INVESTIGATING THE RELATIONSHIP BETWEEN CUSTOMER EMOTIONS AND SPORTSBIKE AESTHETICS

Mamo, James; Farrugia, Philip; Sant, Tonio
University of Malta, Malta

Abstract

When designing a sportsbike, design engineers need to adopt a multidisciplinary approach to develop a product which is aesthetically pleasing as well as aerodynamically optimised as possible. The objective of this research is to investigate the emotions experienced by motorcycle enthusiasts when looking at sportsbike designs. For this study, a literature review was carried out and an online questionnaire was designed with the expert input of two psychologists. The main part of the questionnaire consisted of eight motorcycle images together with a set of Emocards. The results were analysed and verified by using statistical methods. The outcomes of this study can be used to formulate a set of guidelines which can be implemented in a Knowledge Intensive Computer Aided Design (KI-CAD) system.

Keywords: Emotional design, Human behaviour in design, User centred design

Contact:
James Mamo
University of Malta
Department of Industrial and Manufacturing Engineering
Malta
james.mamo.12@um.edu.mt

1 INTRODUCTION

In today's extremely competitive market the features and specifications of the competing products are very close. Consequently the design of the product and the way product connects with the consumer on an emotional level is critical (Perez Mata et al., 2013). The application of user-centred product design approach has become one of the major growth drivers within companies, which seek to move up the value chain and improve the performance metrics of the product (Farrugia et al., 2013). Due to the importance of creating products which deliver emotional satisfaction to the user, a Design for Emotion (DFe) approach must be adopted by product design engineers (Farrugia et al., 2013). At the same time, design engineers have to apply fundamental principles to enhance the performance of complex artefacts. This is the case in the product development of sportsbikes, where design engineers have to ensure that the motorcycle is aerodynamically optimised as possible, yet it is aesthetically pleasing. Thus, design engineers need to adopt a challenging multi-disciplinary design approach to develop successful sportsbikes. The designer must understand very well the target customer and the perceptions that the customer has of the artefact, for it to be successful (Hu et al., 2013). As an example, it may be the case that, for a particular customer segment, the ideal sportsbike has a rounded shape with smooth curves while for another customer segment the ideal sportsbike has sharp lines and distinguished edges. No studies were found that explore the effect of sportsbike aesthetics on the customer's emotions.

Within this context the aim of this paper is to investigate any relationship between the aesthetics of sportsbikes and customers' emotions. Based on this introduction, the rest of this paper is organised as follows. Section 2 critically reviews work in related areas of research. Section 3 describes the methodology used to obtain the data for the study. Section 4 presents the results gathered from the questionnaire. A discussion together with the strengths and weaknesses of the study is disclosed in Section 5 with the conclusions in the subsequent section.

2 RELATED WORK

Emotion measurement concerning product design is the collection and evaluation of the emotions elicited by the product or from the user-product interaction. The method of measuring a person's emotions when interacting with a product or when reacting to an image of the product, can be quite complicated and very inaccurate, if not carried out in a planned and systematic way (Desmet et al., 2001). If the participants are observed when interacting with a product, their reactions will be restricted, and some people find it difficult to express their emotional reactions (Desmet et al., 2001). A more accurate and reliable method of measuring the emotional responses generated from a product is from self-report data, which can be either verbal or non-verbal. Verbal self-report methods are those that ask the participant to choose from a list of emotions represented verbally, while non-verbal self-report methods usually involve emotions represented by images or cartoon characters (Desmet et al., 2000). When a consumer first interacts with a product, there are three levels of product experience: which are aesthetic pleasure, attribution of meaning and emotional response. It is the personal significance of a product rather than the actual product alone which causes the emotions. That is why if two people appraise the same product in different ways, they will experience diverse emotions (Desmet and Hekkert, 2007). The most common self-report tools are rating scales and semantic tools, as these can cover a broad range of emotions as well as mixed emotions. However such tools are limited by language as it may prove challenging to translate emotions verbally from one language to another. For easier data collection, interpretation and standardised data, fixed responses are usually presented to the participants. One drawback to this type of emotional data collection method is that the subjects may be influenced by the list of available responses. On the other hand if they are presented by a free response, the participant would also be limited by the person's vocabulary (Scherer, 2005). A common rating scale used is the Likert Scale which is a tool that measures one's strength of agreement to a statement and is widely used in Kansei engineering techniques (Schütte and Eklund, 2010).

