

Automobile Design:
Approaches to understanding visual form

A thesis submitted in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

**in
Design**

by

Mohsen Jaafarnia



Department of Design

Indian Institute of Technology Guwahati

India

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Department of Design

Indian Institute of Technology Guwahati

India

2011

Certificate

This thesis presented here in titled '*Automobile Design: Approaches to understanding visual form*' by Mr. Mohsen Jaafarnia, was undertaken under my guidance and supervision. The volume of work presented here in for the Degree of Doctor of Philosophy of Indian Institute of Technology Guwahati was not submitted by him earlier for any other degree or diploma.

He has undergone the specified courses and fulfilled all the requirements as mentioned in the rules and regulations for submitting the thesis for the PhD degree of Indian Institute of Technology Guwahati.

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Acknowledgements

I will say thanks to my educators

At first to God who taught me every thing before birth

To my parents who taught me every thing after birth

To my teachers who taught me from school till now

To my books that taught me many things.



Abstract

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Today, body designs of vehicles such as personal cars differ from brand to brand. The challenges of globalization have led to situations wherein manufacturers are prone to introduce an already existing model into new markets, especially emerging ones in developing countries. When such new markets get crowded with competition, manufacturers start customizing the designs developed elsewhere, to suit local preferences. An understanding of visual form- an important aspect of design semantics is a critical factor for the designer to influence the user's aesthetic decision in the purchase of products. Human, animal and insect life forms in the creation of man-made product forms are increasingly inspiring designers. This research attempts to understand the processes and approaches to understanding visual form based on semantics framework of Ferdinand di Saussure. Considering the external form of the car as the focus of study, the research reports the results of the analysis of the users response to the emotion set for the front face and body of car's derived from five approaches viz. Repertory Grid Technique, Semantic Differential technique, Co-relation Technique, Relation Technique and technique of visual analysis of form. Based on the insights drawn from these studies it has attempted to derive a set of 'visual key' that corresponds to different emotional expressions that can help designers to derive expressive styles for cars. Attempt is made to validate the findings by generating concept drawings for a desired expression of car forms for two car manufacturers. Two approaches to generation of car form has been attempted: One method is based on drawing upon the graphical keys' derived from the experiments conducted as part of this research and the other is based on a bio-design method, that were used to semantically transfer common expressions to a car's face.

Such studies with respect to form preferences for automobile design offer diverse challenges. Factors include studies in form preference, cultural preference, economic influences, technology literacy, gender and regional preferences,

This thesis uses an empirical methodology involving user response to two-dimensional images. The data assimilated, based on a semantic framework, has attempted to outline a methodology for deriving 'visual keys' as guidelines for automobile designers to generate expressive forms for cars. It has evolved an approach that covers the wide domains of history of the evolution of car forms; visual approach for form analysis of car forms; and user response to car face based on a semantic framework.

The research work aims at understanding visual preference in the design of external form of cars amongst two targeted user groups (India and Iran). These objectives are met through:

- 1. Tracing and mapping factors that influenced the development of aesthetics in automobile form from a historical perspective.*
- 2. Understanding Design elements involved in the aesthetic preferences of car face and car body designs from amongst potential and existing car users.*
- 3. Identifying the design elements that contribute to the evoked feelings through analysis of visual form by professional designer.*
- 4. Modeling emotional profiles of users as evoked by existing car face designs.*
- 5. Studying the correlation between cultural background and aesthetic preferences for users from Iran and India.*
- 6. Derive relationship models from the above research.*

The instruments used for the study include:

- 1. Data collection through questionnaires and survey instruments (including on line web based survey) involving emotional and attitudinal scales from amongst users in Iran, India*
- 2. Data collection from existing design methods and tools employed for co-relating form with emotions and culture.*
- 3. Based on a Semantic framework, conducting analysis of car designs with photographic representations of existing cars using suitable measuring techniques/tools such as Repertory Grids Technique (RGT) etc.*
- 4. Deducing insights specific to each experiment and cross verifying underlying assumptions based on the data collected from user response through the on-line survey.*
- 5. Deriving the heuristics set of visual guidelines to co- relate elements of form, emotions and culture in the context of car design.*

The research study in this thesis is presented under the following chapter heads:

Chapter 1 introduces the subject of research, its aims and objectives and methods of conducting the Experiments for the research in brief.

Chapter 2 undertakes a literature review that surveys the various developments in understanding the act of design and aesthetics. It establishes the relation between the development of form and the influence of culture, emotional expression in the study of meaning and semantics. The relation between the different parameters helps establish an experiential framework based on which the methodologies and techniques suitable for this research have been examined and developed in the subsequent chapters.

Chapter 3 is on Research methodology. This chapter examines the different approaches / methodologies that would meet the overall aims and objectives of the research. Part 3.1 examines experiential data gathering techniques; Part 3.2 data collection methods and Part 3.3 reviews data gathering techniques and data analysis techniques from literature keeping in mind their suitability for gathering experiential data for a cross cultural setting. Considering the qualitative nature of the research, experiential data analysis and validation techniques have been chosen that meet the research objectives. This has helped to select an appropriate methodology for research based on a semantic framework. This forms the basis on which sets of experiments have been planned for experimental investigations.

Chapter 4 outlines the stages of planning the experimental work: planning the visual database; setting up the different empirical experiments and planning of the online survey for this research.

Chapter 5 of the thesis comprises the research experiments for this thesis. This is divided into three sections. Chapter 5, Section 1 - presents the framework on the basis of which the series of preliminary experimental work is conducted to seek user's response to the visual form of car face. Experiment 1a presents from a historical perspective (1885 onwards till date) the evolution of the overall form of the automobile, and attempted to map factors that influenced the development of aesthetics in automobile forms. This has further been examined in experiment 1b, searching more specifically, the evolution of automobile faces and a study of aesthetics in automobile faces between the same periods 1885 till date. And finally through an on-line survey, experiment 1c, seeks user response to the car forms and their aesthetic qualities to identify those visual elements (texture, color, form...) that are most suitable for transferring emotional value or emotional communication from product to user. Conclusions drawn from these preliminary enquiries seeking methods and materials form the basis for the main set of experiments seeking user emotional response to automobile form. This is outlined and conducted in section 2.

Chapters 5, Section 2 - The experiments in section 2 present the following:

- 1. The approach to creating the set of 'emotive words' shortlisted from users to identify ones that best express different human emotions.*
- 2. The approach to creating the visual data base and comprises of:*
 - The set of expressive images of the female set selected for the experiments and the set of bi-polar set of 'opposites' of these emotions created based on these facial expressions.*
 - A set of animal faces similarly shortlisted and created to form the set of bi-polar emotive expressions.*
 - A set of 35 car faces shortlisted for the experiments based on consultation with three professional car designers who were asked to judge the set of images that better express the emotional expression. The formation of the 7 sub-groups of car forms selected for the online survey.*
- 3. An online questionnaire using pictorial representations drawn from the above visual data base and general queries including the profile of the user.*

Based on analysis and inferences from the above Experiments conclusions have been drawn and summarized for each experiment. The techniques for analysis is based on a semantic framework drawn from user response to visual form of front face of car seeking answers to the following aspects of the automobile form:

- *Identification of the visual elements that influence car designing.*
- *Identification of geometrical proportion, golden ratio through analysis of visual form by professional designer.*
- *Study of User's response to the selected car design categories.*
- *Making a comparative analysis of human face and animal face that inspire semantic expressions on automobile face using RGT technique based on Bio-design principles.*
- *Making a comparative analysis from respondents in Iran and India, of animal faces, human faces and car faces based on semantic differential technique.*
- *Comparative study of respondents views in Iran and India to car face design using Relation Technique.*

Chapter 5, Section 3 presents the attempt at validation of results by drawing cross relations between the different parameters derived as an outcome of the above experimental findings. The heuristic set of guidelines as a 'visual key' that designers could use as a tool in generations of concept drawings for cars is derived.

To validate the findings attempt made in applying the heuristic set and bio-design method drawn from insights concluded from the set of experiments is presented. Further these two approaches have been used to develop concept sketches for two competing car manufactures.

Chapter 6 Summary and Conclusion

The last section comprises of concluding remarks on the hypotheses assumed for this research and the confirmations / observations of the findings of research from the experiments conducted. Further scope for research is also suggested.

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Chapter 1

General Introduction

1.0 Introduction

Approaches to design are centered on users' needs. The quest for identifying and discovering the need can be the most important part of design research. Both physical and cognitive and cultural issues are involved in the identification of users' aspirations and needs. The physical parameters involve identification of materials and their processing for their transformation; economics of costs. On the other hand the cognitive parameters involve subjective considerations of the user such as cognition, memory, emotions, values etc. Dimensions such as the cultural needs, are seen to be changeable and subject to time-lapse. Developments in technology too are rapidly altering the nature of products in many industries. However there is an increasing gap between the rate of change of technology and the rate of change of cultural practices. Users are not changing their habits in the use of artifacts' to keep pace with the quick-changing technologies. Because of these considerations industries find problem in terms of market competition and strategy building. The increasing intensity of competition in global markets is a challenge faced by companies operating in international markets and global design considerations need to be constantly monitored. Such an approach of 'glocal' customization being followed so far, apparently are an afterthought. It is not likely to hold good in the near future, as consumers have become demanding amongst these maturing markets.

The threat of competition from companies in countries such as India, China, Malaysia, and Brazil is on the rise, as their own domestic markets are opening up to foreign competition, stimulating greater awareness of international market opportunities and of the need to be internationally competitive. Companies that previously focused on global design are now targeting cultural needs to meet new sources of competition. In the recent past in India, several models of cars from Europe and US did not find acceptance in the local markets and on the contrary users welcomed its own indigenously designed cars – the best example being the *TATA Indigo*. This has led the larger companies to work with

industrial designers. However a well-designed product on its own is a recipe for success when competing against other more developed nations. The designer, it seems, must understand the importance of creating form that makes inclusive emotional considerations and cover cultural needs of local markets.

If automotive and product designers need to start with customization based on local culture and technology practices - they would require precise inputs regarding users tastes and preferences when the product is specifically being targeted to a niche local market. Data collected through marketing research gives market information on size and trends of consumer's demands. There is very little emphasis on gathering pre-launch requirements data involving the user's deepest emotional needs. Marketing data as presently collected is difficult to interpret and convert into physical design for an Industrial designer. There is a need for modeling users' preferences and tastes in a format that is useful to designers and not just for marketing personnel.

There is a dearth of published literature in this area on Industrial design / product design methodology which involves 'mental modeling' of the users taste, preferences, attitudes, beliefs. All these are culturally dependent and also to a very large extent influence technology such as production, engineering design, material selection etc.

1.1 Identification of the Problem

The elements of design of a car body namely form and its constituents such as volume, color, texture, shape, line, point and surface are manipulated by the designer in order to embed novelty, feelings, value and patriotic appeal aimed at satisfying users' aspirations. Due to subjective nature of the visual quality and heuristic decision making, it is often difficult for a designer to compare the constituents of say two different designs that share similar visual characteristics in terms of user's mental models of expectations and desires. This difficulty gets magnified when manufacturers from a different nationality and culture try and introduce products to another culture. Even if they try to adopt modified designs, they seem to have limited appeal to the users.

A designer needs to collect user preferences, model them and then transform these into physical and visual properties. There is a lack of design methodology, tools and database for designers in countries that intend to become major automobile manufacturers instead

of relying on imports. A widely known model involving emotions research reported in literature and practiced in industry is the –*Kansei* model that originated in Japan. There are research papers reporting on emotional design issues but very few of them are at the level of useable generative models. At best they are analytical in their descriptions and approach.

Feelings and emotions that mould aesthetic tastes as well as help decide on choices are both individual as well as cultural. As groups, individuals share cultural similarity in their lifestyles.

However there are questions like the following that can reveal interesting answers useful to designers of vehicles.

- a) What factors are responsible for establishing the emotional relationship between a vehicle and its users?
- b) Which one of the visual elements (texture, color and form...) is the most suitable for transferring emotional value or emotional communication from product to user – given a vehicle like the car?
- c) Can a set of heuristics be developed using which Designers from a particular culture can incorporate the most relevant feelings and aspirations into the design of the car?
- d) Can such heuristics be used by designers from a different culture for designing for users of another culture/ nationality/ foreign market?
- e) Can a design method be developed using which Designers from a particular culture can incorporate the most relevant feelings and aspirations into the design of the car?
- f) Can such design method be also used by designers from a different culture for designing for users of another culture/ nationality/ foreign market?
- g) Can such heuristics set be also useful for designers engaged in designing for car manufacturers having a brand identity of their own?
- h) Can such design method be also useful for designers designing for car manufacturers with specific brand identity?
- i) Can a semantic framework be used for analysis where the meaning is derived from signified to sign? Can such a framework be used in interpreting and developing visual for a car?

j) Alternatively, can designers approach form-giving using a bio-design method to draw meaningful form from nature (as a signified) and use it in designing a product (as a sign)?

1.2 Hypotheses

- The act of designing must take into consideration a holistic perspective of all design parameters including cultural and emotional which are also specific to the 'region'.
- The acceptance of Product form is influenced by the culture in which it must exist.
- Designers in the conceptualization and generation of product forms can examine those visual parameters that are influenced by the regional/cultural/emotional considerations of the target user segment.
- There exists a cultural pattern of preference for certain 'visual forms' of automobiles in different cultural societies. User preferences for these visual forms of automobiles are dependent on multi-dimensional parameters that are interdependent and can be measured using different evaluative techniques.

Considering the external form of the car as the focus of study, this research study has set out to evolve a set of techniques that can adequately be used to analyze visual form of cars and measure user response to the external form of cars in two specific cultures – Iranian and Indian. Based on the insights drawn from these studies it aims to evolve a 'visual key' that corresponds to different emotional expressions that can help designers to derive expressive styles for cars.

Attempt will be made to validate the findings by generating concept drawings for a desired expression of car forms for two car manufacturers.

1.3 Aim and Objectives of the Study

The research work aims at understanding visual preference in the design of external form of cars amongst two targeted user groups (India and Iran).

Objectives are:

1. Tracing and mapping factors that influenced the development of aesthetics in automobile form from a historical perspective.
2. Understand Design elements involved in the aesthetic preferences of car face and car body designs from amongst potential and existing car users.
3. Identify the design elements that contribute to the evoked feelings through analysis of visual form by professional designer.
4. Modeling emotional profiles of users as evoked by existing car face designs.
5. Study if there is a correlation between cultural background and aesthetic preferences for a given set of users. In other words, how deeply, if at all, cultural values influence the choice of a cars' external visual appeal.
6. Derive relationship models from the above research so as to be of use to Industrial designers working in their respective country and/or for designers from other cultures who want to understand the mindset of the user in another country.
7. Study and measure degree of variances in understanding emotional expressions across two cultures.

The study concentrates on

1. Data collection through questionnaires and survey instruments (including on line web based survey) involving emotional and attitudinal scales from amongst users in Iran, India
2. Data collection on existing design methods and tools employed for co-relating form with emotions and culture.
3. Based on a Semantic framework, conduct analysis of car designs either with real cars or photographic representations of existing cars using suitable measuring techniques/tools such as Repertory Grids Technique (RGT) etc.
4. Deduce insights specific to each experiment and cross verify underlying assumptions based on the data collected from user response through on-line survey.
5. Verify one or two of the hypotheses through design simulation using scaled models.
6. Evolve a design method that aids a designer to co- relate elements of form, emotions and culture in the context of car design.

7. Come up with heuristics set of guidelines that aids a designer to co- relate elements of form, emotions and culture in the context of car design.

1.4 Thesis Layout

Chapter 1 (current chapter) of this thesis introduces the subject of research, its aims and objectives and methods of conducting the Experiments for the research in brief.

Chapter 2 of this thesis undertakes a literature review that surveys the various developments in understanding the act of design and aesthetics. It establishes the relation between the development of form and the influence of culture, emotional expression in the study of meaning and semantics. The relation between the different parameters helps establish an experiential framework based on which the methodologies and techniques suitable for this research have been examined and developed in the subsequent chapters.

