
Stimulus	271.56	11	24.69	18.04	**

Table 5. *(Continued)*

G	50.44	1	50.44	36.86	**
Stimulus * G	44.21	11	4.02	2.94	**
Error	1951.23	1426	1.37		
Total	2324.00	1450			

Table 6. Results of ANOVA to calm affect: Generation and stimuli as factors

	Sum of Squares	df	Mean Square	F	
Corrected Model	1793.10	23	77.96	103.25	**
Intercept	10.47	1	10.47	13.87	**
Stimulus	1623.87	11	147.63	195.52	**
G	70.23	1	70.23	93.01	**
Stimulus * G	47.74	11	4.34	5.75	**
Error	1076.71	1426	.76		
Total	2874.00	1450			

** $p < .01$

3.3   Age-Related Difference in Participants' Perception toward Stimuli

The descriptive statistics for the factor scores of the affective factors are shown in **Table 7**. Two-way analyses of variance were also conducted to confirm age-related effects on how participants perceived stimuli in terms of affective factors. The factor scores of the five affective factors extracted were subjected to two-way ANOVA having two levels of generation (younger adults and older adults) and 12 levels of stimulus (corresponding to the 12 stimuli).

Results of ANOVA on factor score of the "social connection and relaxation" factor (Fac. 1) are shown in **Table 8**. Main effect of generation was significant (F (1, 1426) = 231.099, $p < 0.01$). Along with the results presented in **Table 7**, this result indicated that the mean value of factor score of the "social connection and relaxation" factor was significantly greater for older adults than for younger adults. The main effect of stimulus was also confirmed (F (1, 1426) = 170.743, $p < 0.01$). The interaction effect between generation and stimulus was also significant (F (1, 1426) = 9.395, $p < 0.01$).

As for the "product satisfaction" factor (Fac. 2), as presented in **Table 9**, the two-way ANOVA yielded a main effect for the age groups (F (1, 1426) = 113.515, $p < 0.01$). Along with the results of **Table 7**, it could be concluded that the mean of the factor score of the "product satisfaction" factor was significantly greater for older adults than for younger adults. Likely, the main effect of stimulus was also significant, as well as the interactions effect between generation and stimuli.

The results of ANOVA conducted to the "risky and unpleasant" (Fac. 3) are shown in **Table 10**. Main effects of generation, stimulus, as well as interactions between generation and stimulus were found significant.

Results of ANOVA on the "achievement" (Fac. 4) factor are presented in **Table 11**. Main effects of generation, stimulus, as well as interactions between generation and stimulus were confirmed significant.

Results of ANOVA on the "ethic" (Fac. 5) factor are shown in **Table 12**. Main effect of generation was not observed on this factor "Ethics" whereas main effects of generation, stimulus, as well as interactions between generation and stimulus were found significant.

According to the result of ANOVA, participants' perceptions of affective factors varied across younger and older adults.

Table 7. Descriptive statistics for factor scores of affective factors

Affective Factors	Factor1 Social Connection and Relaxation		Factor 2 Product Satisfaction		Factor 3 Risky and Unpleasant	
	M	SD	M	SD	M	SD
Younger adults	-.29	1.00	-.16	1.06	-.21	.91
Older adults	.22	.90	.12	.89	.15	.97

Affective Factors	Factor 4 Achievement		Factor 5 Ethics			
	M	SD	M	SD		
Younger adults	-.19	1.02	-.01	.86		
Older adults	.14	.84	.01	.87		

n (younger adults) = 618; n (older adults) = 832.