A survey on an online social network was carried out by Perez Mata et al. (2013) aimed at formulating a set of guidelines to assess the perceptions and ownership based on aesthetics, by using pictures of vases. These guidelines are intended to be used by engineering designers when designing the aesthetics or appearance of products. A seven level Semantic Differential scale was utilised, and ten opposite adjectives pairs were used to describe the vases (Perez Mata et al., 2013). Other studies such as those by Burnap et al. (2015) and Pan et al.(2016) were carried out to analyse the interaction and visual

attention generated by automobiles on consumers, the study was carried out on automobiles and the emotions elicited by the vehicle's design were not measured. Lan and Wong (2013) conducted a study based on the Taiwanese motorcycle market to explore the popular motorcycle refit culture. The aim was to help the motorcycle designers understand why people modify their machines and what design improvements can the manufacturers do, but the emotions of the customers were not analysed. The main limitation of this study is that it was carried out on small capacity motorcycles as those are by far the most popular in Taiwan. Research carried out by Hashim (2015) investigated how students positioned pictures of various motorcycles on a multidimensional scale, to try and understand if a motorcycle is capable to communicate its characteristics to the owner (Product Affect), by using the method of 'Room Affect'. The 'Room Affect' is a theory with its roots in environmental psychology, which implies that the characteristics of a room can be transferred to the occupant. The participants were asked to place the pictures on the scale which consisted of an evaluation vs. social axis, like-dislike and cheap-expensive respectively. The other scale subsequently consisted of a potency vs. activity axis, strong-weak and slow-fast. The researchers could then evaluate the participant's perception depending on the type of motorcycle (Hashim, 2015). It was found out that the 'Product Affect' is more evident on females, and that the 'Room Affect' can be extended also to products (Hashim, 2015). This study did not analyse the emotional response of the participants upon looking at the images and the subjects were all university students and thus the age group was limited.

The brand identity of Harley-Davidson motorcycles was studied by Pugliese and Cagan (2002) using shape grammar techniques. A number of simple and abstract motorcycle designs were created and a survey amongst Harley owners was carried out with the purpose of understanding the strength of association to the generated motorcycle models using shape grammar rules. It was concluded that as a motorcycle brand, Harley-Davidson has a very strong brand identity (visually) which can be represented by these rules (Pugliese and Cagan, 2002). This research was aimed solely at understanding the association of a brand to a set of simple motorcycle designs based on shape grammar rules, and not the emotional value of the models created. From the review of literature carried out, no studies were found that asses the emotions experienced by people when looking at sportsbikes.

3 METHODOLOGY

There are several ways in which evaluation of the customer's emotion when looking at a sportsbike can be done, some of which include: conducting a focus group, in-depth interviews with a selected number of people to create a persona or by setting up a questionnaire (paper or online). It can be quite challenging to discuss the emotional response of a product, face to face, due to the very low-intensity emotions generated (Desmet and Hekkert, 2002). When asking a person to describe the emotions elicited by a product, the cognitive process itself may influence the response. Thus self-report methods are preferred for this type of research (Desmet et al., 2001). For the scope of this study, an online questionnaire was created, as this will give a larger range of responses, ideas and cultures, which would be difficult to obtain with a focus group. The questionnaire was shared in closed motorcycle groups on social media, which are made up people coming from different places around the globe, thus providing a broader perspective.