Chapter 3 of this thesis is on Research methodology. This chapter examines the different approaches / methodologies that would meet the overall aims and objectives of the research. Part 3.1 examines experiential data gathering techniques; Part 3.2 data collection methods and Part 3.3 reviews data gathering techniques and data analysis techniques from literature keeping in mind their suitability for gathering experiential data for a cross cultural setting. Considering the qualitative nature of the research, experiential data analysis and validation techniques have been chosen that meet the research objectives. This has helped to select an appropriate methodology for research based on a semantic framework. This forms the basis on which sets of experiments have been planned for experimental investigations.

Chapter 4 of the thesis outlines the following stages of the experimental work that lead to the main contributions to this thesis: planning the visual database and setting up the different empirical experiments and conducting them through an online survey for this research.

Chapter 5 of the thesis comprises the research experiments for this thesis. This is divided into three sections.

Chapter 5, Section 1 -outlines the framework on the basis of which the series of preliminary experimental work is conducted to seek user's response to the visual form of car face. Experiment 1a has examined from a historical perspective (1885 onwards till date) the evolution of the overall form of the automobile, and attempted to map factors that influenced the development of aesthetics in automobile forms. This has further been examined in experiment 1b, searching more specifically, the evolution of automobile faces and a study of aesthetics in automobile faces between the same periods 1885 till date. And finally experiment 1c, through an on-line survey seeks responses from users to the car forms and their aesthetic qualities to identify those visual elements (texture, color, form ...) that are most suitable for transferring emotional value or emotional communication from product to user.

Conclusions drawn from these preliminary enquiries seeking methods and materials form the basis for the main set of experiments seeking user emotional response to automobile form. This is outlined and conducted in section 2.

Chapters 5, Section 2 - The experiments in section 2 have been planned in the following manner:

1. Initially sets of 'emotive words' are shortlisted from users to identify ones that best express different human emotions.
2. A visual data based has been created which comprises of
 - Visual expressions that best express the set of 'emotive words' through two sets of facial expressions that are photographically captured on two models – one female Indian young lady and another male Iranian youth.
 - The set of expressive images of the female set was selected for the experiments based on consultation with three professional car designers who were asked to judge the set of images that better express the emotional

expression. A bi-polar set of ‘opposites’ of these emotions is created based on these facial expressions.

- A set of animal faces is similarly shortlisted and created to form the set of bi-polar emotive expressions.
 - A set of 35 car faces is shortlisted for the experiments based on consultation with three professional car designers who were asked to judge the set of images that better express the emotional expression. These were grouped into 7 sub-groups.
3. A questionnaire is planned using pictorial representations drawn from the above visual data base and general queries including the profile of the user.¹

This constitutes the planning of the experiments for conducting the online survey seeking user response.

Analysis and Inferences from Experiments

Based on these set of experimental studies, conclusions have been drawn and summarized for each experiment. The techniques for analysis is based on a semantic framework drawn from user response to visual form of front face of car seeking answers to the following aspects of the automobile form:

- Identification of the visual elements that influence car designing.
- Identification of geometrical proportion, golden ratio through analysis of visual form by professional designer.
- Study of User’s response to the selected car design categories.
- Making a comparative analysis of human face and animal face that inspire semantic expressions on automobile face using RGT technique based on Bio-design principles.
- Making a comparative analysis from respondents in Iran and India, of animal faces, human faces and car faces based on semantic differential technique.
- Comparative study of respondents views in Iran and India to car face design using Relation Technique.

¹Reference: www.iraniandesign.com

Chapter 5, Section 3 - Validation of Results

Drawing cross relations between the different parameters derived as an outcome of the above experimental findings, a heuristic set of guidelines is developed as a 'visual key' that designers can use as a tool in generations of concept drawings for cars.

To validate the findings attempt has been made in applying the heuristic set and bio-design method drawn from insights concluded from the set of experiments. Further these two approaches have been used to develop concept sketches for two competing car manufactures.

Chapter 6 Summary and Conclusion

The last section comprises of concluding remarks on the hypotheses assumed for this research and the confirmations / observations of the findings of research from the experiments conducted. Further scope for research is also suggested.

1.5 Significance of the Study

Empirical studies with respect to form preferences for automobile design offer diverse challenges. Factors could include studies in form preference, cultural preference, economic influences, technology literacy, gender and regional preferences,

This thesis uses an empirical methodology involving user response to two-dimensional images. The data assimilated based on a semantic framework has attempted to outline a methodology for deriving 'visual keys' as guidelines for automobile designers to generate expressive forms for cars. It has evolved an approach that covers the wide domains of history of the evolution of car forms; gestalts approach for form analysis of car forms; and user response to car face based on a semantic framework of analysis.

Visual studies of this comprehensive nature are few and far in between, particularly in the context of automobile design studies.

It could form a significant knowledge base for designers engaged in design of automobiles for different cultural contexts.

Chapter 2

Literature survey

2.0 Introduction

Design thinking leading to a body of design theory has evolved over the last five decades. The major trends in Design, spread across the decades for the period 1950 up to 1990's, is summarized in the diagram (Fig. 2.1). It highlights the changes in Design thinking influenced by values in society. The period of the 50's and 60's was an era of Modern Design with a focus on design for mass manufacturing resulting in a trend in machine aesthetics in which the focus was on 'form follows function'.

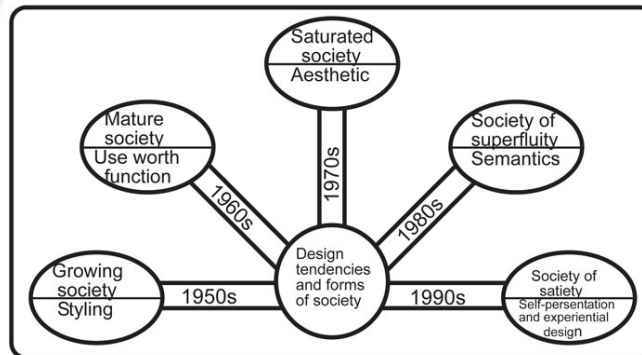


Figure 2.1: Product development

Between 70s' and into the early 90's has been a period, dictated by consumption, leading to a market driven economy. It has resulted into a saturated society of plenty where design was market driven resulting in a trend in which 'form follows function' was considered a 'bore'. Design thinking was influenced by new directions and developments in the domain of linguistics and social sciences. 'Postmodern' thinking and theories in Semiotics and De-construction influenced and resulted in Product Semantics. Form of the product was expected to communicate its functions. Designers pursued trends where 'form followed emotions'. In the present era of information technology exciting new possibilities driven by technology has resulted in the current trend of 'design as experience' in which technology is the driver but issues of cognition, emotions and experiences are significantly playing a major role. Products are no longer dominated only

by the sense of vision and perception but are getting to make inclusive contributions of the sense of touch, smell, and sound in equal measure.

Hauffe (1998) mentions that products produced and used at the same time during the century gone by were carriers of a large segment of cultural history of the 20th century. On the other hand, Sparke (2002) draws the relationship between design and culture and points to the many twists and turns that have been witnessed during the last century, in which design has been 'both the mirror as well as an agent of change in twentieth-century culture'. In a significant departure, trends in product design today have shifted towards a focus on design as experience. Mowen and Minor (2008) suggests that although we assume that consumers will prefer to buy a product with an added emotional value, even mood increasingly has an effect on decision-making.

This chapter, through a review of published literature, seeks to give an overview of the different streams of developments in design thinking with respect to visual form studies. In this process it aims to make observations and establish an experiential framework that will help to understand the complex parameters involving semantics and meaning; design and emotions; cultural factors on the one hand and how they may be reflected on built objects such as a car, through its visual form. It hopes to establish how designers could possibly seek explanation to those visual elements (texture, color, form ...) that contribute in significant measure in transferring and communicating emotional value from product to user' in the design of a car; What factors contribute towards establishing the emotional relationship between a vehicle and its users; in identifying those portion of the car body that are best suited for expressing a desired meaning through form. Relevant literature is reviewed in the sections to follow and a framework for further experimental work outlined.

2.1 Visual language

It is said that speech and visual communication are parallel and often interdependent means, by which humans exchange information. Visual language communicates through visual elements. The elements of visual language include line, shape, color, form, motion,

texture, pattern, direction, orientation, scale, angle, space and proportion. An image - for example a car face, a diagram, a map or a painting- communicating an idea, helps people visualize their thinking. The designer constructs visual units in the form of lines and marks into meaningful shapes, structures or signs. In abstract art the qualities of line and shape, proportion and color; convey meaning directly without the use of words or pictorial representation. Wassily Kandinsky (1947) in *Point and Line to Plane* showed the self expressive quality of lines and marks. Referring to the dynamic nature of this exchange in art, Itten (1983) states that perception is a continuous judgment of scale and color relationships and not only a passive recording of all that is in front of the eyes. Referring to visual perception, Arnheim (1970) suggests that perception involves the process of making categories of forms to classify images and shapes in the world. Cherry (1968) makes an important observation that speech includes visuals and the term 'language' in relation to vision is an extension of its use to describe the perception, comprehension and production of visible signs.

2.1a Design as communication - framework for research

Crilly, Maurice and Clarkson outline in their article - '*Seeing things: consumer response to the visual domain in product design*' –outline a framework based on Shannon's model of communication theory.

The model is shown below:

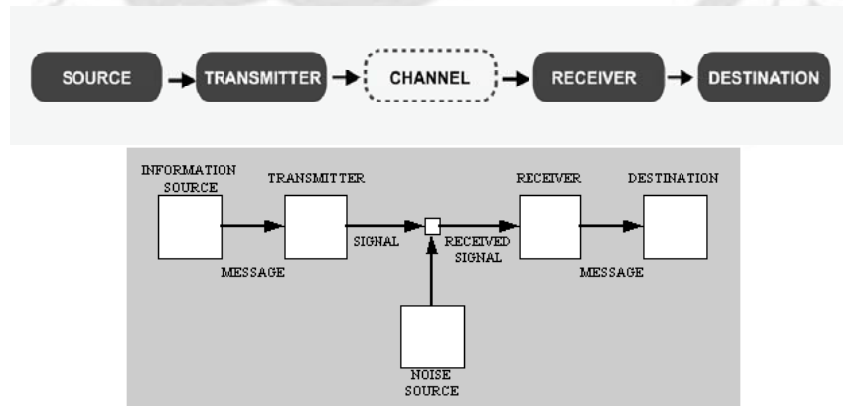


Figure 2.2: Shannon's (1948) Model of the communication process.

This has been extended and adapted by Mono (1997) in the context of Design.

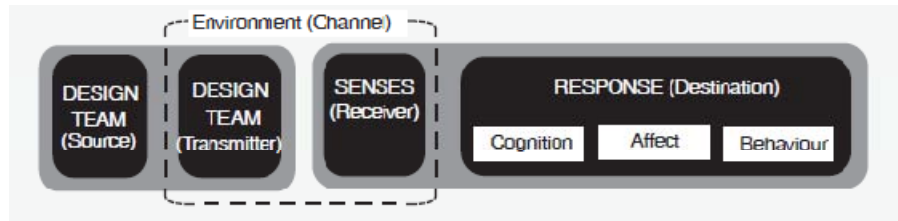


Figure 2.3: Basic framework for design as a process of communication

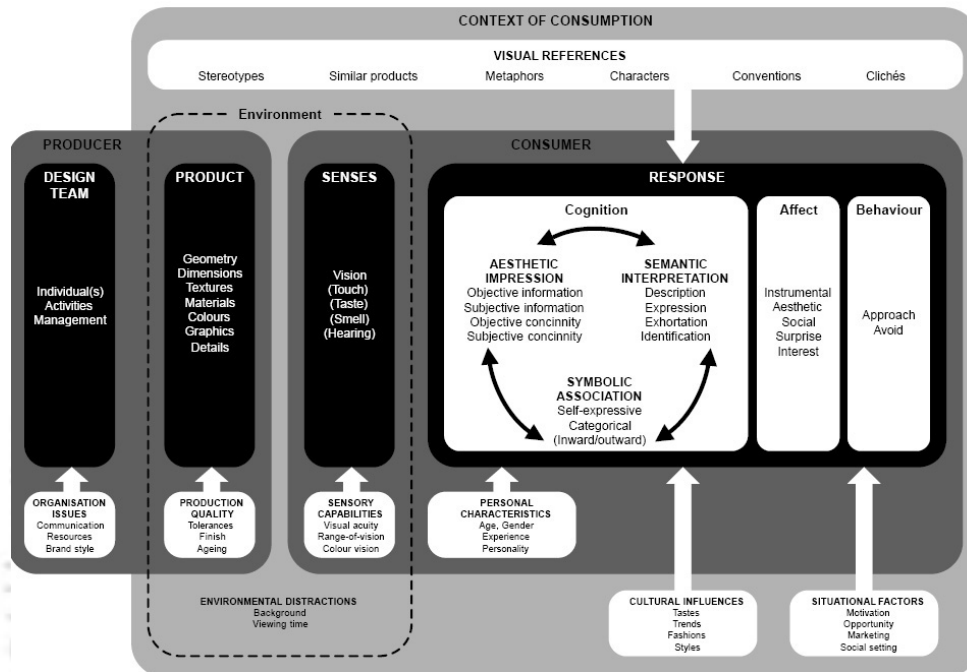


Figure 2.4: Framework for consumer response to the visual domain in product design

This comprehensive framework outlines the various parameters that can be examined in a car form which is the focus of this research. It entails both physical parameters and psychological parameters that come in the purview of the Designer in the creation of the product. These parameters have drawn the attention of design researchers over the last two decades. In the next sections developments in design studies in these domains are being outlined.

2.2 Design, Form and Sentiment

Designing is often a creative problem solving activity that considers the aesthetical aspects in addition to usefulness and tool making aspects (features). For instance, in the design and manufacture of a car, aesthetical features are as important a criterion as the

productive and efficiency aspects of the product. If we assume that the most important contribution of the product designer is one of 'form giving' than it becomes significantly important that for an understanding of aesthetics or the science of perception in general and visual perception in particular it would be necessary to engage in an understanding of:

a) Form Elements: Line, Plane, Volume, Texture, Pattern, Color and a study of the interrelationships of these elements in form.

b) Form Attributes: Measure, Balance, Rhythm and Harmony etc.

These become the building block and the vocabulary that a designer utilizes in creating form and communicating its attributes. Do the common reference to 'Aesthetics' and 'Expression' so commonly used to describe the visual attributes of a car form means the same?

Herbert Read (1972) clarifies the difference in the terms 'Aesthetics' and 'Expression' in the context of plastic arts. Read suggests that any theory of art begins with the supposition that man responds to

'...the shape and surface and mass of things present to his senses, and that certain arrangements in the proportion of the shape and surface and mass of things result in a pleasurable sensation, while the lack of such arrangements leads to indifference or even to positive discomfort and revulsion.

...beauty is the unity of formal relations among our sense-perceptions'.

Herbert Read (1972)

Read states that in art, man's aesthetic sensibility is static. What is variable is the understanding which man builds up from the abstraction of his sensible impressions, his intellectual life. And this, in his opinion, forms the variable element in art, that is to say, Expression. It may therefore be safe to assume that Expression denotes more a direct emotional reaction. Expression is therefore intuitive.

But if the role of the designer is one of creating 'product form', unlike the artist his creation is functional and utilitarian in nature. Every end user who finally uses these

products possesses artistic sensibilities which are shaped by a complex web of influencing factors as one responds to the 'visual' in the product forms.

Read states that the response to the 'visual', may happen in three stages: first, at the mere perception of material qualities – color, sound, gestures and many more complex and undefined physical reactions; second, at the arrangement of such perceptions into pleasing shapes and patterns. The aesthetic sense seems to end with these two processes. There may be, however, a third stage which comes when such an arrangement of perceptions is made to correspond with previously existing state of emotion or feeling. Then it is said that emotion or feeling is given an 'Expression'.

The sense of Expression is therefore derived from the earlier two inherent processes of sensuous perception and formal (pleasurable) arrangement (of products / product systems).

There are other references to aspect of the aesthetic in philosophy and the plastic arts which suggest of it being an engagement of a state of mind. Kant (1790) suggests that the aesthetic principle relies on emotion and not on senses. Sheppard (1996) in his book *Aesthetics, introduction to the philosophy of art* refers to Hume and Nietzsche who believe that 'Beauty is not the quality inside the material (thing) but in our mind and the emotion in which we look at those things'. Referring to the theory of imaginative expressionism Sheppard considers design as an attitude that reflects 'emotions along with internal tendencies and sentiments of the designer'. He states that in the final analysis, the designer presents his/her internal passion and mental form and puts this feeling, expression and internal passion in specific product design that he puts in front of the public.

