Shapes Applicable in Design of Contemporary Vehicles: Differences in Emotional Impact and Applications

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II. PRELIMINARIES

Abstract—In this study, a connection is considered between vehicles shapes and emotions. Some investigations are presented in order to apply the methods and techniques of measuring the emotional power of selected shapes and specify the reasons of differences in emotional reactions elicited by one and the same shape. The obtained results can support designers in manipulating the emotional impact of the contemporary vehicles, and they are applicable in training of new designers.

Index Terms—Emotional impact of shapes of contemporary vehicles, differences, training of new designers.

I. INTRODUCTION

In recent years there has been a growing interest in the general area of design and emotions [1-6]. The study of the emotional influence of products' design is known to be an important problem in the design theory and practice. Also, significant progress in studying methods for measuring the emotional impact of products has been made during the past decades. See [2] and the references therein. Recently, the emotional influence of the contemporary vehicle design becomes an active research subject. The knowledge about the intensity of this influence becomes a valuable factor in the automotive design practice and in the engineering in general. But, relatively few works are concerned to the emotional influence of a particular design characteristic used in the contemporary vehicle design independent of the brand recognition, which is very important in theories and applications and also is a very challenging problem. In the work [7] the shape of contemporary vehicles is considered as a specific vehicle's feature that can provokes emotions. A selection of main shapes used in vehicles design is introduced. The selected shapes are used to estimate the emotional power of form-formation in contemporary vehicles design. The obtained results provided empirical evidence on the correlation between emotional experiences and shapes of contemporary vehicles and shows that the emotional impact can be a major shaping factor. However, the results received for some shapes seem contradictory. In this paper, the reasons for these contradictions are explored further in a discussion with future designers. Applicability of the obtained results in training of new designers, and in the real design practice will be also discussed.

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Stamov Trayan Ganev, Department of Machine Elements and Non-Metallic Constructions, Technical University of Sofia, Sofia, Bulgaria. In this section the conceptual base for our study, as well as, some experimental results for the emotional impact of main shapes used in contemporary vehicles design will be presented [7]. Plastic display of the building blocks of a vehicle is a universal characteristic, the main reason for certain emotional responses. The form-formation is basic for plastic display elements and structures, combinations of density, color, outlines, light and side effects. In order to evoke determined emotional responses, the design process must comply with the main form-formation principles, categories, properties and tools, which a designer has to learn, master and apply creative. In the process of designing he personally creates a link between the creative knowledge about compositions of shapes and form-formation and the knowledge of their emotional impact. Without such a creative symbiosis the work of a designer becomes a routine. The process of shaping in the real world have attracted the attention of researchers for a long time. Since ancient times, there exist many theories that explain how to use a limited number of basic forms in that process. Also, patterns of nature are intensively used in the development of future technologies. Number of established engineers and designers of vehicles draw inspiration for their innovative ideas and models from the rich world of animals and plants (Fig. 1)



Fig. 1. Frame of "Mercedes-Benz Aesthetics" resembling whale fin

Using many existing theories [8-11] we introduced in [7] the following set of five main shapes used in the contemporary vehicles design:

A. First Main Shape

The main characteristic of this shape is its even rounding, the "non-directional" shape. On the plane the main element used in this shape is represented as a dot or as a circle spot. In the space the sphere is used as a main basic symbolic form. According to [11] this is the shape from which all others arise.





Fig. 2. Using of the First Main Shape in the vehicles design

B. Second Main Shape

This shape is mainly used in the design of vehicles having a characteristic length greater of the total formulation. The main property of the shape is in its contrast, which is characterized by the opposition of "strongly oriented" and "weakly oriented" forms. One of the main rules in a plane representation is that all axes must have one and the same direction.



Fig. 3. Using of the Second Main Shape in the vehicles design

C. Third Main Shape

The shape is characterized by domination of right angles in the plastic design. In the form formation of a vehicle a cube and a parallelepiped are mainly used. Two opposite directions are determined in the plastic display.



Fig. 4. Using of the Third Main Shape in the vehicles design

D. Fourth Main Shape

The main plane body applied in the plane design for this shape is a triangles. For the plastic design of forms from this category tetrahedrons are used.



Fig. 5. Using of the Fourth Main Shape in the vehicles design

E. Fifth Main Shape

This shape is characterized by numerous curved forms. The rounding in this new shape differs from the comprehensive evenly "without direction" rounding typical for the First Main Shape. Moreover, in the plastic design all forms of developments which can be visually perceived independently can be used. Note that there exist more shapes categories applied in the process of shaping in the material world such as "ambiguity" and "undetermined", but we will not consider them in our research related to the vehicles design.