3.1 Questionnaire Design

In section 1 of the questionnaire, the participants were asked to choose their preferred motorcycle style from a list of the seven most prominent motorcycle classifications ("ACEM Press Release", 2014), together with an 'other' option for participants that may prefer a different style from a niche market. The scope of this question was to analyse the person's preferred motorcycle style and the effect that it may have on the emotions elicited by the sportsbike designs. These motorcycle styles are illustrated in Figure 1. Section 2 of the questionnaire dealt with the emotions elicited by sportsbikes. For the scope of this research, a total number of eight motorcycle images were used. The models were chosen systematically from two European manufacturers (Triumph and Ducati) and two Japanese manufacturers (Yamaha and Honda). All of the eight motorcycles selected for the questionnaire are depicted in Figure 2. The ones shown on the bottom row are the latest models from each make; the other four (on the top row) are older generations of these models. The older sportsbikes were chosen based on the impact they had in the motorcycle industry. Thus all four of the older generation of sportsbikes chosen, were innovative in

terms of technology and design for the manufacturers (Brown, 2003). In the case of the Ducati and Honda, there is a gap of more than twenty years between the old and new model.

Figure 1. Seven classifications of motorcycle styles

Figure 2. Sportsbikes used for design outlines (all images obtained from web-site of OEM)

The designs of the sportsbikes used to investigate emotions elicited, were all depicted in the same manner in the questionnaire. All branding and company names, logos and colour were removed from the pictures. Features such as the front and rear wheel details; front forks and handlebars; chassis; mirrors and number plate bracket were all removed, to mask the brand of the sportsbike as much as possible (see example in Figure 3a). By modifying the images in this way, the chances of someone rating a particular design based on the motorcycle manufacturer rather than the aesthetic design of the sportsbike itself, are diminished. Another reason for these modifications was to keep the focus of the participants on the design of the sportsbike's body. This was further confirmed in the pilot study which is mentioned later on in this section.

There are several methods to find a person's emotional response towards a product. From an extensive literature review, it was discovered that the most commonly used non-verbal self-report tools in the engineering design domain are Emocards, the Self-Assessment Manikin (SAM) and PrEmo. For the purpose of this research, the Emocards (refer to Figure 3b) were chosen as they are relatively simple to use and can be implemented easily in any online questionnaire, in this case, Google Forms. Under each

sportsbike image, an emotion scale (1-8) was placed so that the participant can mark the emotion evoked. A five-point Likert scale was also added after each design to evaluate the participant's opinion on the aesthetics of each sportsbike.

The sportsbike designs in the questionnaire were placed in a way to reduce the primacy effect as much as possible. A pilot study was carried out in order to diminish the primacy effect, by changing the order of the images until no associations could be noted. Two psychologists were consulted when designing the questionnaire, and both agreed that it would be interesting to explore if there are indeed any trends regarding the participant's personality traits and the emotions elicited by the particular motorcycle design. Thus a sample of questions was chosen from the HEXACO-PI-R (Lee and Ashton, 2009) which explore the six main personality domains, which are Honesty/Humility, Extraversion, Conscientiousness, Emotionality, Openness to Experience and Agreeableness. In the last section, the participants were asked about their age and place of origin. The relationships between the place of origin and the emotions elicited by the sportsbike designs were not tackled in this study, but will be disseminated in future publications. The sportsbike image together with the Emocards was presented in the survey as can be seen in Figure 3.
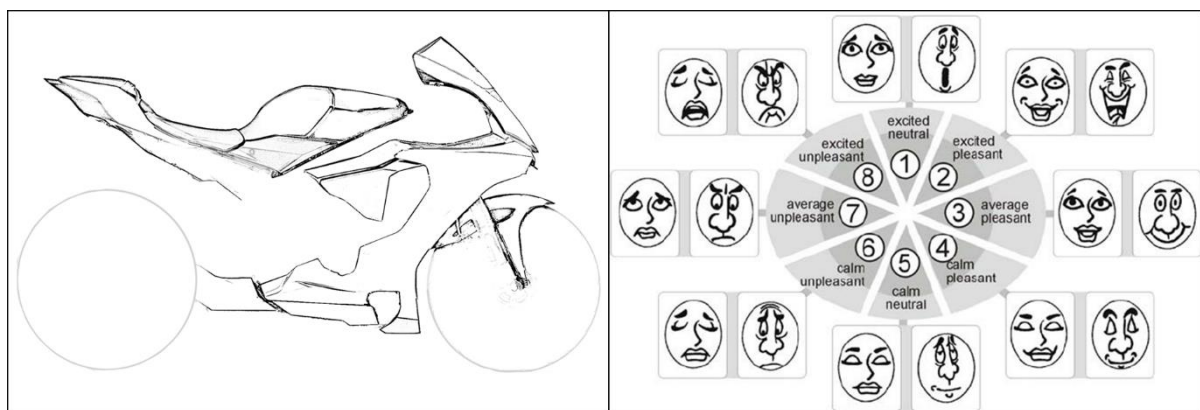