Tolstoy (1898), also an exponent of the *Theory of Expressionism*, suggests all art as the reflection and contagion of emotion in which the artistic works play the role of a medium that communicates between the artist and the addresser. Tolstoy separates art from intellectual action and perception. He considers art as the expression of emotions and sentiments.

Adding to Tolstoy, Bendto Croche, another believer of the Theory of Expressionism suggests that art is the struggle of sentiments:

'...is not just the mental figure (imaginable) but the sentiment' (Croche 1922)

From the above deliberations one may summarize that if visual form of the product can contribute in generating an aesthetic impression in the minds of the end user than more than the material itself, the sentiments, passion and internal enthusiasm of the designer will be the primary attributes reflected in the product so designed. According to this theory, a designer will have to model his design in such a way so as to influence the emotions of the user in relation to their cultural background.

If in the ultimate analysis, the responsibility of the designer is one of 'form giving' (Bonsiepe 1989) and goal oriented problem solving activity, then the professional designer plays a very significant role in bridging the demands of art on the one hand and technology on the other in bringing about a marriage between the demands of these two streams.

The study and analysis of the 'aesthetic' elements in car form needs to be examined from the point of view of the designer creating the form and on the other by the manner in which the user responds to the 'visual' of the car form.

With reference to interaction between inanimate objects such as a car how does communication happen between the user and the product? If it does, than what role does human perception vis a vis the sense organs play? Can they be studied and can one measure such an influence.

2.3Senses, Perception and Design

Technology today is the driver in the creation of innovative new products. Digital technologies have influenced every domain of the current range of products of everyday use including transport vehicles which are today complex intelligent black boxes. It is increasing becoming important to examine the role of engaging the different senses in

product interaction and to study their contributions in enhancing the emotional experience for the end user.¹The user can exclusively receive their information with external senses from four main functions of product viz. aesthetic, physiologic, technical, and economic. (Jaafarnia and Bass 2011). These perceptions can lead to wide ranging emotions.

What are the key attributes of each of the different human senses? How can their understanding help in enhancing product experience? Below is a summary of the attributes of the five human senses.

Senses

The human senses and their operation, are being studied by a variety of fields, most notably neuroscience, cognitive psychology (or cognitive science), and philosophy of perception. It is a known fact that the senses are the physiological channels that provide inputs for perception. The nervous system has a specific sensory system or organ, dedicated to each sense (sight, hearing, smell, taste and touch) Fig. 2.5.

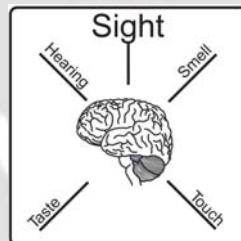


Figure 2.5: Five external senses

Sense of Sight has a predominant ability that often overrules other powers and brings in conviction (Lindstrom 2005). **Sight or vision** is the ability of the brain and eye to detect electromagnetic waves within the visible range (light), which is why people interpret image as 'sight'.

The skin is the largest organ of the body and its sensitive element makes us feel cold, heat, pain, or pressure. **Touching** an object creates the sentiment of possession. It is established that sales can be increased if customers are allowed to hold the products, which in return develops a bond with the product. Modern stores bank on this aspect and

¹BOLZ, N. 2000, The meaning of surface,
<http://www.doorsofperception.com/doors/doors1/transcripts/bolz/bolz2.html/> accessed in June 2000.

these days provide customers the forum to experience the emotional connect with products.

Smell is the strongest of the senses with a potency to evoke our emotions more than any other senses. There are more connections between the olfactory regions of the brain to the amygdale hippocampal complex (where emotional memories are processed) than any of the other senses. Scent is instinctive which links the customer to their memories and emotions awaiting stimulation (Gobe 2001). Despite being exposed to thousands of different smells there is extremely limited vocabulary to identify them. Even the car industry has transformed every feature down to the very smell of the car into a production exercise. For example Singapore Airlines maintains the aroma in the cabin as consistent as the color scheme, which matches the makeup and uniforms worn by the hostesses.

In reference to marketing strategies in the near future, Lindstrom (2005) comments that appealing to all the senses would be the dominant strategy for all future marketing endeavors.

'Of all the senses, smell has the most power to get customers' attention and build long term relationships with products, according to a global...' Lindstrom (2005)

Taste and **Smell** are interrelated. However, one smells more flavors than one can taste. Smell is estimated to be 10,000 times more sensitive than taste, making taste the weakest of our five senses. The color, feel and the very peppiness of visual brand identities stimulate us and make us want to taste (Biricik 2006).

Car manufacturers now prioritize the smell of a new car, which creates a bond between the product and a new owner. For example in the case of Rolls-Royce the company has identified the smell in its model 'Silver Cloud' (1965) as a reference point, and the scent is reconstructed, identifying 800 separate elements. The aroma is now sprayed under the seats to re-create the scent of a classic "Roller." (Biricik 2006). Hirsch suggests that the

things people are nostalgic for are now more artificial and product-related than in the past.

'If a company can associate a mood state with a smell, it can transfer that happy feeling to the product.'

Though not accepted today as product identifier, increasing competition, it is suggested, can lead to a respectable position of the smell in products. In comparison the potency of vision falls short in garnering an emotional response, as scent has more to offer.

'Seventy-five percent of the emotions we generate on a daily basis are affected by smell,... Next to sight, it's the most important sense we have....'

Lindstroem (2005)

Therefore the scent must match logically with the product and its customers and justify its existence.

Sound also generate mood and emotions. Studies indicate that activities, such as listening to music, encourage the release of endorphins in the body, activating the very powerful pleasure centers of the brain. Body movement, gestures, mimicry and other body language does not create the same impression as the tone of voices which gives an idea as to how one feels and thinks. For example the ring tone of a Nokia mobile phone, makes one visualize connecting hands and the slogan 'connecting people' making one decipher the idea that the 'best communication tool is Nokia' (Heskett 2002).

2.4 Design semantics

In the field of Design, the study of design semantics has been a subject of design research for more than two decades now. Let us consider the design of a product such as a refrigerator or the design of a package for cold drinks. How does the designer communicate an attribute such as 'coldness' through the product / package? Similarly, it is seen that we tend to wear warm clothes even when it isn't cold. What makes us develop this false feeling of being cold? No doubt some signs of coldness are received

but our mind concocts the remaining illusion. It can be argued that human reflexes are emotion oriented. It is evident from these examples, that sometimes aesthetic valuation differs from reality and designers attempt to identify these signs for their desired utility in product design.

Product semantics was developed and introduced by Krippendorff and Butter (1984) and is defined as

'the study of symbolic qualities of man-made shapes, in the cognitive and social context of their use'.

Such a theoretical framework in Design has been strongly influenced and drawn from theoretical developments in the domain of linguistics and social sciences. Semiotics or Semiology is the study of cultural sign processes (Semiosis). Umberto Eco emphasizes that communication lies in every cultural phenomenon. Semiotic theories take signs as their object of study: the communication of information in living organisms falls under the purview of bio-semiotics.

Semiotics branches out into

Syntactic: Relations among signs in formal structures

Semantics: Relation between signs and the things they refer; their meaning

Pragmatics: Relation between signs and the effects they have on the people using them.

Syntactic is the part of semiotics that deals with the properties of signs and symbols. It deals with the rules that govern how words are pooled to form, phrases and sentences.

Semantics is the study of meaning. It concentrates on the relationship between signifiers (words, phrases, sound), signs (symbols, design, form) and signified (original sources) and what they signify.

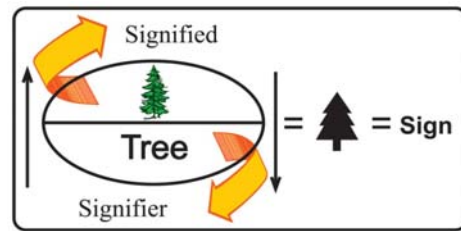


Figure 2.6: Signifier and signified

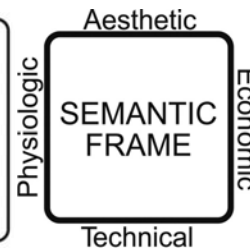


Figure 2.7: Quadrangle of semantics

Charles Morris adds that Semantics deals ‘with the entire psychological, biological, and sociological phenomenon occurring within the purview of signs’. It therefore includes a variety of fields, such as linguistic semantics, general semantics and design semantics.

Linguistic semantics is the study of meaning that is used by writing or reading to express a concept through language. It refers to the interpretation of signs or symbols as used by agents or communities under various contexts. Sounds, facial expressions, body language, proxemics with their relevant branches of study, too have semantic (meaningful) content (Neurath et al. 1955).

Semantics contrasts with syntax, which denotes the study of the relationships between the symbols, their meaning, and its users (Kitcher and Salmon 1989). The signified is the idea, the meaning, the thing indicated by the signifier. It need not be a 'real object' but is some referent to which the signifier refers. Ideas are shared through signifiers. The signifier is more established while the signified varies between masses and contexts. The signified become constant with habit, as the signifier indicates thoughts and images. And the signifier is the pointing finger, the word, the sound-image fairly unlike the word.

However, this linguistic model when applied in the Design context occurs in a different framework - one of them is design semantics (Chaturvedi 1997).

Wikstrom (1996) opines that the semantic function provides scope to the designer to communicate a clear message through the product. This means that the designer has to be definite as to what should and should not be communicated through the product. The semantic functions should make the product comprehensible. Both the whole products and its individual parts should deliver the intended message, so that the user can decipher its usability and applicability. Citing examples of door knobs or electrical buttons,

Norman (2004) enquires through design can the form communicate to says ‘turn me’ and ‘press me’ respectively.

Semantic design also involves various disciplines, such as art, ergonomics, semiotics, communication, logic, philosophy, and psychology. When product semantics is appropriately applied, products can become more emotionally and psychologically contented for users, with persuasive and expressive shapes or details, building emotional connections with otherwise unfriendly objects. These become intuitive products where the user knows how it works and what it does without instructions (Green and Jordan 2002, Mc Donagh et al. 2004).

Products generally have a special identity bound in a semantic frame. This frame contains four functions (aesthetic, physiologic, technical and economic) forming a quadrangle (Fig. 2.7). Every side of the square is linked to the other. A small alteration in one of the sides can affect the other sides both positively or negatively. Changing one or more of the sides consequently lead to new emotional expression. A product’s semantic frame has numerous emotional expressions; some are fairly weak while others are strong (Jaafarnia and Bass 2011).

A product communicates, about itself and also at times about the individual who owns it. Through its design and function, the product expresses values, the individual then interprets its significance, relating to certain societal norms of acceptance or rejection, liking or disliking. However, the product can, through its semantic content and expression, either strengthen or weaken this role, creating positive or negative perceptions, emotions, values and associations within the individual person (Wikstrom 1996).



Figure 2.8: Mercedes Benz (C63 Class)¹: Painted steel with maroon color (top and left) Gold plated steel.

¹<http://www.dragtimes.com/Mercedes-Benz-C63-AMG-Timeslip-17161.html>
<http://thepirata.com/gold-plated-mercedes-benz-c63/> accessed in December 2009.

In Fig. 2.8, both the Mercedes Benz have the same design and model number (C63 Class) but the designer has changed the semantic frame and emotional expressions for each car. The original material for the body was painted steel, but the redesign was gold-plated. We can see the effect on the four sides of the semantic frame as follows:

Aesthetic: Changing the material from painted steel to gold-plated steel had a positive effect on the aesthetic of the car. The color, luster of the metal and reflectivity was enhanced by the gold material, which also reinforced the concept of speed better than that of the painted steel. Some modifications were made to the frame to accommodate the precious golden metal. The golden color also eliminates the ‘depression’ expression predominantly found in the maroon color of the painted steel.

Technical: Changing the coating had negative effects on the technical side. In production, gold-plating requires special methods not ordinarily used in conventional body production.

Physiologic: The gold's reflectivity had a positive effect in terms of safety. The gold car worked as a mirror at night. Its surface reflected other cars’ lights and was easily visible in traffic or on the road. So other drivers develop relaxed emotion because of visibility apparently missing in the maroon color.

Economic: The economic side weakened because of the gold's value. Due to the cost of the gold, the final price shot up. This led to different emotional expression for people in different economic levels.

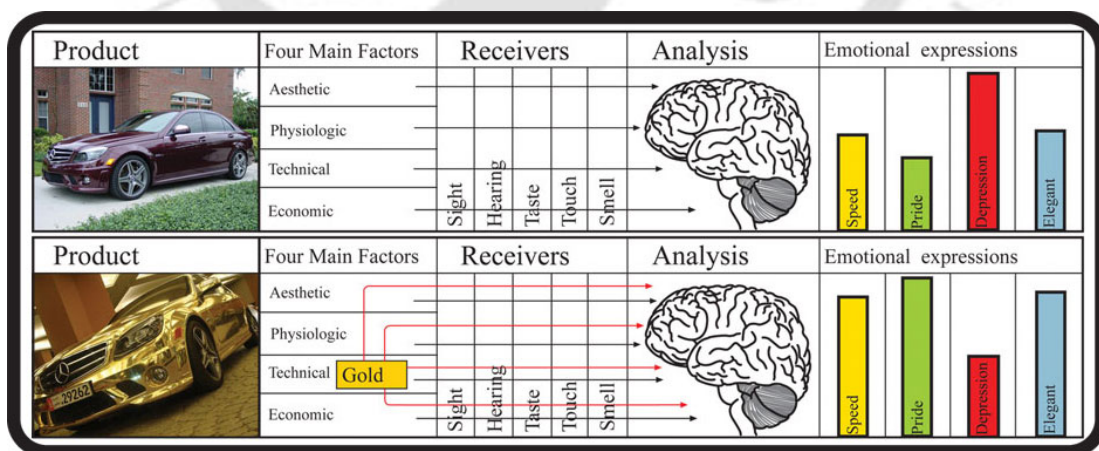


Figure 2.9: Emotional expression in Cars, Mercedes Benz (C63 Class) Emotional expressions of body with painted steel (top) Emotional expressions of body with gold plated steel (bottom).

Changing the coating on the car affected all the sides of the semantic frame. It changed the visual aesthetic of the car and created an impact on the physiologic, technical, and economic angles of the frame. The new frame created a totally new emotional expression for the consumer (Jaafarnia and Bass 2011). (Fig. 2.9)

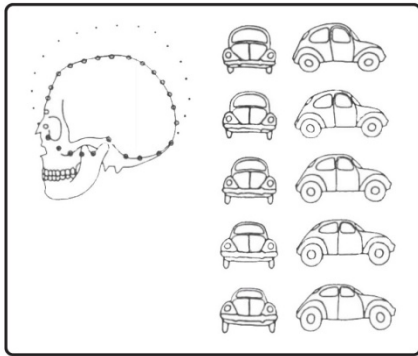


Figure 2.10: Drawings show how changes in proportions can age a car (Papanek 1995).

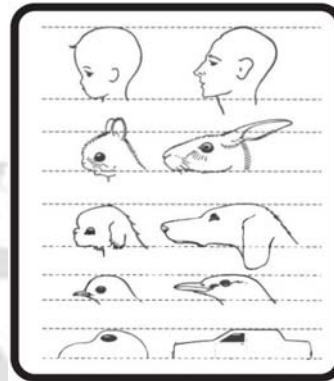


Figure 2.11: Baby features and 'cuteness' factor in living beings and objects (Papanek 1995).

Papanek (1995) discusses a case where the visual element is enhanced by transforming the curve alone elaborating on how such an element can change the entire perception. Variations in proportions and curves contribute to the visually perceived 'age' of products (Fig. 2.10). 'Cuteness' when categorized is connected to the overwhelming feeling of 'happiness' and 'security' (Fig. 2.11), often used in product design. With this one can decipher as to how a line can change 'age' and 'cuteness' in car designs. And the gestalt rules of perception can be used in the analysis of all types of visual images (Baxter 1995).

