Using Pupillary Response for Evaluating Users' Emotion Elicited by Cars

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Abstract: Products elicit users' emotion through all senses, and its can also interact with users' emotion. In all senses, largest amount of information gathered by vision and most feelings elicited by product images at first sight. The result of researching emotional response elicited by products not only helps designers directly know what users need but also help users choose appropriate products. Thus, the importance of emotional interaction between users and products is more and more emphasized in nowadays. Physiological measurement is a way usually taken to gauge user preference.

Lu and Ho (2010) took pictures of openers as stimulus to research pupil size in relation to emotional images. Based on previous research, this study, takes cars instead of openers as stimulus, explore users' emotional reaction elicited from complicated products by pupil size.

Result shows a significant difference in pupil size variation. Pupil size variation got bigger when participants saw positive and neutral pictures.

Key words: pupillary response, emotion, SAM, IAPS, cars

1. Introduct

Products can evoke many different kinds of emotions [8]. Previous research indicated that emotional images of products can effect users' preference of sense [8]. An attractive product elicits positive emotion of people, and they feel product more useful. Emotional response makes consumers to decide what they want from a row of products. it is perceived that emotion plays an important role in mind mapping of shopping [7]. It's necessary to measure users' emotional response from products. Research found that by measuring emotional responses, it was possible to design products that target specific types of emotions [8]. Nowadays there are many researches of emotion in Kansei Engineering [14,15]. Kansei Engineering takes questionnaires to obtain users' subjective opinions about products by adjectives. Researchers than convert Kansei words into products [6] by Semantic Differential [23].

Measuring emotion by questionnaires may leads to deviation result because different participant cognized text words as different meaning. Some studies have attempted to avoid it by adopting cartoon patterns, a non-verbal instrument, instead of adjectives to measure emotional responses [8,9].

Questionnaires get subjective opinions by participants themselves. Some participants may not be able to clearly and completely explain product differences [18]. Others may change their opinion if they do not want to express their true feelings or feel inhibited [5,21]. Compared with questionnaires, physiological measurement to

obtain users' preference directly through subconscious signals. Physiological measurement tells the true result of body reaction. Present research on physiological use measurement, includes electromyography (EMG) signals, galvanic skin response (GSR), blood pressure (BP), electroencephalography (EEG), to measure emotion [1,18]. Some psychology studies used measuring pupil size variation to evaluate emotional responses evoked by visual stimuli [3,11,25].

The steady of Bradley et al. [3] reassess the effects of valence and arousal on pupillary responses during picture viewing using a eye-tracking system and a large set of well-validated pictures from the International Affective Picture System [17]. They founded that pupillary changes were larger when viewing emotionally arousing pictures, regardless of whether these were pleasant or unpleasant. Lu and Ho [19] based on Bradley's study, taking openers' pictures as stimulus instead of IAPS to evaluate pupillary responses on products' picture. This study takes cars' pictures as stimulus to compare with previous study.

2. The Present Study

Previous research indicated that user pupil size variation could indicate the interest value of an object [10]. Exploit pupil response by measuring pupil size variation have been used to evaluate emotional responses evoked by visual stimuli in some psychology studies [3,11,25]. There are different opinions about measuring pupil size variation to evaluate emotion. Early researches suggested that dilating pupils meant positive emotion, and contracted pupils meant negative emotion [10,11,13,20]. Otherwise, recent researches indicated that pupil size got bigger variation when participants viewing emotional pictures whether they were positive or negative [3,13,24,25,26]. Regardless of whether pupil size can indicate positive emotion or not, these researches show that pupil size changes when viewing pictures which can evoke emotion. There are limited researches on pupil variation relate to products. This study is going to measure pupillary response for evaluating users' emotion elicited by cars.