Figure 3. (a) 2015 Yamaha YZF-R1 (b) Emocards (Desmet et al., 2001)

4 RESULTS

The total number of complete responses gathered from the online questionnaire was 124, 77% being from Europe. A total of six responses (4.6%) were discarded as the data was incomplete. The dataset was sorted by age in ascending order, with the ages ranging from 18 to 71, thus giving a broad spectrum of views on the subject. The average age was found to be 39, and the data was classified as below and above median age. The motorcycle designs were also grouped together depending on the date of manufacture for easier data investigation.

4.1 Emotions Elicited by the Sportsbike Designs

Each sportsbike design had 124 responses regarding the emotion elicited by the image on the participant, based on the Emocards; these responses were classified into three parts: Neutral (excited, calm); Pleasant (excited, average, calm) and Unpleasant (excited, average, calm). The data presented in this section is shown in the column chart illustrated in Figure 4. The x-axis represent each sportsbike design from A to H and the y-axis represent the percentage of the emotions elicited. Neutral emotions have been left out of the chart for better clarity of results. With reference to Figure 4, it can be observed that on average, all of the sportsbike designs elicited positive emotions. The sportsbike which elicited the most positive emotions, 79%, was the *Ducati 916* (Figure 2, Design A), followed by the *Triumph Daytona 675* (Figure 2, Design H) with 76%. The two designs that evoked the least number of positive emotions were designs E and F (refer to Figure 2) with 46% and 58% respectively. Collectively the modern sportsbikes generated more positive emotions in the participants with an average of 90% positive emotions for each motorcycle design when compared to 80% of the older motorcycles.
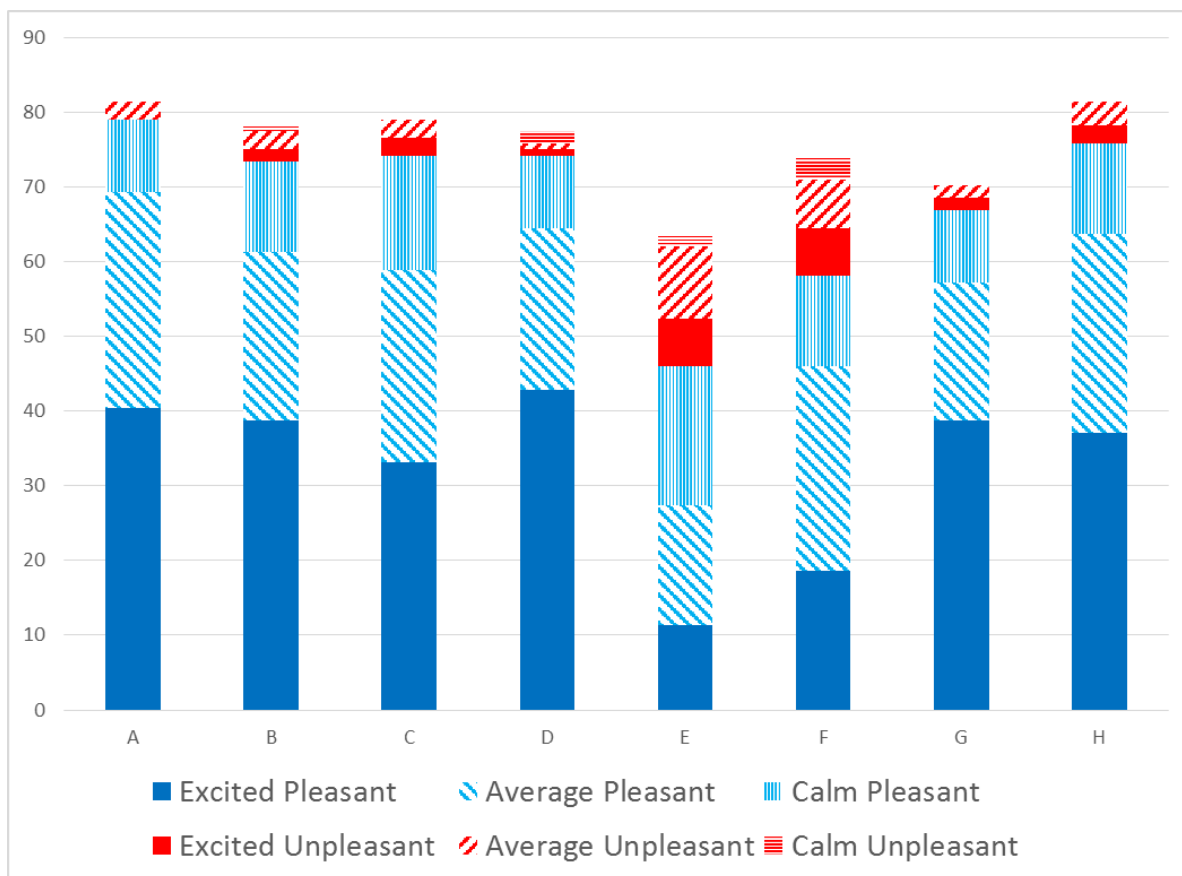
Figure 4. Pleasant and Unpleasant Emotions elicited by each sportsbike image