2.5 Design and Emotions

The subject of Emotional Design has explored Semantics and perception in the development of consumer products since the early 1980s. However, in the recent past efforts have been made to understand people and learn both the physical and psychological aspects of design, which is also believed to create meaning. In the design of eyewear, it is important to consider both the physiological parameters such as the basic ergonomic issues such as the fit and comfort, as well as the psychological aspects like the perception of the design by the user. The entire experience of wearing should be one of

'feel good'. At what point would eyewear frames be perceived to feel too tight or too loose? Formosa (2007) suggests that in practice, consideration of the physiological and the psychological are inseparable.

Griffin (1999) suggests that products are reflectors of meaning. The process of interpreting and decoding the unfamiliar products' meaning involves two different reactions. The first one based on knowledge, is dependent on communal and cultural surroundings and the second reaction on the emotional. Meaning is then interpreted based on associations derived from previous experience.

'..... Furthermore, emotions are closely related to human psychology. If we were to look at a simple psychological definition of these factors that activate emotions, we would see that emotions are not triggered by situations or events, but by our thoughts, beliefs, values and attitudes about the situations or events. The emotional response is not an automatic response to an object, a thing, or a situation. It is an automatic response to the thoughts that we have associated with the situation or the object'.(Demirbilek et al. 2001).

Griffin (1999) further splits knowledge (thoughts, beliefs, values, mood and attitudes) and emotions into two different categories of reactions, which are closely related and are inseparable. Piaget (1990) states that people learn through their experiences and culture, which start early in childhood, is an ongoing process. Demirbilek et al. (2003) highlights how thoughts can be susceptible to change and the response or reaction to a meaning reflected by a product could vary depending on social class, educational level, religion, etc.

These developments highlight the importance of studying form and emotion and their contributions in a search for meaning in the generation of product form. Cultural parameters can influence meaning. Designers can factor in cultural consideration that may help to interpret design elements. Design semantics can draw from cultural factors as they form a dominant consideration of emotional expressions.

2.6 Designing for action and emotion

With reference to human emotions, Visser (2006) opines that emotions are conscious thoughts reflecting complex interaction of mind and body. Human behavior revolves around emotions and sometimes these emotions spring from reactions to different human actions.

However the response of humans to man-made artifacts' such as a product can invite a response of various emotions including disappointment, attraction, shame, pride, disgust, contempt, admiration, satisfaction, fear, and anger amongst others. Prinz (2007) states that to declare an act as morally good is expressing strong emotions towards it. Similarly, products may also incite users' emotion in variations (Desmet et al. 2003). Desmet (2003) further states that people react differently to products; while some get inspired others get disappointed. Frijda (1986) on the other hand mentions that emotions become instrumental as they establish ones position in relation to ones immediate environment. Desmet (2002) uses this vision to draw up a broad model of 'product emotions' that sets forth three major parameters: (1) Appraisal, (2) Concern, and (3) Product. These three parameters, lead to whether a product elicits any particular emotion (Fig. 2.12). Wakefield and Baker (1998) suggest this as a primary reason for some products being chosen over another by people. Adding to this Norman (1998) believes that pleasant looking things work better. Drawing from these various literature sources Forty (1995) summarizes that in the last fifty years the main function of design has been to make things beautiful.

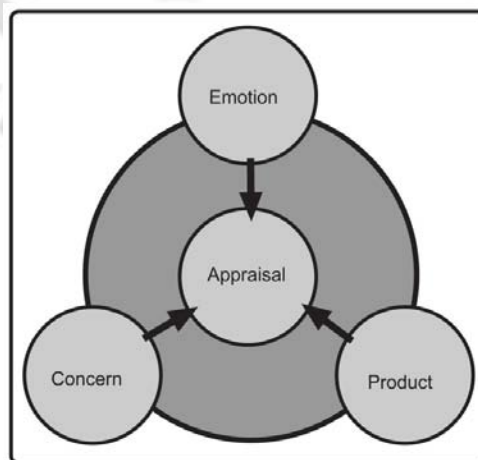


Figure 2.12: The basic model of product emotions (source: Desmet 2002).

2.7 Facial expressions and emotions

In the earlier section we have noted the subtle difference in the terms ‘aesthetic’ and ‘expression’ in reference to the plastic arts as suggested by Read. We have also explored how communication processes involved the creation of meaning in product form, can result in generating emotional response in the user.

In this section we examine studies undertaken in the domain of facial expression and emotion and to explore if these findings can be superimposed on products as an approach in the analysis and generation of new product forms.

Whenever we look at the face of another human, most of the time we try to interpret the meaning, which provides an excellent condition of communication. (Kirst-Ashman 1976) in Russell and Miguel (1997)

Joseph Campos, student at the University of California at Berkeley, in his doctoral thesis suggests:

‘Indeed, there is profound agreement that the face, along with the voice, body posture and hand gestures, forecast to outside observers what people will do next.’

He however, also says:

‘The face is a component [of emotion],” and “to make it the center of study of the human being experiencing an emotion is like saying the only thing you need to study in a car is the transmission. Not that the transmission is unimportant, but it's only part of an entire system.’

The exhaustive study undertaken by Izard (1997) is an important reference in the study of facial expression and emotions. From his studies he opines that a social relationship is based on shared thoughts and feelings (which are verbally communicated) along with emotion signals which is nonverbal and is purely based on facial expression. Therefore he states that the information in verbal, non verbal and symbols appears to be a natural part of social interactions and relationship.

Facial expressions are motions of the muscles reflected on the skin, which can change the form of eyes, lips, eyebrow, nose, color etc. Bell (1806) and Duchenne (1862,1990) believe that facial expressions are God-given language created for the expression of emotion. Izard (1971) concurs with this idea and states that emotion at one level is the neuromuscular activity of the face. Russell and Miguel (1997) refer to Darwin who believed that expressions were related to “states of mind” and facial expressions are associated with emotions (Izard 1997 and Knutson 1996). These movements express the feeling of the human or animals to observers, because expressions are directly tied to their emotion and most of the time is involuntary. In some instances, human and animal faces often falsely express some emotions, even in normal state, because the physical proportions of eyes, lips, eyebrow, color and nose result in such an expression.

The face comprises of fixed elements – the eyes, nose lips etc. While these elements could be considered the fixed elements, it is the subtle changes in the facial muscles that lead to a whole gamut of expressions that convey different meaning – a twitch of the nose, a turn of the lips, raised eyebrow, a scowl on the face etc. Let us consider the parts of the human face and correlate their expression to human emotions.

Eyes: the outline of eye is flexible and the top part of that is controlled by eyelid. In most expressions eyelid covers the pupil, for example, it can act surprised, scared and happy by keeping it completely open and also the angle of gazing away from a steady vision may also vary the expression. For example, looking down does not generally refer to a craven expression but could also reveal guilt, shame or docility. While in order to express anger, mysteriousness and drowsiness some part of the pupil can be covered and sometimes also the cheek can change form of this outline in case of expression of disgust. Here in case of most expressions depending on the size of covering of pupil, eye through different forms can display different expressions.

Eyebrows: are thick lines and depending on their form and size between two eyebrows the expression becomes different. Eyebrows can have many forms such as straight, one arc, bend and also the combination of both; for example, frowning can mean distraction, dissatisfaction or confusion. Raising the eyebrows can convey uncertainty,

disbelief, amusement and exasperation (Lera and Garreta-Domingo 2007), surprise and sudden interest (Kirst-Ashman 1976).

Lips: they are two lines when the mouth is closed; straight lines reflect complacency or normalcy while compressed lips could mean fear, frustration or cluelessness (Lera and Garreta-Domingo 2007). It goes curve down, expressing sadness and curve up expressing smile. When the mouth is open with curve down it is an expression of fear, and in case of curve up it is an expression of happiness; when the mouth is open with upper lip curved down and lower lip curved up it can express extra happiness or a surprised feeling. However the case is opposite with upper lip curve up, lower lip curve down and visible teeth which expresses fear and cry.

Nose: this part has a positive form that comes out from face and whenever human has expression of disgust or accuracy it goes up.

Color: face has an ability of changing color and usually it can keep three colors, white expresses fear, yellow expresses weakness and red expresses anger, danger and shy.

These are important details of face and combination of them can express very accurate expression. Consider the following expressions:

Happy: Happy expression is common and easy to recognize, and is interpreted to show messages related to pleasure, enjoyment, a positive nature, and friendly. In this state human beings use eyes and lips to show happy expression. Happy expression is also shown by human beings even when one does not have any emotion. Some often keep it to hide other emotions and manipulate or trick other people.

Sad: Sad expression is interpreted as opposite of happy expression. Sad expression show messages related to loss, anxiety and pain. In this state human beings use eyes and lips to show sad expression. Sad expression is also shown by humans sometime to hide other emotions and manipulate or trick other people.

Anger: anger expression is interpreted as opposite of normal and relaxed expression. Anger expression show messages related to violence, fight and pain. In this state human use eyes, lips and red color to show anger expression.

Fear: Fear expression shows signal about impending danger. The particular objects, which show fear for any person, are varied. In this state human use eyes, lips and white color to show fear expression. The experience of fear has a real negative felt quality, and when the threat has been avoided or has passed, reduces, along with the bodily concomitants.

Disgust: Disgust expression is often showed as a commentary on events and people. Disgust expression is interpreted as opposite of like expression. Disgust expressions show messages related to dislike, hate and abhorrence. In this state human beings use eyes, lips and nose to show Disgust expression.

Surprise: Surprise expression shows messages about something being unexpected, sudden, novel, or amazing. Surprise is to be distinguished from startle as it is pretty different. In this state human use eyes and lips to show surprise expression.

Scientists have examined if human facial expressions are universal (Ekman 1972; Scherer and Wallbott 1994). Related to cultural differences Paul Ekman (1993) says:

‘When I began my study of facial expressions, I just had one question ‘are they universal or culture specific. I found more than one answer; different aspects of expression are both universal and culture specific.’

Conforming to this Russell (1994) also shares a similar opinion like Ekman. Their findings suggest that facial expressions of the viewers can be different depending on different cultures (Jack et al. 2009). Emotions like that of happiness are found similar between varying cultures hence it is easily identifiable by the viewers. Izard (1980) believes that the six fundamental emotions (happiness, sadness, anger, disgust, surprise, and fear) are universal, and since everybody is able to recognize these expressions, it is reasonable to conclude that these six fundamental emotions are genetically based or pre-programmed, but some expressions differ completely from one to another. For example expression of emoticons differ between Japan and the United States. This is to mean that people read facial signals differently, say for instance people in Japan focus on the eyes, but in USA people focus on the mouth (Yuki et al. 2007). This dissimilarity between the

expressions of face is not seen a lot in different cultures. Referring to Japanese people, Matsumoto (1992) finds that the reactions of Japanese people to negative emotions such as anger, disgust, fear and sadness are lesser than for Americans. However in terms of bodily expression dissimilarity is more apparent in different cultures.

Scientists think that facial expressions have a communicative function and express some internal feeling. Therefore in case of the face and non-verbal communication, new expression can be a result of changing visual pattern of face over time.

Can the findings of these studies form a basis in the generation of product form for effective communication of desired emotional responses towards products?

In this section through detailed study of facial expressions, both animal and human, we examine the scope for visual form generation and their application for design of manmade objects.

2.8 Product design and facial expressions

In the previous section a mention about the value of facial expression was made. Studies have been undertaken to examine emotional response to product forms. Desmet et al. (2000) in their paper: "*When a car makes you smile: development and application of an instrument to measure product emotion*", use facial expression as a measuring instrument to evaluate product form and users emotional response. In their research they have developed an instrument of measurement 'ProEmo' (product Emotion) which uses expressive cartoon characters as a tool to elicit users' response to 14 selected emotional response to a set of car forms under study. Front face of select sample cars were presented to users who were to pick and select the appropriate emotional expression from the 14 cartoon character images that best reflected their response to the product form. In the experiment while the expressions were related to front face of the cars, the user was to select one of the whole body cartoon characters. This researcher felt the approach debatable. Instead, it would have been logical to evaluate user response to product form,

which co-relates only the facial expression directly to the 'product face' of the car. In fact, Desmet et al. (2001) in a subsequent paper: "*Designing products with added emotional value; development and application of an approach for research through design*", seem to correct this as it is seen that they use 16 facial expressions in their experiment to map emotional responses of respondents to mobile telephones.

In another experiment, Jan R Landwehr et al. (2011) in their research "*It's Got the Look: The Effect of Friendly and Aggressive "Facial" Expressions on Product Liking and Sales*" examine, how people translate emotional 'facial' expressions from whole product shapes; they attempt to built visual features on cars and cellphones based on the perception of human faces. In their research paper they suggest that perception of friendliness can be expressed through the grille (mouth), while aggressiveness can be communicated with both the grille and the headlights (eyes). They have examined the combination of these two emotional expressions and found that consumers prefer a combination of an upturned (friendly) grille with slanted (aggressive) headlights. Drawing upon similar facial expressions, the experiment was further explored with cellphones. In this experiment too they were able to achieve distinct expressive qualities on the cellphone. They summarized that there is no relation between facial expression and product forms' expression even when the product does not have any part like human face.

This seems to point to the possibility that product forms can be as expressive without having to relate to the human face expression.

Based on the concept of facial expression, the model of semantic framework is being examined as a part of this research as related to the study of car forms. Here we can assume that:

- Real image of human or animals represents the signified.
- Visual configuration represents sign of characteristic.
- Term of expression represents the signifier.

2.9 Culture, Emotions and Product Form

People carry 'mental habits' which are developed in the family in early childhood, later reinforced in schools and organizations and these mental habits form a major component

of national culture. They are most obviously expressed in different values that predominate people from different countries. In some regions we can see similarities in national cultures. Here cultural consequences aim at being specific about the elements that are common in the two cultures (Hofstede 1984). The need for consideration of cultural diversity among users, designers and evaluators in the design process has been emphasized strongly in the recent past (Khaslavsky 1998; Marcus and Gould 2000; Hertzum and Jacobsen 2001, Nielsen 1990). The need for understanding and accommodating 'Culture' factor in design process has become important because of expansion of the global market. Often a designer comes from a specific culture while the users' belong to other cultures and cultures are not only geographically but also socially separated from each other. Also the designer's understanding of the user is likely to be influenced by the designer's culture. Researchers have reported differences in users and evaluators behaviors when they belong to different cultures. Researchers have observed that the differences in behaviors are specific to the culture they belong to (Yeo 1998, Yeo 2001, Clemmensen and Goyal 2005, Vatrapu and Pérez-Quñones 2006).

If one looks at the history of design (Fig. 2.1), one can see that culture has a powerful effect on products. Tracing a large segment of cultural history of the 20th century, Hauffe (1998) finds reflection of culture in the products produced and used during the same time. Sparke (2002) suggests that design was both a mirror as well as an agent of change during the last century.

How does one define a complex entity such as culture? How does one examine cultural parameters that influence developments in design?

The term Culture suggests a way of life or the method that people do their work and this evolves over time and is transmitted from one generation to the next. Kroeber and Kluckhohn (1952) state that Cultures vary according to places. It can be said to be a complex compilation of knowledge, beliefs, arts, roles, habits and every things that person take from the society. Alfred Kroeber and Clyde Kluckhohn (1952) in their book (Culture: A Critical Review of Concepts and Definition) suggest that culture is a complicated and multi faceted term comprising of three senses: viz.

- Excellence of taste in the fine arts and humanities, also recognized as high culture.
- An integrated pattern of human knowledge, belief, and behavior.
- The outlook, attitudes, values, goals, and practices shared by a society.

While Dr.Mohamd Moiin suggests that the word culture comes from Politeness, Knowledge and customs and should be studied through the practice of ‘art’ prevalent in ones society.

Gombrich (2005) states that ‘Art is the performance of voluntarily arranging items (often with symbolic significance) in a way that affects ones senses, emotions, and intellect or are created for a purpose of transmitting a meaning (semantics) or concept (signifier) to help, inform guide viewer in their life. It includes a variety of human activities, creations, and methods of expression, including music, literature, film, photography, sculpture, design, dance and paintings’.

Adding to the concept of culture, emotion and forms, Barnard (2001) writes on visual culture:

‘Visual culture in this sense is an inclusive conception. It makes possible the inclusion of all forms of art and design, as well as personal or body-related visual phenomena, under a single term. Thus, all kinds of fine art (painting, drawing and sculpture, for example), all kinds of design (graphic, interior, automotive and architectural design, for example), and things like facial expressions, fashion and tattooing may be included under the title of visual culture. Many of the volumes appearing are content to use visual culture in its weak sense.’