Fig. 6. Using of the Fifth Main Shape in the vehicles design

Some images of vehicles in the design of which the selected shapes dominated are shown in Fig. 2-6. The selection of main shapes used in the modern vehicles provides the necessary tools for real creative design process and opportunities not only in design and traditional design culture, but also in new areas of knowledge where solving problems of the emotional impact of the appearance of products becomes a real prospect. In order to conduct our experimental studies and evaluate the emotional influence of the five selected shapes, the PrEmo (Product Emotion Instrument) introduced by Desmet [2] is used. The instrument consists of 14 emotions, applicable for products, the so called "product-emotions". The set of these 14 emotions contains 7 pleasant and 7 unpleasant "product-emotions", as follows: Pleasant emotions: Desire, Pleasant Surprise, Inspiration, Amusement, Admiration, Satisfaction and Fascination; Unpleasant emotions: Indignation, Contempt, Disgust, Unpleasant Surprise, Dissatisfaction, Disappointment and Boredom. For each of these emotions a corresponding pictogram (a face that portrays an emotional expression) is elaborated (Fig 7).





Fig. 7. Emotions measured by PrEmo-6 and their pictograms

Several experimental studies were conducted in [7]. It was concluded that the Fourth and Fifth Main shapes, evoked high intensively pleasant emotions, while the predominant use of the Third Main Shape in the vehicle design provokes mainly unpleasant emotions. The First and Second main shapes elicited mainly inspiration and fascination. At the same time and almost with the same intensity they caused the unpleasant emotion *boredom* and the pleasant emotion *pleasant surprise*. The Third Main Shape elicited with the highest intensity the emotions boredom, disappointment and dissatisfaction. Moreover, these shape caused also the pleasant emotion inspiration. These answers seem contradictory. The Third Main Shape is both irritable and amazing. It will be good if we find an answer to the question: "Why we received conflicting answers?" Furthermore, although the brand identity of selected vehicles is deleted, it is possible that some participants have recognized it and one preferred or non-preferred a brand, their responses may have been manipulated and therefore inaccurate. In order to specify the reasons for the contradictory answers our experimental study is supplemented with discussions held in a focus group of future designers. Their answer and comments are presented in the next Section.

III. DIFFERENCES IN THE EMOTIONAL IMPACT FOR VEHICLES SHAPES

Following Desmet (2002), to accurately measure the magnitudes of impacts for each of the evaluated emotion, the differences in average scores received were calculated for each pair of shapes. The results of the test are given in Table

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1. Each column in this table represents a pair of estimated shapes. The value in each entry is the difference between the main scores for the shapes in each pair (for example, the main score for contempt for the First Main Shape is by 0.2 higher than the main score of the same emotion for the Second Main Shape, and the main score for dissatisfaction for the Third Main Shape is by 0.55 higher than the main score of this emotion for the First Main Shape). The significant differences are in bold. The statistical analysis confirms the expectation for minor differences in the strength of emotional reactions received from the Fourth and Fifth main shapes, which shows that both shapes elicited similar emotions. Both of these main shapes have caused significantly larger number and more intensively developed pleasant emotions. It can be concluded that in the combined use of the Fourth and Fifth main shapes a strongly pleasant emotional impact on the subjects would be resulted. The emotions elicited by the First and Second main shapes are also similar. We will note only a significant difference in the intensity of boredom, for these two shapes. There are, significant differences between emotional responses received for the Third Main Shape and for all other shapes. Furthermore, noticed a significant difference in the pleasant emotions than unpleasant. Most noticeable differences are determined in the strength of the emotions evoked by the Third and Fourth main shapes, as well as by the Third and Fifth main shapes. The largest rank (1.39) has the difference between the scores for pleasant surprise received for the Third and Fifth main shapes. Also, significant differences are seen in the intensity of the received emotional reactions for the First and Fourth main shapes, and for the First and Fifth main shapes.

Fable 1. Differences in	the	average s	cores for the
emotional responces	for	each pair	of shapes.

Emotions	Comparison by pairs						
	(The average score of the first shape of the given pair minus the average score for the second shape of this pair)						
	1-2	1-3	1-4	1-5	2-3		
Indignation	0	-0.3	-0.05	0	-0.3		
Contempt	0.2	-0.07	0.2	0.11	-0.27		
Disgust	0	-0.07	0	-0.05	- 0 .07		
Unpleasant surprise	0.09	-0.11	0.05	0.09	-0.2		
Dissatisfaction	0.09	-0.55	0.13	0.09	-0.64		
Disappointment	0.04	-0.5	0.25	0.22	-0.54		
Boredom	0.41	-0.21	0.48	0.57	-0.62		
Desire	- 0 .06	0.53	-0.18	-0.34	0.59		
Pleasant surprise	-0.02	0.43	-0.68	-0.96	0.45		
Inspiration	0.23	0.66	0.05	-0.18	0.43		
Amusement	-0.09	0.52	-0.5	-0.7	0.61		
Admiration	-0.23	0.34	-0.71	-0.89	0.57		
Satisfaction	-0.06	0.1	-0.38	-0.52	0.16		
Fascination	0.11	0.6	-0.09	-0.46	0.59		



Fable 1. (Continued) Differences in the average scores for	r
the emotional responces for each pair of shapes.	