4.2 Analysing relationships in the data

For the data validation tests, the ANOVA method was used to compare multiple levels of independent variables together. Three independent ANOVA tests were carried out to examine the relationship between the:

1. Age and the emotions elicited by each sportsbike design
2. Preferred style of motorcycle and the rating given to each design
3. Preferred style of motorcycle and the emotions elicited by each design

A two-Factor ANOVA test with replication was carried out for all of the datasets. This type of ANOVA test compares the variance in two groups of data. All the hypotheses were tested at a 95% confidence level, meaning that for the null hypothesis to be rejected the p-value value must be less than 0.05. In each of the ANOVA tests there were eight columns, each representing a sportsbike design from A to H. For the first and last test, the values in the columns were the emotions experienced by each participant when looking at that particular sportsbike design (in the form of numbers 1-8, based on the Emocards depicted in Figure 3b). For the second test the values in the columns represented the Likert scale rating (1-5) given by each participant to that particular motorcycle design. The rows represented the response for each participant (1 row per participant), thus the variances which are the most important for this study are those between the rows. The participants (rows) were divided into two groups for each test. For the first test they are divided by age groups (youngest 50 and oldest 50 participants) and for the other two tests they were divided by motorcycle style preference (based on the classification shown in Figure 1). A summary of the ANOVA tests mentioned in this section is shown in Table 1.

For the first test, the youngest and oldest 50 participants were chosen, with the aim to investigate if there are any differences in the emotions experienced when people from these two groups look at the sportsbike designs. The null hypothesis was '*There is no difference in the emotions elicited by the sportsbikes between the youngest and oldest 50 participants'*. The null hypothesis was rejected (p < 0.05). This shows that there is a difference in the emotions that the two groups experienced. When looking at the results of this ANOVA test is was also evident that there was a significant difference in the emotions elicited by each sportsbike design individually (p << 0.05) e.g. the emotions elicited by design A (Ducati 916) are very different to those of design C (Yamaha YZF-R1).