How can cultural parameters that influence values in a society be measured? Here it becomes important to look into Hofstede's dimensions of culture where he specifically identified five Dimensions as mentioned below to assist in differentiating cultures (Hofstede 2001 ,Hofstede and Hofstede 2005).

Power Distance Index (PDI):

This can be defined as that which the less powerful members of society accept and expect the power that is to be distributed unequally. It suggests that a society's level of inequality

is acceptable by the followers as much as by the leaders. This is detected by High Power Distance, which also identifies inequalities of power and wealth that exists inside the society and the less powerful members of the society accept this condition. It means in this kind of society, everyone has his/her rightful place in social levels (De Mooij 2010). On the contradictory, the rank of Low Power Distance shows equality between everyone in a society. For example if we look at the form and expression of table in offices in India we often find that the size and stature of the desk belonging to a high level person is bigger than his junior in terms of position which is a kind of expression of power.

Individualism (IDV):

Hofstede defined that individuals are integrated into groups. It means that the ties between individuals are loose in societies: everyone is expected to look after himself/herself and his/her immediate family. Here the rank of High Individualism shows that individuality and individual rights are paramount within the society. On the other hand, the rank of Low Individualism shows a more collectivist nature with close ties among its members in societies. This could find reflection in different elements of car designing, for example a person in the individualistic culture needs a form for his/her satisfaction but in the collectivistic culture people select cars with specific form and expression to communicate with others in the community and thereby bring out a sense of belongingness.

Communication is very important between parts in collectivistic cultures with an indirect style of communication. Therefore in the sales process of automobile, it is necessary to first build a relationship and trust between parties (De Mooij 2010), consistency between their attitudes, feelings and behavior is important in individualistic culture. Owing to this, the behavior of customers can be predicted from their attitudes towards car design, after that a purchase prediction is derived from a positive attitude, But in collectivistic cultures, the relationship does not need to have a consistence between attitude and behavior.

Also there is a reverse relationship between behavior and attitude in which the product usage (behavior) comes first and later defines the attitude (Chang and Chieng 2006).

Masculinity (MAS):

It focuses on the scale to which 'masculine' values like competitiveness and the acquisition of wealth are valued over 'feminine' values like modesty, tenderness, relationship building and quality of life. The rank of High Masculinity shows that society values like assertiveness and aggressiveness are 'masculine' traits. While rank of Low Masculinity, shows societies that have more of nurturing and caring 'feminine' traits.

In masculine societies, achievement of performance is important; and achievement must be demonstrated, therefore product such as automobile can be a good means to express one's success (De Mooij and Hofstede 2002 ,De Mooij 2010).

In masculine cultures, form goes to express values of assertion and aggression and in the feminine cultures, form goes to express values of tenderness.

Uncertainty Avoidance Index (UAI):

It focuses on the rank of tolerance for uncertainty and ambiguity inside the society. The extent to which a culture and its members feel either uncomfortable or comfortable in unstructured conditions finds expression here. The rank of High Uncertainty Avoidance shows the country has a low tolerance for uncertainty and ambiguity. On the other hand, the rank of Low Uncertainty Avoidance shows the country has less concern about ambiguity and uncertainty and has more tolerance for a diversity of opinions. This is reflected in a society that is less rule-oriented, more readily adaptable to change and susceptible to more and greater risks.

Here we can see differences in the agreement of innovations between people who are less open to change and innovation, in a state of high uncertainty avoidance than low uncertainty avoidance cultures. (Yaveroglu and Donthu 2002, Yeniurtand Townsend 2003, Tellis et al. 2003).

Long-Term Orientation (LTO) or Confucian dynamism:

The last dimension was found in another study comprising students of 23 countries, and was proposed by Michael Bond. It proposes a focus on the degree the society embraces,

or does not embrace, long-term devotion to traditional values. The rank of High Long-Term Orientation shows the country prescribes to the values of long-term commitments and respect for tradition where long-term rewards are expected as a result of today's hard work. While the rank of Low Long-Term Orientation shows the country does not reinforce the concept of a long-term, traditional orientation and people expect short-term rewards from their work. Both the positively and the negatively rated values of this dimension are found in the teachings of Confucius, the most influential Chinese philosopher who lived around 500 B.C. (Hofstede 2001).

The automobile industry operates under a multi-polar, multi-location context of manufacture and multi-cultural context of consumption. How does one approach design in such a global context? Manufactures factor in cultural condition while producing them. Can these cultural dimensions form the basis to examine preference patterns for car forms for two cultural societies? It requires a study of visual preferences amongst the identified target groups.

2.10 Design as communication - Outline for a framework for research

In this section factors that influence human response to the visual form has been reviewed. They include consideration involving visual elements and their inter-relations, human emotions and their response to the visual, product semantic that helps in creating and communicating meaning and finally cultural consideration that influence human response to product forms. A framework based on Shannon's model of communication theory proposed by Crilly, Maurice and Clarkson earlier in the chapter can be extremely useful for visual design analysis of cars which forms the focus of this research. This model forms the basis to outline a set of experiments for this research that aims to examine user response to the visual elements constituting the car form which trigger specific emotional response amongst a cross section of users in two geographically different locations.

Through the process of study of user response it aims to identify visual design elements (lines, planes, volume and texture and color) that point towards a set of 'visual keys' in generations of specific product expressions that trigger certain set of identified emotional

response amongst users. It will further attempt to use these 'visual keys' as a basis to generate new concept car forms that may result in emotional response amongst users to the desired identified expression.

The study objectives follow:

1. To trace factors that influenced the development of aesthetics in automobile form from a historical perspective.
2. To understand specific visual elements involved in the aesthetic preferences of car face and car body designs from amongst potential and existing car users.
3. Identify the elements that contribute to the evoked feelings through analysis of visual form by professional designers.
4. Modeling emotional profiles of users as evoked by existing car face designs.
5. To study correlation between cultural background and aesthetic preferences for a given set of users.
6. To derive relationship models from the above research so as to be of use to Industrial designers working in their respective country and/or for designers from other cultures who want to understand the mindset of the user in another country.
7. Finally to arrive at the degree of variances in understanding emotional expressions across two cultures.

In chapter3 we review the possible techniques for analysis for conducting the experiments proposed as above.

Chapter 3

Research Techniques and Methods

3.0 Introduction

In Chapter I, the basic area of investigation for the research was presented while in Chapter II, the experiential framework as pertinent to the study of the automobile form and pertinent literature was reviewed. It included developments in the study of design vis-a-vis senses and perception; meaning and semantics; emotion; cultural consideration. Through this review one could gain clear direction of the different parameters of car form that need to be examined in depth for the subsequent stage of the research to follow. It is evident that experiential research processes that engage in a study of visual form involve considerations that demand subjective evaluation and objective assessment. The methodology and techniques that are to be selected for the study needs a sensitive engagement of visual assessment; assessment by expert group and also appropriate data gathering techniques and statistical analyses techniques that are required to derive insights for experiential research.

In this chapter the appropriate methods and techniques, quantitative and qualitative, to help measure users' response to the visual and emotional aspects to an object are being examined. The ones that suitably meet the goals of the research process are appropriately selected for setting up experiments in the chapters to follow.

3.1 Introduction to experiential data gathering techniques

Keywords for research

Data Collection, Data Analyses, Visual form of automobile, Emotion, Expression, Semantics, User experience, User response, Form giving, Design, Designer, Form generation, cross cultural studies, qualitative methods, quantitative methods

Based on the aims of this research, both quantitative and qualitative research methodologies exist for gathering and analyzing users' data. The comparative chart gives the characteristics of Quantitative Methods vis a vis Qualitative Methods of data analyses.

Table 3.1: Properties of quantitative and qualitative methods

Quantitative Research Methods	Qualitative Research Methods
Relies exclusively on analysis of numerical or quantifiable data	Focuses on the meaning in the communication
The data is in form of numbers, which can be statistically analyzed	The qualitative data come in many form, including text and images having rich meaning in them
Focuses on doing thin slicing of a natural phenomena to be able to count the instances of it	Involves an in depth understanding of human behavior and the reason that govern human behavior
Aims to classify features, count them and construct statistical models in an attempt to explain what is observed	The aim is a complete, detailed description of the phenomena.
The quantitative research methodology demands that researchers should be clear about what they are looking for in the phenomena under observations, or in other words, the researchers should have a clear hypothesis before embarking on the research.	The qualitative research methodology allows a certain amount of fuzziness in what is being observed in the research process.
Quantitative research focuses on what, where, and when of research	Qualitative research relies on reasons behind various aspects of behavior. It investigates the why and how of decision-making.
Quantitative research needs large random samples, as categorization of data into patterns is the primary basis for organizing and reporting results	Qualitative research needs smaller but focused samples.
In quantitative research we should have big sample size. And sample size should be 3% in small society with less population and 5% in big society.	In qualitative research we do not need to have big sample size. (Guest et al. 2006), (Morse 1994), (Bernard 2000), (Creswell 1998), (Bertaux 1981) and (Charmaz 2006).

3.2 Data collection Methods

The purpose of this study is to assess users' emotional response to the different visual expression of the automobile form. Through this process understand how meaning is

perceived in the users mind; draw insights through such a study and subsequently identify those 'key' visual elements in the car form that contribute to the defined expression and can subsequently be utilized by the designer to generate new concepts for the automobile.

The different approaches of data collection necessarily imply

- Undertaking preliminary exercise in identifying and creating a visual data base of car forms with different expressive personalities.

- Subsequently taking this further to the users to assess their response to the car forms to verify and confirm if they match with the selected personality type from the visual data base earlier created.

- Based on cross verification, to identify those 'key' visual elements that match and form the basis for generating specific expressions to the automobile form.

To be able to meet these objectives necessarily imply that planning phase of the different experiments of the research will include method of Self assessment and Assessment by expert group for an identified set of automobile forms to the create the visual data base for the subsequent phase of study of user response.

The planning phase to create the visual data base through Self assessment and interaction with expert group is self explanatory. User assessment of visual response to the automobile forms could be undertaken by a combination of Online research methods, Direct observations, Picture documentation, Video documentation, Presence interviews, Presence questionnaire and On-Line questionnaire.

In the sections to follow below, combinations of these methods have been reviewed for the purpose of this research study.

3.2.1 Online research methods (ORMs)

The ways in which researchers collect data via the internet is referred to as Online research methods (ORMs). Most online research methods are related to existing research methodologies. Online questionnaires form a sub-set of a wider-range of online research methods. ORM offers the following advantages:

- a) It offers greater flexibility while displaying questions through the use of Check boxes, Pull down menus, Popup menus, Help screens and Graphics (Sharp et al. 2002).

- b) Quicker user response time (Bradburn et al 2004).

- c) Cheaper cost to administer as it reduces cost of purchasing paper or other materials for printing. Postal charges are also eliminated. ¹
- d) Shorter time for analysis of data since data is collected into a central database ²
- e) It is easier to correct errors on an online questionnaire, without requiring reprinting all the questionnaires for distribution (Sharp et al. 2002).
- f) ORM helps provide better quality data as it attract willing as opposed to reluctant participants.

ORM also have a few disadvantages viz.:

- a) Access to the Internet in some instances is limited and so is the response rate (Sharp et al 2002).
- b) Many people refrain from completing questionnaires online (Presser et al 2004).
- c) Studies indicate that responses to online questionnaire invitations are usually biased to younger people (Groves et al 2004).
- d) Response rates can frequently be low and can drop further due to over-surveying of web-users.

Design of the Questionnaire

The design of the Questionnaire involves the following considerations:

- Establish what is the data to be obtained. The Questionnaire quality is reflected in the value of the data obtained and participant satisfaction (Sharp et al 2002).
- The length, conciseness and question sequence are import considerations for retaining the quality (Couper et al 1998). Questionnaires should only be as long as they need to be (Bradburn et al 2004). Removing redundant and irrelevant questions benefit the researcher (Groves et al 2004).
- Finally, placing the questions in a logical sequence so as to fill the mental map for the respondents engaged in filling out the questionnaire (Bradburn et al 2004). Random movement between subjects in a non-intuitive sequence can confuse the participant (Sharp et al 2002).

¹ Online Questionnaire Design Guide, "Web Based Questionnaires"
http://lap.umd.edu/questionnaire_design/questionnaires.html/ accessed in March 2007

² StatPac, "Questionnaire Design - General Considerations"
<http://www.statpac.com/questionnaires/questionnaire-design.htm/> accessed in February 2007

Online Survey

Online survey can be developed in two ways by using professionally designed survey templates.

1. The Do-it-yourself method is preferred for people who are fairly competent with using HTML, PHP and MySQL or have easy access to someone who is competent and understands the design of the questionnaire. Being able to use the technology is not the only hurdle. The logic behind the questions and the extraction of analysis from questionnaire is essential.
2. Off the shelf tools and Google Documents¹ is usually recommended for most people. This is recommended for people who are not familiar with the above technology as they guide them to build a professional looking web based questionnaire.

3.3 Selection of experiential data gathering techniques

The following five data gathering technique already in practice in emotional and semantic research and other allied fields have been studied for purpose of selection for this investigation.

- Repertory Grid technique
- Semantic Differential technique
- Technique of analysis of visual form by professional designer
- Co-relation Technique
- Relation Technique

Here each technique is introduced in brief and the procedure for application is described.

3.3.1 Repertory Grid Technique

Repertory Grid Technique (RGT) methodology is usually applied in the areas of marketing business, artificial intelligence, education and human learning. Here it is proposed to be used in the field of product design². RGT is a method for eliciting

¹<https://www.google.com/accounts/ServiceLogin?service=writely&passive=1209600&continue=http://docs.google.com/?hl%3Den%26tab%3Dwo&followup=http://docs.google.com/?hl%3Den%26tab%3Dwo<mpl=homepage&hl=en/> accessed in March 2011

² Marleen van de Kerkhof, Repertory Grid Technique (RTG),

http://www.ivm.vu.nl/en/Images/PT4_tcm53-161509.pdf / accessed in February 2011

personal constructs. RGT is based on George Kelly's Personal Construct Theory (1955). According to the Personal Construct Psychology (PCP) people's view of objects interacted with, is made of related 'similarity–difference' dimension, which is referred to as personal constructs. Kelly argues that people make sense of the world through their own 'construing' of it and a 'construct' is a single dimension of meaning for a person allowing two phenomena to be seen as similar and thereby as different from a third (Bannister and Fransella 1986).

The advantage of the repertory grid technique (RGT) lies in the fact that it consent to the elicitation of observation without the researcher intervention or prejudice (Whyte and Bytheway 1996).

RGT's function lies on the ability of users to experience things, based on both emotionally-based constructs (warm-cold) and more 'rational' ones (professional-popular).

Repertory grid analyses use the following procedure:

Step 1 - Element elicitation: The designer needs to select a series of elements representative of a topic which could be either name or picture shown to participants.

Step 2- Construct elicitation: The next step is knowledge elicitation of personal constructs about these fundamentals basically to understand individual perception (understands/compares) of these fundamentals to determine constructs about elicited elements.

Step 3 – Rating: These constructs are reused for rating all the elements in a matrix (rating grid), usually on a simple five or seven point scale. A construct always has two poles, characteristic pairs with two opposites. These poles represent distinction and not necessary 'real oppositions', but both are expressed with same kind of 'Likert' level.

Step 4 – Analysis: Individual grids are analyzed with multivariate statistical procedures like the two-way cluster analysis or principal component analysis.¹

3.3.2 Semantic Differential Technique

The semantic differential (SD) is a method of examining and determining the psychological meaning of concepts (Kerlinger 1983). The references are used to derive

¹ http://edutechwiki.unige.ch/en/Repertory_grid_technique/ accessed in February 2011

the attitude towards the given object, event or concept. Semantic differential (SD), developed by Osgood, was designed to evaluate the suggestive meaning of ideas as points in what are called 'semantic space' (Kerlinger 1983, Osgood et al. 1957).

The bipolar adjective pairs are used in this technique. The scales or bipolar adjectives are seven point rating scales, the underlying nature of which has been determined empirically. That is, each scale measure one, sometimes two of the basic dimensions or factors viz.: Evaluation, Potency and Activity. These factors may be called clusters of adjectives. These three dimensions of affective meaning are found to be cross-cultural universals in a study of dozens of cultures.