Emotions	Comparison by pairs (The average score of the first shape of the given pair minus the average score for the second shape of this pair)											
								2-4	2-5	3-4	3-5	4-5
								Indignation	-0.05	0	0.25	0.3
	Contempt	0	-0.09	0.27	0.18	-0.09						
Disgust	0	-0.05	0.07	0.02	-0.05							
Unpleasant surprise	-0.14	0	0.16	0.2	0.04							
Dissatisfaction	0.04	0	0.68	0.64	-0.04							
Disappointment	0.21	0.18	0.75	0.72	-0.03							
Boredom	0.07	0.16	0.69	0.78	0.09							
Desire	-0.12	-0.28	-0.71	-0.87	-0.16							
Pleasant surprise	-0.66	-0.94	-1.11	-1.39	-0.28							
Inspiration	-0.18	- <mark>0.4</mark> 1	-0.61	-0.84	-0.23							
Amusement	-0.41	-0.61	-1.02	-1.22	-0.2							
Admiration	-0.48	-0.66	-1.05	-1.23	-0.18							
Satisfaction	-0.32	-0.46	-0.48	-0.62	-0.14							
Fascination	-0.2	-0.57	-0.79	-1.16	-0.37							

The last difference is not expected, since the methods of forming and the plastic display for both shapes are similar. Different types of rounding are used in both shapes. Of course, the rounding in the Fifth Main Shape is covered differently than the comprehensive evenly "non-directional" rounding typical for the First Main Shape, which is the probable reason for the resulting differences in emotional responses to these two shapes. A discussion is organized in order to clarify the reasons for the received different emotional effects for one and the same shape. The main goals of the discussion are:

- 1. Clarification of the possible reasons for getting different emotional responses for one of the main shapes or set of shapes;
- 2. Examination of the opportunities to identify consequential prerequisites and conditions for inducing predefined emotions.

To be useful the results of experimental investigations in design practice, it is not enough to clarify what emotions are caused by the use of a shape in the design of contemporary vehicles. It is also necessary, the results to be applicable to the design of new vehicles. All participants were informed for the results of the experimental study (given in Section II). They were informed about the different emotional reactions mainly received for the use of the Third Main Shape. The results obtained and possible reasons have been commented. In a free discussion the following answers were received, which explained some of the reasons for observed differences in the emotional impact:

- The connection between the shape and the interest of the subject, who experiences the emotion;
- The purpose of the vehicle;

• Distinguishing brand manufacturer from the given shape;

• A subjective assessment of the usefulness of the vehicle.

At the end of the discussion, the following conclusions were made:

- 1. The relationship between the subject and the object of the emotional impact is essential in the measuring of emotions elicited by shapes of contemporary vehicles.
- 2. It is necessary to know the laws under which conditions are created to induce an emotion reaction. To be able to define predefined emotions, the designer must determine key variables, i.e. the interests of the subject, the purpose of the vehicle and assessment. In addition, the designer must understand how these variables can be combined to form consequential prerequisites to induce emotions.

IV. APPLICATIONS IN THE EDUCATIONAL PROCESS

The obtained results about the relation between emotions and contemporary vehicles shapes show that the emotional impact of products can be the crucial shaping factor. The conducted complex analysis of shapes through establishment of their emotional influence can be successfully used in the education process. More precisely, our results can be incorporated and applied in "Industrial and design projecting", "Design of machinery and electro-technical products and equipment", "Design of products for life", "Design of wheeled and non-wheeled vehicles" and "Design and manufacture of lighting equipment and systems" classes in Technical University of Sofia and other technical universities where product designers are trained. The above conclusion is also supported by the discussion in the group of the future designers. The general impression of all is that the development of original conceptual methodology for analysis and synthesis of seeking solutions with an emphasis on the emotional impact of products can be a solid basis for training aesthetic principles and criteria of morphology, of form-formation and shape composition. Note that the purpose of the discussed above disciplines are useful for the training of future professionals.

V. APPLICATIONS IN THE REAL DESIGN PRACTICE

The results of our study of the emotional impact of shapes, applicable in contemporary vehicles design can be a useful tool in the design practice. Despite of the fact that the task of defining simple design rules based on the relationships between the shape of a vehicle and emotional responses is filled with a number of difficulties, our results can support designers in their understanding of emotional aspects in the process of form-formation, or shaping. Every designer who is able to define regularities in emotionally evocative terms may use these laws to guide emotional response to products of its design activities.

VI. CONCLUSION

The emotional influence of shapes, applicable in contemporary vehicles design has been investigated. The reasons for eliciting of different emotional reactions for one and the same shape are discussed. The technique can be



Published By: Blue Eyes Intelligence Engineering & Sciences Publication Pvt. Ltd. applied in studying the emotional effect of shapes in the product design. The applicability of the obtained results in education and in the real design practice is also discussed.

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