Lang et al. [3] constructed Self-Assessment Manikin(SAM) [16] for IAPS database. In IAPS 2-dimensional affective space, pictures evoked more emotion made pupillary variation greater [3]. Lu & Ho [19] used two dimensions of SAM, valence and arousal, as well as pupillary response to research the relationship between them on products. Lu and Ho [19] found that pupillary variation was same as previous research when participants viewing IAPS database. That is to say, pupillary variation got greater when participants viewing positive and negative pictures from IAPS database. However, results of openers' pictures are different from pictures from IAPS. Pupillary variation got greater when viewing positive and neural picture and did not differ significantly between positive and neutral. From participants' subjective judgments, fewer stimuli get extreme negative scores. The reason for the result could be that products were designed with pleasure shapes, so products could not evoke strong negative feel. In general, the aim of product design is profit-oriented. Designers' goal is to design products evoking users' positive emotion whatever at visceral, behavioral, or reflective level [22]. Thus, extreme responses on viewing opener images were not observed in this study. Based on Lu and Ho's study, this study takes more complex product as stimuli to research pupillary variation on measuring emotion.

Cars are industrial designed products with more complex appearances and functions than others. Many researches have mentioned the importance of car appearance [4,27]. Designers think car design is knowledge about emotion [2]. Research indicated that level of education and experience of buying cars couldn't effect users' feel about cars' appearances. This is to say, consumers make decision by relying on emotional level [4]. This

study is going to take cars' picture as stimuli to feasibility of evaluating emotion elicited by products by measuring pupillary variation.

3. Method

The experiment consists of two steps: the first step is building up an emotional pictures database. After choose 30 pictures as stimuli from database, the experiment goes to the second step. The second step is measuring pupil size. The result of pupillary variation will be taken to statistics analysis.

3.1 Building stimuli database

3.1.1 Participants

Eight students from the National Cheng Kung University, between the ages of 23 and 31 years, three males and five females, volunteered to participate in the study. All the participants had normal or corrected-to-normal vision. None of them was identified as having special expertise in cars in general and car design in particular. The participants did not smoke cigarettes or drink caffeinated beverages within 2 hours before the testing session. In addition, none of them reported any injuries, diseases, or previous eye surgery.

3.1.2 Apparatus and stimuli

Hardware: MacBook Pro 13" 2011 late

Software: Adobe Photoshop CS5.1, e-prime 2.0, Microsoft Excel 2011, SPSS

Pictures were selected from six cars yearbooks. Totally 175 car pictures were selected. The selected pictures were equalized using Adobe Photoshop (version CS5.1; Adobe Systems Inc., San Jose, CA). Pictures' backgrounds and logo were removed, and only cars left in pictures. All pictures were 15cm width with proportional height, and were displayed in 8-bit grayscale. This size was appropriate for viewing whole picture on screen. Mean luminosity of the selected pictures was modified such that the mean and distribution of luminosity values for each of the pictures did not differ.

3.1.3 Procedure

Total 175 pictures were displayed on screen randomly using e-prime (version 2.0). Every picture was shown randomly. A white cross on black background was presented 3 sec. before cars' pictures. Participants viewed cross versions for 3 sec, and viewed cars' pictures for 6 sec. Participants rated each picture on a 9-point scale of valence after viewing. All the data were analyzed with cluster analysis. All pictures were categorized into 5 categories. 6 pictures were selected from each category according to average points. Finally, 10 pictures each of positive, neutral, negative, in total 30 pictures were selected as stimuli for pupillary measuring.

3.2 Measuring pupil size

3.2.1 Participants

Five graduate students from the National Cheng Kung University, all females, volunteered to participate in the study. All the participants had normal or corrected-to-normal vision. None of them was identified as having special expertise in cars in general and car design in particular. All participants did not smoke cigarettes or drink caffeinated beverages. None of them reported any injuries, diseases, or surgery on eyes. Before the testing session,

participants were gave informed consent and confirmed slept enough last night for consciousness. The participants could not wear cosmetics contact lenses and make-up on eyes. Participants who had corrected-to-normal vision should wear glasses.

3.2.2 Apparatus and stimuli

Hardware：a HP computer, a 22-in. monitor (ViewSonic VX2235 WM-4)

Software：GazeTracker , Microsoft Excel 2011, SPSS

30 selected pictures were presented by software (GazeTracker). Pictures were displayed on a 22-in. monitor (ViewSonic VX2235 WM-4) at a distance of 66 cm (25.9 in.) from the participant.

3.2.3 Procedure

Participants were gave informed consent before test. Participants were confirmed appropriate for experiment then they were invited sit down in front of the apparatus. Participants' heads were stable on a holder and they were confirmed in comfort positions during whole experiment.