Osgood and his colleagues have found that when analyzed, adjective pairs like good- bad, bitter-sweet, large-small and clean-dirty etc. fall into clusters. The most important cluster seems to consist of adjectives that are Evaluative - such as good-bad and pleasant-unpleasant etc. A subsequent group has adjectives that seem to share power or strength idea- Strong-weak and rugged-delicate are examples. A third significant feature is called Activity because its adjectives seem to articulate motion and action - Fast-slow and hot-cold are examples.

An actual Semantic Differential (SD) consists of a number of scales, each of which is a bipolar adjective pair, chosen from a large number of such scales for a particular research purpose, together with the concepts to be rated with the scales.

The Semantic Differential (SD) technique is one of the most widely used scales in the measurement of attitudes, primarily owing to the versatility of the items.

3.3.3 Technique of visual analysis of product form

An apt description for explaining Gestalt theory (Hothersall 2004) is the following -

'The whole is greater than the sum of the parts'

Gestalt psychology is a theory of mind and brain which propose that the operational principle of the brain is holistic, parallel, and analog, with self-organizing tendencies. It is based in the way we see things. It can be divided into two: figure or ground, at first view does one see the figure or the background? With respect to visual recognition it highlights the form-forming capability of minds ability to interpret figures and whole forms instead of compilation of simple lines and curves. This is called the Gestalt effect. Max

Wertheimer believes that the perceiving eye tends to bring together elements that look similar and will complete an incomplete form. An array of random dots tends to form relationship (Behrens 1998). The perception of a shape needs the understanding of the important structural features, to create a 'whole' or *gestalt*. All these natural abilities express how the eye and the mind are looking for pattern and simple shapes. Looking at more complex visual images (every artwork) will show that art has been a unbroken endeavor to "notate" visual order. Although Gestalt is criticized for being only explanatory, it forms the foundation of further research into the perception of patterns and objects and research into behavior, thinking, problem solving.

However there has also been criticism of Gestalts Theory. Bruce et al. (2003) make a critical comment on Gestalt theoretical influence on the study of visual perception:

'The physiological theory of the Gestaltists has fallen by the wayside, leaving us with a set of descriptive principles, but without a model of perceptual processing. Indeed, some of their "laws" of perceptual organization today sound vague and inadequate. What is meant by a "good" or "simple" shape, for example?'

Bruce et al. (2003)

In spite of the criticism, the gestalt laws of visual perception still forms an interesting basis for the purpose of visual analysis of form.

3.3.4 Co-Relation Technique

In brief, Correlation is a statistical technique used to measure the relation between two or more variables and to understand if they are related and if so how? The scale of measurements used is interval based in which co-relation coefficients range between -1 and +1. The value of -1.00 shows a perfect negative correlation and value of +1.00 shows a perfect positive correlation. A value of 0.00 shows a lack of correlation.¹

Amongst the different correlation techniques the most common type is the Pearson or Product-Moment correlation technique. Like all statistical techniques, co-relation

¹ <http://www.statsoft.com/textbook/basic-statistics/> accessed in May 2011

technique works for quantifiable data where numbers are meaningful. This technique is not used for categorical data, such as gender, brand purchased, or favorite color.

- Rating Scales

Rating scales are a middle case in which the numbers in the rating scale have meaning, but that meaning isn't precise. They are not exact quantities. For example a rating scale of 2 may not necessarily imply that it is mid way between 1 and 3 or a rating of 'good' cannot be assumed to be exactly half way between 'excellent' and 'fair'

Although the scales of measurement are relatively imprecise, many researchers continue to use co-relation technique with rating scales, because the result reflects the real world. Hence one can use co-relations with rating scales, but with care. While working with quantities, co-relations provide precise measurements. While working with rating scales, correlations provide general indications.¹

3.3.5 Relation Technique

This test is a statistical test, which measure the frequency of an answer. It is a form of assessment in which respondents are asked to select the best possible answers out of choices from a list. This kind of question is most frequently used in educational testing, in market research, and in elections, when a person chooses between multiple candidates or parties.

Relation technique consists of a stem and a set of options. The stem is the beginning part of the item that presents the item as a problem to be solved, a question asked of the respondent. The options are the possible answers that the researcher can choose from, with the correct answer and the incorrect answers (Kehoe 1995). Sometimes only one answer can be acceptable as correct. This contrasts with multiple response items in which more than one answer may be keyed as correct.

The advantage of Relation technique, on many assessments, reliability has been shown to improve with larger numbers of items on a test, and with good sampling (Downing 2004).

¹ <http://www.surveysystem.com/correlation.htm/> accessed in March 2011

Multiple choice tests are the strongest predictors of respondents' opinion compared to interviews

An important point is that relation technique is not qualitative technique and it is completely quantitative. Despite being a quantitative technique, this research uses the technique (in experiment 4) of morph (fuzzy logic) and makes it a qualitative technique.

3.3.6 Selection of techniques and methods followed for study

In this chapter the different techniques and methods of data analysis have been examined in a general manner so as to gain an overall understanding. The nature of enquiry of this research is developing an understanding of visual aspects of car forms with respect to parameters such as user's perception, cultural parameters affecting user's choice etc. Based on such an understanding attempt is made to generate a heuristic set of visual guidelines for designers to assist them in generation of a visual key for form generation of cars.

Considering the nature of aims and objectives set for this research, a qualitative approach has been adopted for the experimental phase of the research. The techniques and measurement instruments for data gathering and analyses that have been examined have been selected based on the strength and shortcomings of the methods considered in this chapter. Each of the different techniques examined in this section have been utilized in planning the set of experiments in the chapter to follow. The details of the experiments planned and conducted to study the different parameters pertaining to visual study of car forms in which these tools for data collection and measurement have been adopted is outlined in next chapters.

Chapter 4

Planning the Empirical Experiments

4.0 Introduction

In chapter 2 it was suggested how the model outlined by Crilly, Maurice and Clarkson (Nathan et al. 2004) could form the basis for planning experiments for this research. This framework is presented below:

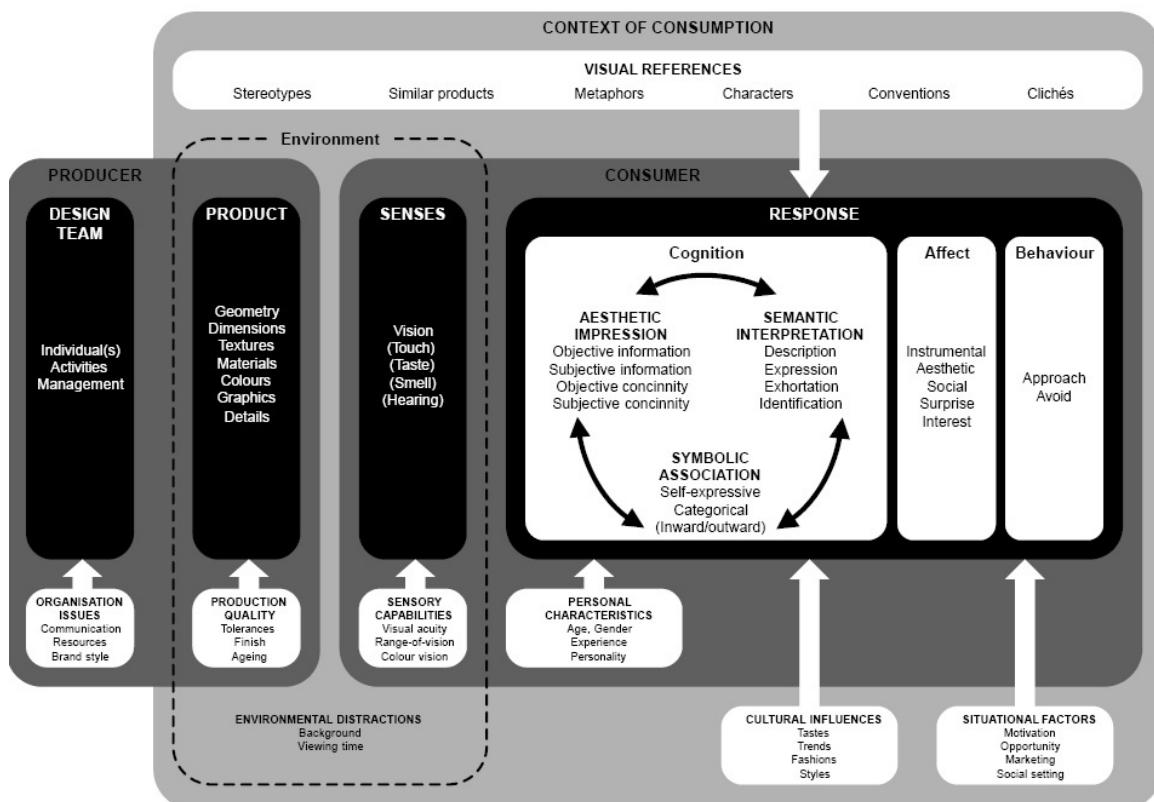


Figure 4.1: Framework for consumer response to the visual domain in product design
Source: Nathan Crilly et al.,(2004) 'Seeing Things: consumer response to the visual domain in product design,' *Deesign Studies* 25 (6):547-577.

This model has been developed in the context of design based on Shanon's classical communication model. The model proves very useful in locating the position of the designer and the user and the parameters one needs to examine in the context of a study of user response to the visual domain in product design (Mokashi Punekar 2008).

Further, to establish a framework for a study of the visual in product form, Kalvianinen and Pontecorvo (2000) in their article ‘Consumer-Designer Interaction through a Generative Design Medium’ state that use of Images, instead of words can be more effective for design to elucidate ‘deep’ emotional aspirations, values and desire of users. In the design task, visual and other sensory information helps designers to be empathic through emotional understanding (Mokashi Punekar 2008).

‘Style discrimination is an essential part of Aesthetic Enjoyment. Style differentiates products through their distinctive qualities of form, their holistic composition of color, shape, line, pattern in visual style, sound or scent’
(Kalviainen and Pontecorvo 2000).

Further, Style deals with surface impressions, yet it forms a corridor between the world of things and human consciousness (Ewen 1990), style perceptions can be conveyed to the designer in holistic images.

“Our interpretation reflects an inner map that is used unconsciously to organize and understand sensory experiences. We interpret intangible product meanings with the help of associations, or ‘stimulus chaining’ that occur in human cognition. One thought leads to another. Thoughts are not language but images.”

... “Meaning is interpreted both from denotative and connotative messages in the product. In denotation an object conveys information about its functions and what it stands for. Connotation refers to an aesthetic dimension, which conveys a subjective impression and emotion about the product”.

They opine that as designers think intuitively and visually it might be easier for them to apply consumer information gained in images than in visual information.

“Holistic Gestalt distinction of products offer the most practical and comprehensive way of inquiring about intuitive product perception”.

The framework outlined by Crilly, Maurice and Clarkson suggest that the user response to the visual domain can be interpreted best based on a three layered structure of analysis - Cognition / Affect / Behavior .

Cognition comprises of the first interaction comprising of three components

Aesthetic Impression: Objective Information / Subjective Information / Objective concinnity / Subjective concinnity

Semantic Interpretation: Description / Expression / Exhortation / Identification

Symbolic Association: Self expressive / Categorical (inward / outward)

Affect on the user could be of the following kinds: Instrumental / Aesthetic/ Social/ Surprise/ Interest.

And the user's response could be reflected in his Behavior which could be one of Approach or Avoid.

The response of the user can be influenced by the context of consumption. These could be governed by the following considerations -

Visual References comprising of: Stereotypes / Similar Products / Metaphors / Characters / Conventions / Clichés

Personal Characteristics including: Age / Gender / Experience / Personality

Cultural Influences could be based on considerations of: Tastes / Trends / Fashions / Styles

And Situational Factors which might comprise of considerations of: Motivation / Opportunity / Marketing / Social Setting.

The above considerations form the broad guidelines for formulating specific set of empirical experiments for this research which set out to seek answers to the following research questions:

- a) What factors are responsible for establishing the emotional relationship between a vehicle and its users?
- b) Which one of the visual elements (texture, color and form...) is the most suitable for transferring emotional value or emotional communication from product to user – given a vehicle like the car?

- c) Can a set of heuristics be developed using which Designers from a particular culture can incorporate the most relevant feelings and aspirations into the design of the car?
- d) Can such heuristics be also used by designers from a different culture for designing for users of another culture/ nationality/ foreign market?
- e) Can a design method be developed using which Designers from a particular culture can incorporate the most relevant feelings and aspirations into the design of the car?
- f) Can such design method be also used by designers from a different culture for designing for users of another culture/ nationality/ foreign market?
- g) Can such heuristics set be also useful for designers engaged in designing for car manufacturers having a brand identity of their own?
- h) Can such design method be also useful for designers designing for car manufacturers with specific brand identity?

4.1 Planning the experiments

Based on the different considerations in the above model, this research has first planned to undertake an analysis of the car form from the point of view of visual elements including its geometry, point, plane, volume and color. Techniques in the study of visual perception and form can be used for such an analysis. This enquiry can be further enriched through a study of the historical evolution of the car form over period of time. This can result in identifying trends in the evolution of visual form of the car over a defined time line.

The study of consumer response to the visual domain in car forms on the other hand can be analyzed and assessed from a set of experiments that enquire into aspects of product semantics and emotional response of the viewer to a select set of car forms that are chosen by the designer through planning. The results can be analyzed using statistical methods and techniques that measure users response. It is proposed to assess the user response to visual form of the car forms using Semantic Differential techniques, Repertory Grid Technique, Co-relation Technique and Relation techniques outlined in chapter 3.

The finding from each of these individual experiments can then be mapped amongst overlapping and inter-related parameters. Based on the conclusions drawn a heuristic set

of guidelines that designers could use in the design of the visual form of the vehicle is attempted.

To meet the above objectives the experimentation is planned in the following manner:

Initially a historical review of the developments in car styles is undertaken to examine factors that have influenced the aesthetics developments of the car over time.

This is presented in chapter 5, Section 1 comprising of:

- Experiment 1a: A historical perspective (1885 onwards till date) on the evolution of the overall form of the automobile. It attempts to map factors that influenced the development of aesthetics in automobile forms.
- Experiment 1b: The same historical perspective is further examined, searching more specifically, the evolution of automobile faces and a study of aesthetics in automobile faces between the same period 1885 till date.
- Experiment 1c: This part of the experiment seeks to evaluate an overall understanding of user response to visual expression of the car form. In particular it seeks to gauge those visual elements (texture, color and form...) that the user feels are most suitable for transferring emotional value or emotional communication on the different profiles / views of the car.

This is followed through in chapter 5, section 2, where in a set of experiments to specifically source user response to the car face is undertaken. For this a theoretical framework based on Ferdinand de Saussure's model for semantics is considered in planning the experiment.

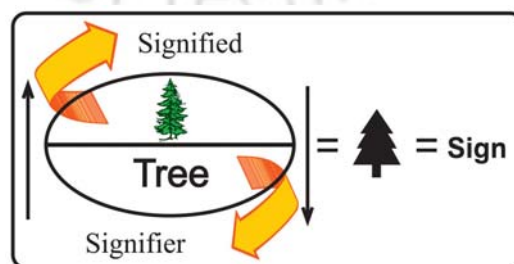


Figure 4.2: Semantics framework

A visual database is first generated to create the set of car faces to be shortlisted for the study. A pilot study is conducted with a select group of respondent to identify those visual design elements on the car form that contribute to the expression of the car face. Considering aesthetics of the car form, from the above pilot study it was deduced that the car front face seems the pivotal point that carries the cars expression, followed by the rear side. Based on this assumption the face of the car has been chosen for the user study to be conducted during the online survey in the different experiments to follow.

The creation of meaning is examined through analysis of users' emotional associations to visual expressions of human faces; animal faces vis a vis the selected car faces. The technique used is based on drawing inferences following RGT, SD, Co-relation, and relational methods for analyses of data. To derive a cross-cultural perspective from the online survey, respondents are screened and the ones from Iran and India are shortlisted. The Questionnaire comprising of 32 questions is planned to bring out the profile of the respondents; their response to the different forms of car faces and to follow this up by making a comparative study of:

- a) User response to car faces vis a vis human face expressions and
- b) User response to car faces vis a vis animal face expressions. (Refer Apendix)

Based on semantics framework of Ferdinand di Saussure (Figure 4.2) The following set of experiments constitute the study presented in the chapter to follow.