As mentioned earlier, the participants were asked to choose their preferred style of motorcycle (e.g. Sportsbike, Tourer/Adventure, Dirt bike etc.) as shown in Figure 1. This question was used to analyse if there is any significant variation in the emotions experienced by participants with different motorcycle style preferences. From 124 responses, 72 chose sportsbikes as their preferred motorcycle style, with the second most popular choice being tourer/adventure bikes, with 18 choosing the latter. For each of these two tests (2 and 3), 18 responses were randomly selected by the software from the sportsbike group, to be compared to the tourer/adventure bike responses. The null hypothesis for test 2 was: *'There is no difference between the preferred choice of motorcycle style and the Likert scale rating given to each sportsbike design'*. This hypothesis was accepted (p > 0.05), which means that there was no significant difference in the way that each sportsbike was rated (on Likert scale) from the two groups (touring/adventure bike vs. sportsbike) of people with different motorcycle preferences. There was however, a difference (p << 0) in the way they rated each sportsbike individually e.g. Ratings given to design B were different from those given to design E.

For the final test, the emotions elicited by the sportsbike designs were compared to the two groups of motorcycle style choice. The null hypothesis tested was *'There is no difference between the preferred choice of motorcycle style and the emotions elicited by the sportsbikes'*. The null hypothesis was rejected (p << 0), hence implying that the emotions elicited in each group were significantly diverse. Each individual sportsbike design elicited different emotions as there was a variance between the columns (p < 0.05).

Table 1. Summary of the ANOVA results

	Source of Variation	p-value
Test 1	Age (rows)	0.0006
	Emotions (columns)	0.0000
Test 2	Motorcycle Preference (rows)	0.7240
	Emotions (columns)	0.0000
Test 3	Motorcycle Preference (rows)	0.0000
	Emotions (columns)	0.0267

5 DISCUSSION

To get the best possible feedback for the study, the questionnaire was directly targeted towards motorcycle riders and enthusiasts, as it was shared in closed motorcycle groups on social media. By involving these typical end users, other than people who are not familiar with motorcycles, a more accurate result was obtained. As a consequence of the large sample size and broad age range, the way that people of different ages rate old and new sportsbikes could be analysed.

A spin-off analysis was carried out to see what percentage of participants preferred the older motorcycle designs compared to the new models. After rating all the motorcycle designs, the participants were asked to choose the design that they like most. From the *below-average-age* group it was expected that the majority prefer the newer motorcycle designs, and in fact from this group 80% (47/59) preferred the more modern sportsbike designs. An interesting outcome was that when looking at the respondents which were from the *above-average-age* group, the results were much closer, with 43% (28/65) saying that they prefer the more modern sportsbikes. When comparing the two groups together, the first group (*below-average-age*) showed a larger difference in the choice with a difference of 60% separating the preferences, as opposed to a 14% difference in the second group (*above-average-age*). This shows that the majority of the participants, 60.5% (75/124) prefer the modern sportsbike designs. This data can be seen represented in the chart depicted in Figure 5, where the results are split into two groups; *below-average-age* and *above-average-age*. The vertical axis shows the frequency of people and the sportsbikes are classified in two groups; *Old* and *New*, for the older and newer models respectively. After viewing and rating the eight motorcycle designs, the participants were presented with a small image of each sportsbike design and were asked to choose the one they like the most. To eliminate any bias, the images were automatically shuffled by the questionnaire application. The sportsbike which participants liked the most was the *Ducati Panigale* (Figure 2, Design D). An ANOVA test was also carried out and the null hypothesis that there no difference in the way that the youngest and oldest 50 rate the sportsbikes, was accepted (p > 0.05). Four respondents commented that their choice of