Table 8. Results of ANOVA to the "Social Connection and Relaxation" factor (Fac. 1): Generation and stimuli as factors

	Sum of Squares	df	Mean Square	F	
Corrected Model	835.5 6	23	36.33	95.70	**
Intercept	1.94	1	1.94	5.10	*
Stimulus	712.99	11	64.82	170.74	**
G	87.73	1	87.73	231.10	**
Stimulus * G	39.23	11	3.57	9.40	**
Error	541.33	1426	.38		
Total	1376.89	1450			

** $p < 0.01$; * $p < 0.05$;

Table 9. Results of ANOVA to the "Product satisfaction" factor (Fac. 2): Generation and stimuli as factors

	Sum of Squares	df	Mean Square	F	
Corrected Model	1017.30	23	44.23	176.97	**
Intercept	.42	1	.42	1.69	
Stimulus	969.33	11	88.12	352.59	**
G	28.37	1	28.37	113.52	**
Stimulus * G	39.22	11	3.57	14.27	**
Error	356.40	1426	.25		
Total	1373.70	1450			

Table 10. Results of ANOVA to the "Risky and Unpleasant" factor (Fac. 3): Generation and stimuli as factors

	Sum of Squares	df	Mean Square	F
Corrected Model	757.41	23	32.93	81.75**
Intercept	.90	1	.90	2.24
Stimulus	687.87	11	62.53	155.24**
G	46.18	1	46.18	114.65**
Stimulus * G	9.21	11	.8 4	2.08*
Error	574.43	1426	.40	
Total	1331.85	1450		

Table 11. Results of ANOVA to the "Achievement" factor (Fac. 4): Generation and stimuli as factors

	Sum of Squares	df	Mean Square	F
Corrected Model	708.05	23	30.79	79.65**
Intercept	1.35	1	1.35	3.49
Stimulus	652.04	11	59.28	153.37**
G	36.73	1	36.73	95.05**
Stimulus * G	41.21	11	3.75	9.69**
Error	551.13	1426	.39	
Total	1259.18	1450		

Table 12. Results of ANOVA to the "Ethic" factor (Fac. 5): Generation and stimuli as factors

	Sum of Squares	df	Mean Square	F
Corrected Model	677.32	23	29.450	101.68**
Intercept	.06	1	.06	.20
Stimulus	658.03	11	59.82	206.55**
G	.10	1	.10	.33
Stimulus * G	7.51	11	.68	2.36**
Error	413.00	1426	.29	
Total	1090.32	1450		

** $p < 0.01$; * $p < 0.05$;

4   Discussion and Conclusion

This study investigated the differences in the factor structures of affective factors distilled from Japanese younger adults and older adults. This research also assessed how people's affective responses toward stimuli varied across age. To achieve this goal, a questionnaire-based survey was administered with both younger and older adults.

The results revealed similar factor structures among Japanese younger and older adults. Thus, a five-factor structure of affective factors for the combined data of both age groups was distilled and validated.

Then, ANOVAs were conducted to explore whether participants' affects elicited by stimuli varied between younger and older adults. According to the results obtained, age had significant effects on strong and calm affect. This pattern indicated that older adults' strong or calm affects were more likely to be evoked comparing with younger adults. Next, to assess age-related differences in perceptions towards affective stimuli, a series of two-way ANOVA were conducted. Older adults and younger adults perceived affective elements in different ways. In general, older adults were more likely to score higher on all affective factors except for the "ethic" factor. This result suggested that older participants were more likely to recognize elements contributing to their affective experiences among the given stimulus than younger people.

In this study, comparison between younger and older adults was only conducted with Japanese participants. Consequently, it is still ambiguous whether results obtained in this study could be generalized to younger and older adults from other countries. Thus, the need to collect more samples from different regions is still left as an important issue for future research. More evidence is required to further confirm the differences between younger and older adults observed in this study. Furthermore, it would be valuable to explore the effects of the interactions between culture and age on people's affective experiences elicited.

This study offers the structure of affective factors of Japanese younger and older adults. Designers could refer to the five affective factors comprising the structure for hints when trying to design affective products and services for Japanese customers. In addition, age-related differences were clarified in regards to participants' affects elicited by stimuli and the ways affective experiences were triggered in terms of affective factors. Generally, the older adults were more sensitive towards the affective elements embedded in objects or experiences. Additionally, older adults' strong and calm affect were more likely to be elicited comparing with younger adults when shown the same stimulus. These results enable designers to evoke users' affects more effectively during design process when they target at younger or older adults. It should be noted, however, that a practical methodology is still required for the application of the results attained. Besides, feedbacks from both designers and customers are necessary for further validation of the findings of this study.

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