- Experiment 2a:
Objective: Visual analysis of elements of visual design on the front face of selected cars using Technique of analysis of visual form is undertaken by a professional designer through Self Evaluation to analyse the car forms to identify and derive 'Graphical key elements' that contributes to the expression of the car form.
- Experiment 2b:
Objective: Using Co-relation Techniques cross verification of users visual response to car expression vis a vis 'key visual elements' is undertaken to validate the results of Experiment 2a.






- Experiment 3a:
Objective: To study and measure respondents' feeling to the selected set of car faces (sign) vis-à-vis expressions of animal and human faces (signified) is undertaken using RGT Technique. From the above study, inferences of user emotional response to car form is summarized.
- Experiment 3b:
Objective: To study and measure respondents' emotional feeling to the selected set of car faces (sign) vis-a-vis expressions of animal and human faces (signified) is undertaken using Semantic Deferential(SD) Technique. From the above study user emotional response to car form is summarized.
- Experiment 4:
Objective: To study and measure the respondents' emotional reaction to visual key (being the signified) for the car faces is undertaken using Relation Technique.
- Discovering the relation between car face (being the sign) vis a vis emotional expression word (being the signifier) is undertaken using Relation Technique.



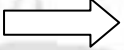
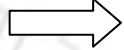
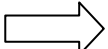
Summarizing insights from the above has formed the basis for deriving a heuristic set of guidelines constituting the 'visual key' that designers could use in the design of the visual form of the vehicle. It is important to note that the inferences and conclusions are therefore cumulative and comprehensive derived from these set of inter-related experiments.

In Chapter 5, Section 3 an experiment is planned to apply the resulting 'visual key' developed in the above experiments in developing concept sketches for a chosen car model to validate the results. It can help to ascertain if such a design approach that has evolved as an outcome of these experiments can form a basis for designers designing for car manufacturers with specific brand identity.

A summary of the different experiments and their co-relation is summarized in the diagram below.

Table 4.1. Diagram of research, design and consumer behavior

Hypotheses	Methodology of research				
	Experiment				Objective
Experiment	<p>1a and 1b: Historical review of evolution of Car Forms and Car front face.</p> 	<p>1c: Preliminary experiment to seek user response to 'Expressive words' association vis a vis a set of car forms.</p> 	<p>Experiment 2a: Selection of Car face . Undertaking self assessment of Car form through Eye movement analysis; Study of geometric proportion and analysis of visual form by a professional designer through self assessment.</p> 	<p>Creating the visual data base by selection of Human and animal face that correspond to equivalent Expressive word.</p> 	<p>Creating the visual data base</p> 
Technique used	Visual analysis through self assessment	Preliminary Online survey	Consultation with expert group for selection of car forms Self-assessment of chosen car forms	Photo-documentation of human face expression and selection of Animal face expression.	
Out come	Identification of visual evolution of the car form	Preliminary Study of user response to visual form of car to enable planning the main experiments	Generation of 7 sets of car images, each set containing 5 images to form the visual database of car forms for the study. Identification of graphical key and identification of corresponding Expressive word	Group 1 - Seven sets containing bi-polar images generated from photo documentation of human faces Group 2 - Seven sets containing bi-polar images selected from animal faces To be used as data for seeking user response	

	Objective	Experiments			
Experiment	Testing the user response through on-line survey 	Experiment 2b: Seeking user response to co-relation between bipolar human face expression vis-a vis 35 car face expression. 	Experiment 3a: Seeking user response to measure degree of similarity and dissimilarity to bipolar human face expression (and Animal face expression) for a set of 7 car face. 	Experiment 3b: Seeking user response to measure degree of similarity and dissimilarity to bipolar human face expression (and Animal face expression) for a set of 7 car face. 	Experiment 4: Seeking user response to selection of car face expression vis a vis word expression for a set of 20 car face expression 
Technique used		Online survey using Co-Relation Technique	Online survey using Repertory Grid Technique	Online survey using Semantic Differential Technique	Online survey using Relation Technique
Out come		Verification of points of agreement and difference between two cultures for the expression of selected car form	Relative measure of points of agreement and difference between two cultures for the expression of selected car form	Relative measure of points of agreement and difference between two cultures for the expression of selected car form	Verification of points of agreement and difference between two cultures for the expression of selected car form

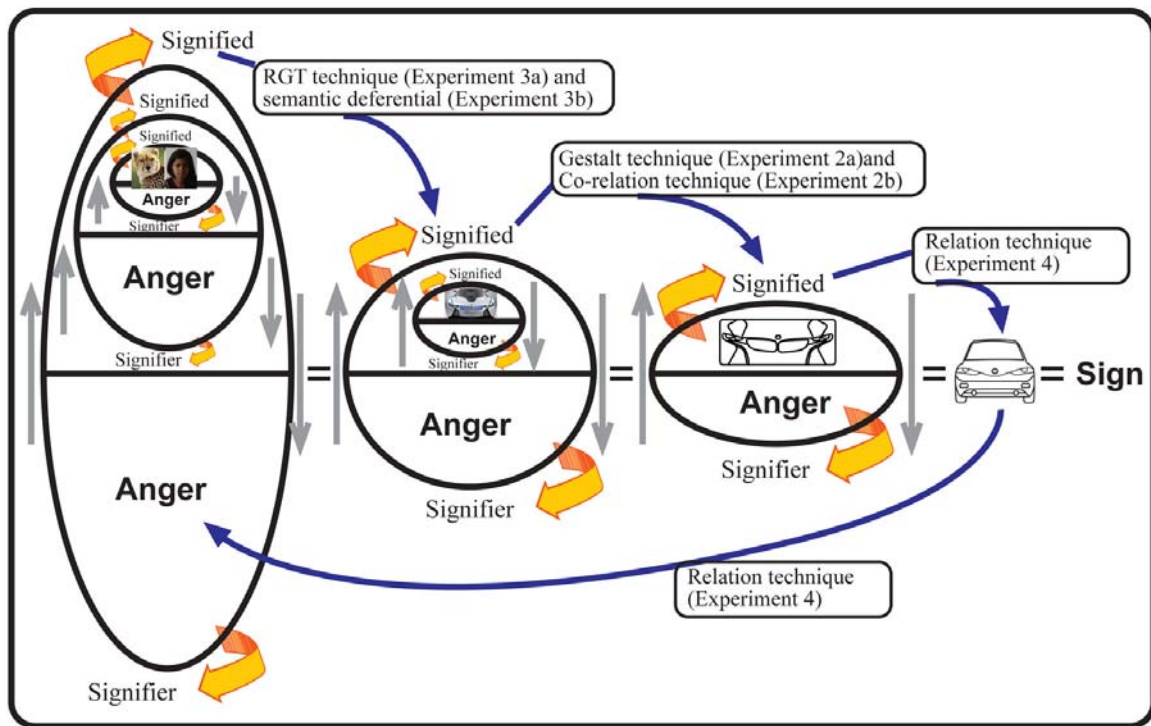


Figure 4.3: Example of framework of thesis only for J1

Chapter 5

Empirical Experiments for Understanding Visual Form of Automobiles

Section 1

Conducting the Experiments

In this chapter the experiments planned in the previous chapter are being conducted and presented in three sections.

Section 1:

The Section 1 is divided into three Experiments.

- Experiment 1a
Historical review of evolution of Car Forms. It attempts to study and map factors influencing the development of aesthetics in the overall form of the automobile between the period 1885 till date.
- Experiment 1b lays emphasis on the car front face. It summarizes the observations on factors that may have influenced the aesthetics of the automobile based on a historical review.
- Experiment 1c
Forms a preliminary experiment to seek user response to 'Expressive words' association vis a vis a set of car forms. It aims to seek user's response to the following questions: a) What factors are responsible for establishing the emotional relationship between a vehicle and its users?
b) For a vehicle like the car, which of the visual elements (texture, color, form ...) is most suitable for transferring emotional value or emotional communication from product to user?

Experiment 1a

Evolution of car form ¹

E1a.1 Overview

The study of history often yields clues to the future. Influences such as new technology, lifestyle and culture have shaped automobile design since manufacturing began. Right from a horseless carriage, automobile design has been driven by the attempt to create an emotional expression of speed. This reached an apex with the adoption of missile designs of the 1950's. Over time, changes in lifestyle and culture have altered the semantic meaning of the frame. This study based on a time line helps automobile designers comprehend the maker's ideas that influenced the evolution of the automobile, and acts as a tool to predict the future of car designs.

Experiment 1a has examined from a historical perspective (1885 onwards till date) the evolution of the overall form of the automobile, and attempts to map factors that influenced the development of aesthetics in automobile forms. It seeks to find out those factors that are responsible for establishing the emotional relationship between a vehicle and its users.

In this experiment using selected well-known automakers, attempt has been made to map the influence of new technology; lifestyle and culture on automobile design starting from 1885 till the present day. These have been categorized into identified seven eras till date.

E1a.2 Early products

In the beginning, all vehicles basically looked the same. In 1885, the new motorized vehicles did not have a body or shell. Inventors were more concerned about function than

¹ This study was undertaken as part of this research and the same has also been published as a joint paper co-authored by the researcher with Prof. Adel Bass under the title "Tracing the Evolution of Automobile design: Factors influencing the development of aesthetics in automobiles from 1885 to the present." during the IMProVe International Conference on Innovative Methods in Product Design, Venice, Italy.

form. The first car comprised an engine, three wheels and a frame all exposed for easy access. Getting the machine to work properly was the foremost priority. Design aesthetics came later. The first typewriters, electric shavers, sewing machines and airplanes had no external shell. Fig. 5.1a.1 compares the original forms of these early machines with later versions (Heskett 1980). Products like cameras and submarines did have a shell.

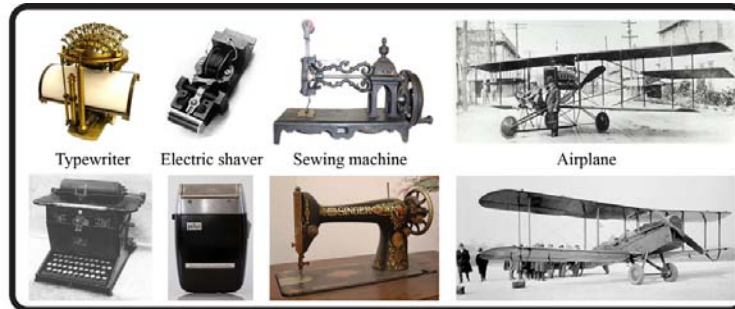


Figure 5.1a.1: Early product development¹

E1a.3 Evolution of the Automobile

This part of research tries to identify those factors that are responsible for establishing the emotional relationship between a vehicle and its users. This is being traced by studying the history of car body by dividing the time line into seven different eras. The seven eras in chronological order are: Invention era, Innovation era, Manufacturing era, Capsule era, Classic era, Integration era and Modern era. Each era is earmarked by a particular style or design aesthetic. The particular aesthetic was influenced by a number of factors like fashion, makeup, hairstyles, art and architecture, popular culture and movies. This period in history witnessed the transition from the horse carriage to the Model T Ford. Automobile semantics followed an arc of speed and power reaching its zenith at the missile era in U.S. politics. In the modern age, designers have arrived full circle using organic forms, animals and bio designing as part of their emotional expression.

E1a.3.1 Invention era

This era began with the invention of the Benz car and continued roughly ten years with the introduction of Henry Ford's first automobile. Before Benz introduced his motorized wagon, vehicles capable of human transport were mainly steam-powered (Eckermann 2001). The Benz car was the first car to use a gas powered internal combustion engine.

¹ <http://www.angelfire.com/oz/edomar/index2.htm>
<http://www.chuckstoyland.com/national/19101914/> accessed in May 2010.

This new horseless carriage had a powerful allure, but it confused people. Most found it strange, that a carriage could move without a horse.

Karl Benz produced industrial machines and static gas engines. He wanted to create an automobile that would run entirely on its own power. This would not be simply another motorized stagecoach or horse carriage. Using the same technology that was in his beloved bicycle, he introduced the Benz Patent Motorwagen in 1885. It featured wire wheels (unlike the wooden ones on carriages) (Georgano 1985 and Seidel 2005) and a four-stroke engine of Benz' own design. It incorporated a very advanced coil ignition and evaporative cooling system rather than a radiator. Power was transmitted by means of two roller chains to the rear axle¹.

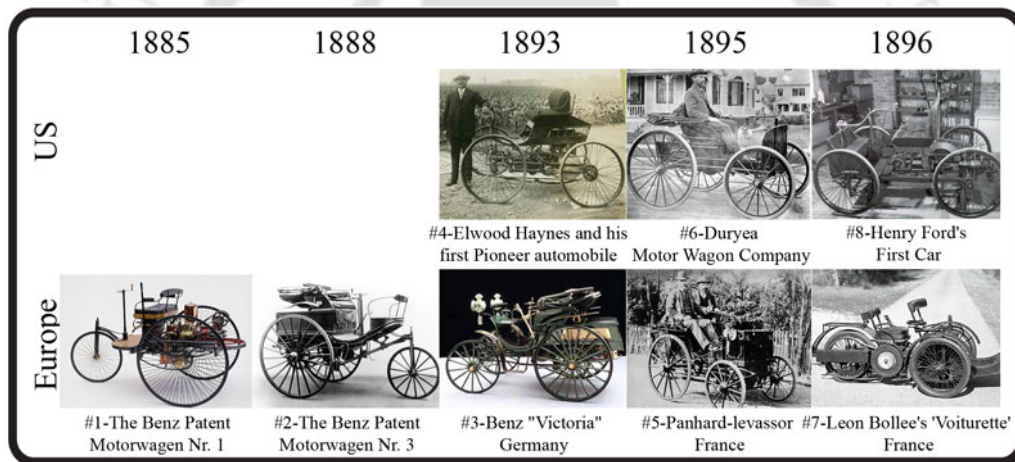


Figure 5.1a.2: Invention era²

Designing technology is a basis of many of our metaphors and is important in terms of how we think and how our ideas materialize. The use of metaphor and processes of design and the evolution of car designing are cyclic in the sense that metaphors help to shape technology, and sometimes new technology leads to new metaphors. Major changes arise periodically, such as the transition from horse-drawn carriages to motor-driven vehicles. The initial description of the latter is naturally metaphorical, as in the term "horseless carriage." The association with the previous technology is both verbal and visual. The early designs of such vehicles show visual evidence of the metaphor, as

¹ DRP's patent No. 37435, 1886

² <http://www.terencemorleyclassiccars.co.uk/page1.php>
http://www.allcarcentral.com/ford_pix-1930-1935.html/ accessed in May 2010.

they retained much of the appearance of horse-drawn carriages. The horse-drawn carriage was itself a technological innovation, as were the horseless carriage and later automobiles (Wake 2000).

E1a.3.2 Innovation era

After 1896, automobiles changed radically from those in previous years. Throughout the Innovation era, widespread car use was still uncommon and the automobile was seen as more of a novelty than a genuinely useful device. The horse and carriage was the reliable method of transportation, but automobiles sparked people's imaginations. Automobile designers knew that the carriage's form, designed in accordance to the horse was not appropriate for their new automobiles.

The new cars reflected changes in society. The new industrialists were quickly adapting the fast-paced lifestyle. As the automobile evolved, it epitomized speed and freedom. Henry Ford was the first to bring his innovative designs to the New World. Ford's automobiles were different from the other available cars. His new mass production methods and quality materials set his cars apart. The price of Ford's car was higher than other vehicles. This only added to the allure.