sportsbike design was based on emotional attachment to the particular model, not because it looks especially better than the others.
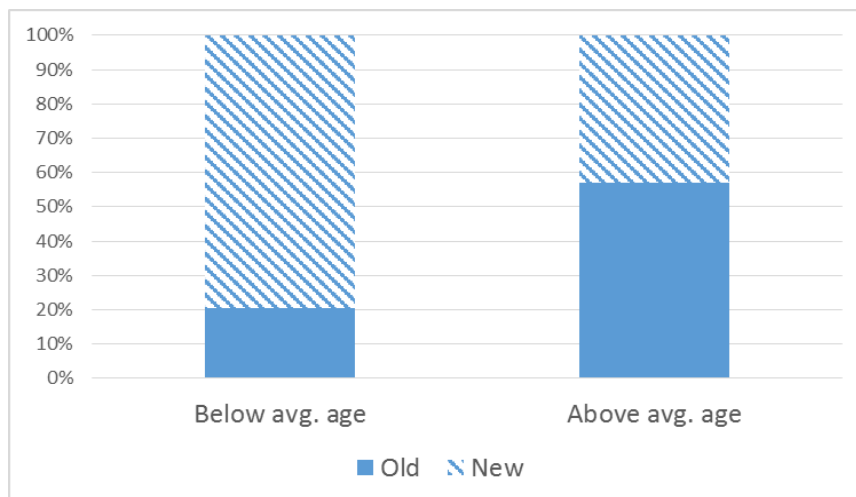

Figure 5. Preferred choice of old and new sportsbikes

The participants that took part in the questionnaire came from various parts of the world: Europe, Asia, Australasia, North America, and Africa; thus giving a wider perception on what emotions do sportsbikes elicit in people of different ethnicities and origins.

From the results of the ANOVA tests described in this paper, it was noted that there was no significant variances in the Likert scale ratings. Hence implying that the way in which people rate a sportsbike is very personal and not something that is dependent on age or motorcycle style preference. A variance was present between the ratings given to each sportsbike design individually.

A noticeable result was that the emotions evoked by the sportsbikes was different for the two groups of people (both of different ages and different motorcycle style preferences). In the ANOVA test 1 there was a clear variance between the emotions elicited in the younger and older groups of people. Although the participants rated the sportsbikes with no significant variances, the emotions elicited by the sportsbikes were relatively different depending from which group the participants came from. The positive emotions elicited for the *Ducati 916* could be attributed to a number of reasons. It has been around for over twenty years. When this model was introduced in 1994 it was the start of a new superbike era which revolutionised the sportsbike world, and remains an icon till this day amongst motorcycle enthusiasts. In test 1, the *below-average-age* group marked as experiencing different emotions than the *above-average-age* group when looking at the same designs. Test 3 gave a similar result, this time when analysing the preferred choice of motorcycle style and the emotions elicited by the sportsbike designs. This suggests that when appraising a sportsbike, people who prefer a motorcycle style other than that of a sportsbike, would experience a different emotional response to those who would choose the latter.

When analysing the data no correlation could be found between the respondent's personalities and rating given to the designs or the emotions elicited by the images. Although the consulting psychologists admitted it would be difficult to find a link between a set of personality traits and emotions evoked by sportsbikes; it will be interesting to examine this issue in further detail as all of the participants are motorcycle enthusiasts.

A possible weakness in this study lies in the fact that the free online application used to create the questionnaire does not have a function to lock the questions (Likert scale and emotion scale) to an image (sportsbike design). This issue restricted the images to be presented only in one order, and could not be shuffled randomly.

6 CONCLUSION

From this study, it is concluded that sportsbikes, both old and new, generate positive emotions in people who like motorcycles. From the ANOVA tests it was very clear that the emotions experienced by the participants showed relevant variances from one group to another. The sportsbike designs elicited different emotions in the young and old age groups, with notable variances in the emotion scale rating in the two groups. Another conclusion which can be drawn is that the majority of the participants

preferred the newer sportsbikes, although the motorcycle (Ducati 916) which elicited the most positive emotions (collectively) resulted from the older sportsbike group.