Pictures were displayed for 6 s each. A blackscale image was displayed 6 s before picture presentation on each trial to control level of illumination prior to picture onset. A white cross on black background was presented 3 s after black picture. As figure 1 shown. Participants gave each picture Participants viewed black versions images for 6 sec., viewed cross versions for 3 sec, and viewed cars pictures for 6 sec. Participants rated each picture on a 9-point scale of valence after viewing.

All the data were analyzed with repeated measures analyses of variance.

For each trial, a 1-s prepicture baseline average was subtracted from each of the following pupil samples.

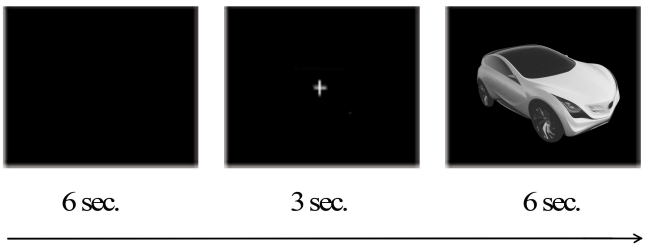

Figure 1. Trial Sequence

Table 1. Pupillary Variation

factors	average variation
negative	0.053
neutral	0.096
positive	0.085

4. Result and discussion

According to Table 1, positive and neutral pictures' pupillary variation was larger than negative pictures. There is a significant difference in pupil size when viewing pictures that evoke negative emotion. The result is not similar to prior study [3,19]. According to Figure 2, the results of previous study [3] indicate that there is a significant difference in pupil size when viewing IAPS pictures that induce positive and negative emotional reactions. That is, after affective picture viewing, emotional response can be distinguished by pupil size. For openers' pictures, a distinction cannot be made between positive and neutral emotional responses to pictures when measuring pupil size [19]. In this study, cars' pictures have the same tendency. From participants' subjective judgments, the average of positive score is 6.68, and average negative score is 2.92. Participants rating scores for products are not similar to for IAPS pictures. Products' pictures do not as some IAPS pictures get extreme low scores and pupillary variation larger than viewing neutral stimuli, regardless of openers or cars.

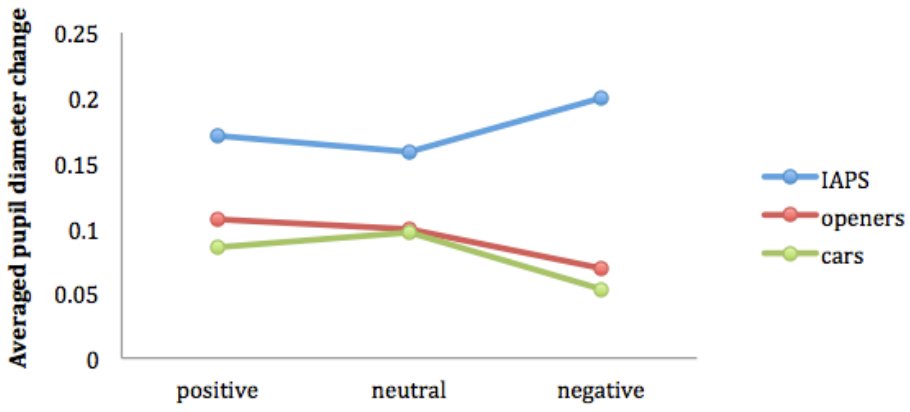

Figure 2. Viewing stimuli averaged pupil diameter variations from baseline during the different stimulus categories.

Cars are complex than openers, regardless of appearance or function. Hustwit [12] said people express themselves by their cars intentionally or unintentionally. Cars have more factors to effect users' emotion, and to evoke stronger emotional response. But according to this study, the result of cars is similar to openers. In sum, pupil measurement can help to assess whether the product evoked a negative participant perception response. Future research is obviously required to determine with certainty the universal of this method. If the result is a common response in pupillary variation for products, we can apply pupillary variation to distinguish product evoked negative emotion from positive and neutral product. That is to say, we can distinguish between like and dislike product by measurement pupil size.

5. Acknowledgement

The authors would like to thank the National Science Council of the Republic of China, Taiwan, for financially supporting this research under Contract No. NSC99-2221-E-006-167.

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