This study also revealed that people with different motorcycle style preferences (e.g. those who prefer a sportsbike and those who prefer a touring/adventure bike) experienced different emotions when looking at the sportsbike designs. This suggests that the use context of the motorcycle potentially affects the emotional response of the person. The perception of a sportsbike would differ between a person who selects a dirt bike and another who selects a sportsbike as the preferred motorcycle style.

Another conclusion is that this study had contributed a step towards the formulation of a set of guidelines which can be implemented in a Knowledge Intensive Computer Aided Design (KI-CAD) system. Such a system can proactively guide motorcycle designers to take a user-centred design approach.

There are several areas of future work with regard to motorcycles and sportsbikes that can stem out from this research, some include: analysis of the emotions elicited from different motorcycle brands (e.g. Europe and Japan); analysis of the emotions experienced by people of different origins and cultures when looking at sportsbike designs.

REFERENCES

Brown, R. (2003), *Ultimate History of Fast Bikes*, Parragon, Bath, UK.

Burnap, A., Arbor, A. and Gonzalez, R. (2015), "Balancing Design Freedom and Brand Recognition in the Evolution of Brand Character", *Idetc/Cie 2015*, Vol. 2, e9 doi:, pp. 1–12.

Desmet, P., Hekkert, P. and Jacobs, J. (2000), "When a car makes you smile: Development and application of an instrument to measure product emotions", *Advances in Consumer Research*, Vol. 27 No. 1, pp. 111–117.

Desmet, P., Overbeeke, K. and Tax, S. (2001), "Designing products with added emotional value: development and application of an approach for research through design", *The Design Journal*, Vol. 4 No. April, pp. 32–47.

Desmet, P.M. a. and Hekkert, P. (2007), "Framework of Product Experience", *International Journal of Design*, Vol. 1 No. 1, pp. 57–66.

Farrugia, P.J., Borg, J.C. and Pollacco, K. (2013), "Exploiting Logarithmic Aesthetic Curves for Proactively Providing 'Design for Emotions' Guidance", IASDR, Tokyo, pp. 1884–1895.

Hashim, A.M. (2015), "The Application of Experimental Aesthetics in Social Psychology to Marketing Research in the Motorcycle Industry", *Advances in Psychology and Psychological Trends*, No. December, pp. 30–39.

Hu, T., Zhao, J. and Zhao, D. (2013), "A Study On The Semantic Gap Between Designer And User In Automobile Design", *Consilence and Innovation in Design - IASDR*, Tokyo, pp. 526–533.

Lan, Y. and Wong, J. (2013), "To explore the negotiation between designers and users through", *Consilence and Innovation in Design - IASDR*, Tokyo, pp. 483–493.

Pan, Y., Burnap, A., Liu, Y., Lee, H., Gonzalez, R. and Papalambros, P.Y. (2016), "A Quantitative Model For Identifying Regions Of Design Visual Attraction And Application To Automobile Styling", *International Design Conference - Design 2016*, Dubrovnik - Croatia, pp. 2157–2166.

Perez Mata, M., Pérez Mata, M., Ahmed-Kristensen, S. and Yanagisawa, H. (2013), "Perception of aesthetics in consumer products", *Proceedings of the International Conference on Engineering Design, ICED*, Vol. 7 DS75-07, Seoul.

Pugliese, M.J. and Cagan, J. (2002), "Capturing a rebel: modeling the Harley-Davidson brand through a motorcycle shape grammar", *Research in Engineering Design*.

Scherer, K.R. (2005), "What are emotions? And how can they be measured?", *Social Science Information*, Sage Publications, Vol. 44 No. 4, pp. 695–729.

Schütte, S. and Eklund, J. (2010), "Rating Scales in Kansei Engineering - modifications for an European context", *International Conference on Kansei Engineering and Emotion Research KEER2010*.

ACKNOWLEDGMENTS