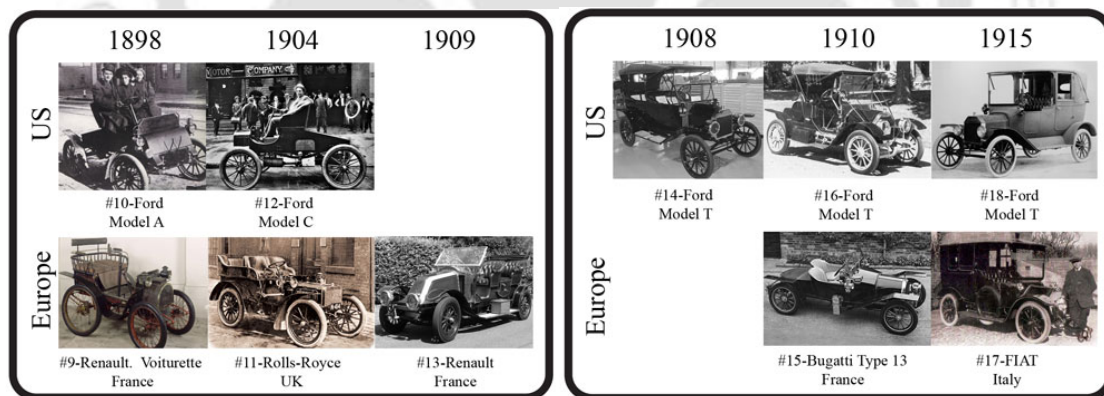


Figure 5.1a.3: Innovation Era ¹ Figure 5.1a.4: Manufacturing Era ²

¹ <http://www.terencemorleyclassiccars.co.uk/page1.php>
http://www.allcarcentral.com/ford_pix-1930-1935.html/ accessed in May 2010.

² <http://www.autogallery.org.ru/pmb.htm>
<http://www.shorey.net/Auto/French/Bugatti/>
http://www.allcarcentral.com/ford_pix-1930-1935.html
<http://trendsupdates.com/henry-ford-father-of-20th-century-american-industry/>
<http://oldcarandtruckpictures.com/ModelTFord/> accessed in May 2010.

E1a.3.3 Manufacturing era

The Manufacturing era roughly prevailed from 1908 to 1914, the beginning of World War I. Before 1908, designers favored the ornate Edwardian architecture, which was the preferred architectural style. This new industrial era reflected simpler, more affordable automobiles. Automotive technology developed rapidly as hundreds of small manufacturers began to compete for gaining the world's attention. Key developments included the electric ignition system, independent suspension and four-wheel brakes (Hockman 1993). Transmissions and throttle controls were widely adopted, allowing a variety of cruising speeds.

With the high price of the car it was still only the hobbyist and enthusiast who could afford one. It was unreal for most people. Henry Ford, the father of modern assembly lines, revolutionized the industry when he established the Ford Motor Company in the U.S in 1903. Ford had a global vision, with consumerism as the key to peace.¹ (Heskett 2002) One of the first adopters of mass production techniques, he introduced the automobile to the ordinary man. He is credited with using the assembly line to make large numbers of inexpensive automobiles coupled with high wages for his workers. Ford vowed to build a great car at a great price (Noblet 1993). His commitment towards affordable costs led to many technical and business innovations. Ford introduced the Model T in October 1908 at an affordable price of \$950. The year, 1908 was heralded a cult when the majority of automobile sales shifted from the hobbyist and enthusiast to the average user.

E1a.3.4 Capsule era

Between 1920 and 1930 designers closed the body of the car. While designing a car interior, the value and semantic meaning can be manipulated by opening or closing the space. Simply changing the way the space is divided can change the emotional expression of the space for the consumer (Jaafarnia 2007). The new closed body accentuated by curved glass and privacy had intrinsic value for the consumer.

¹ <http://www.youtube.com/watch?v=S4KrIMZpwCY/> accessed in May 2010

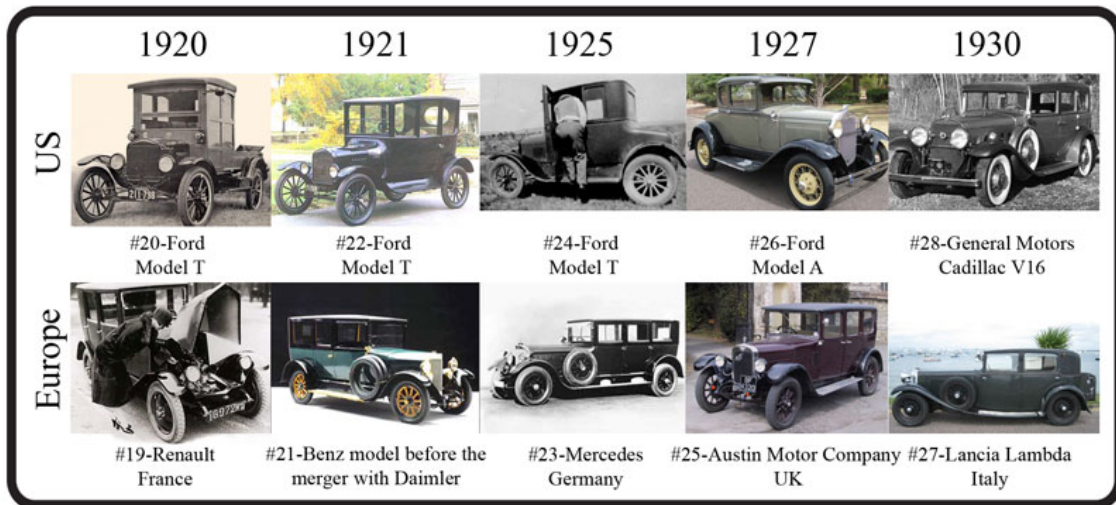


Figure 5.1a.5: The Capsule era¹

E1a.3.5 The Classic era

The classic era ushered with the Great Depression in 1930 and ended around 1940 shortly before World War II. The cars of this period were less rectangular and industrial. The new automobiles were sleek and beautiful. The new technology allowed designers to create luxurious aerodynamic cars with big curves and deep arches. The new salon/sedan body style was made for cruising and even incorporated a trunk or boot at the rear for storage (Duncan 1998).

Le Corbusier had comparative analysis on cars (1921) with the Parthenon (431 BC) and Corbusier found many similarities between them (Banham 1972).

Automobile designers modeled their forms on airplanes and trains because these objects semantically carry the meaning of speed. Applying the airplane's meaning to a car assured the automaker that its jalopies would look fast even if, in real, that was not the case (Beyer 2006). The wheels, lights and fenders hugged the body and articulated the safety and strength of the frame. Tires were wider and thicker than in the Capsule era adding to the solidity of the vehicles. The old open-top runabouts, phaetons, and touring cars were phased out by the end of the Classic era as wings, running boards, and headlights were gradually integrated into the body of the car. Integrated fenders and fully closed bodies began to dominate sales.

¹ http://www.jancia.eu/Index/Jancia/lancia_astura_pictures.htm
<http://www.autogallery.org.ru/pmb.htm>
http://www.allcarcentral.com/ford_pix-1930-1935.html
<http://trendsupdates.com/henry-ford-father-of-20th-century-american-industry/>
<http://oldcarandtruckpictures.com/ModelTFord/> accessed in May 2010.

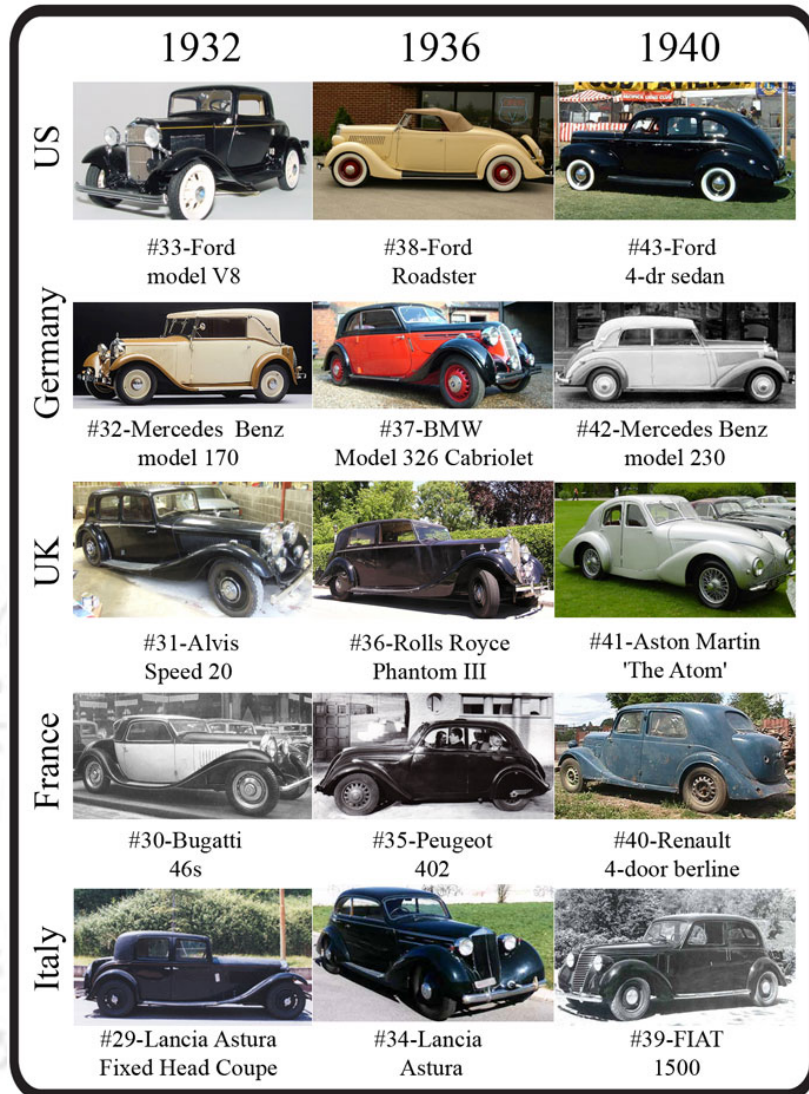


Figure 5.1a.6: The Classic era¹

E1a.3.6 Integration era

Since, 1945 designing had become a profession in its own right (Dormer 1995). Automobile design finally emerged from the shadows of World War II in 1949. The Integration era joined all the parts of the car to make a shell very similar to the modern car body we know today. This was the year that United States carmakers, General Motors, Oldsmobile and Cadillac, introduced modern one-piece auto bodies.

¹ http://www.autobelle.it/archivio_carrozzeri/zagato.php
http://www.jancia.eu/Index/Jancia/lancia_astura_pictures.htm
<http://www.shorey.net/Auto/French/Bugatti/>
http://www.allcarcentral.com/ford_pix-1930-1935.html/ accessed in May 2010.



Figure 5.1a.7: The Integration era¹

The relationship between design and technology is not one sided. Technological developments do not determine what the manufacturer wants to produce, nor do they rigidly determine the shape a designer creates (Dormer 1995).

In this era Cadillac was the first company to successfully borrow the form of the missile and apply it to its cars (Hauffe, 1998 and Noblet 1993). (Fig. 5.1a.8) Cadillac's 1959 Cyclone is a prime example of the application of the semantic frame of a missile to an automobile. In the late 1960's General Motors, Chrysler, and Ford tried to market radical

¹ <http://www.netcarshow.com/>
http://www.carpictures.com/vehicles/vehicle_list.php?make=Jaguar
http://www.autobelle.it/archivio_carrozzeri/zagato.php
http://www.jancia.eu/Index/Jancia/lancia_astura_pictures.htm
http://www.allcarcentral.com/ford_pix-1930-1935.html/ accessed in May 2010

small cars, like the GM A-bodies, but had little success. In America, performance became the prime focus of marketing, exemplified by pony and muscle cars like the Ford Mustang, and the Plymouth Barracuda (Tambini 1996). In this era most of the cars had ‘Speed-lines’ on the sides, all of which contributed to the automobile’s message of ‘power, speed and sex’ (Sparke 2002). In this time the Chevrolet Corvair was a European-looking response, signaling the end of General Motors’ more fantastical line of cars (Julier 1993). Third world countries entered the automobile race in the late 1950’s. Indian and Iranian car design can be traced from 1959 onwards (Fig. 5.1a.12) The first Indian automobile produced in 1958 was similar to Germany’s 1953 Opel Capitan, shown in (Fig. 5.1a.12) The first Iranian car introduced in 1968 (that was in the modern era) was similar to American cars designed ten years earlier, shown in blue, in (Fig. 5.1a.12). Both, in fact were designed by UK designers. On the technology front, the biggest developments of this era focused on safety while designing the automobiles.



Figure 5.1a.8: Effect of the missile on Cadillacs¹

E1a.3.7 The Modern era

This era began at around 1968 and continues till date. Designers today take into account not only the functionality, but also consumer’s emotional reactions to their automobiles. Designers today are well aware of how to create the feeling of speed. But the feeling of speed is not the sole expression the consumer looks for. Designers have recognized ways

¹ <http://www.american-automobiles.com/Mackle-Thompson.html/> accessed in May 2010.

in which all areas of an automobile can be used to appeal to the consumer's personal desires and tastes. The semantic frame of the car is changing once again.

Automobile designers no longer only borrow semantic meaning from planes and missiles. Today, they venture out to portray more organic and bionic forms. Car Designers study the bio mimicry of animals and insects and indirectly insert the animal's emotional expression into the look and feel of the car. It's not necessary to use the animal's literal form. The meaning is implied (Benyus 1997).

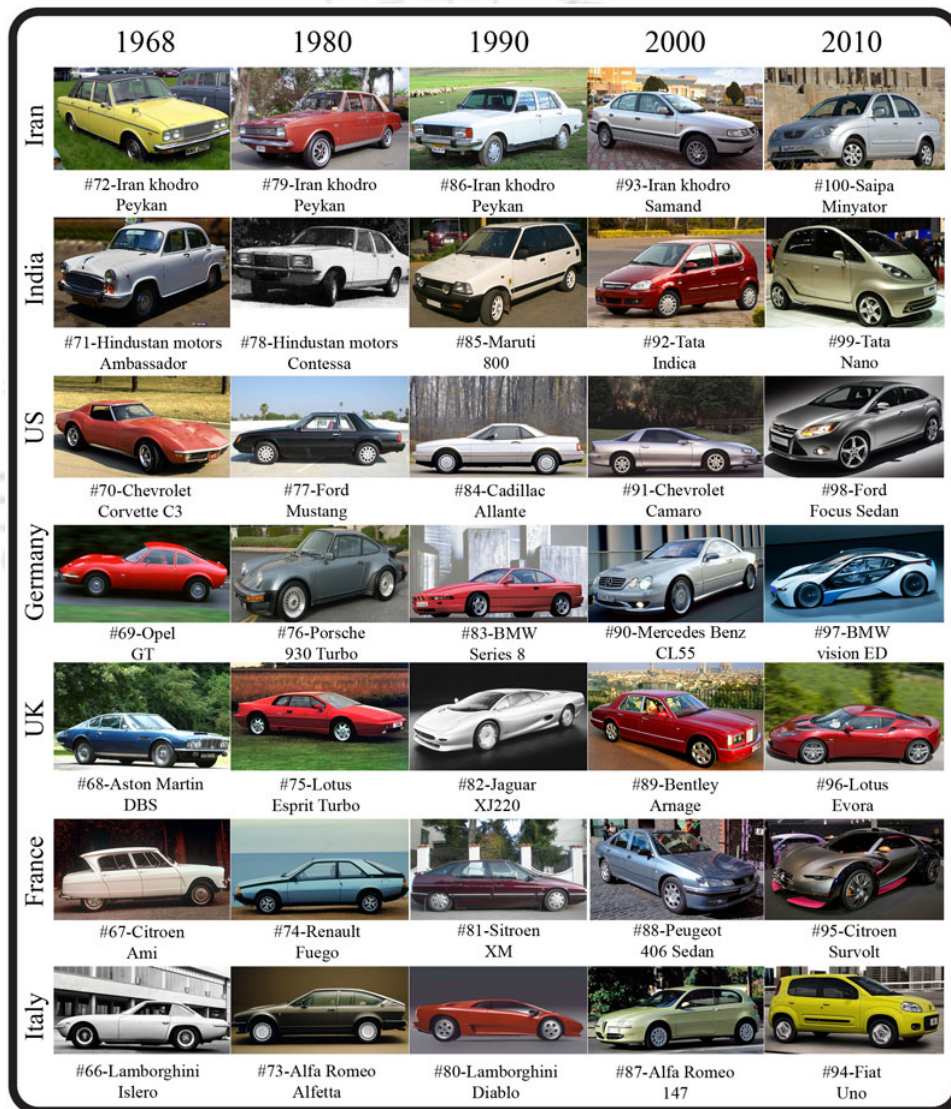


Figure 5.1a.9: The Modern era¹

¹ <http://www.netcarshow.com/>
http://www.carpictures.com/vehicles/vehicle_list.php?make=Jaguar
http://www.autobelle.it/archivio_carrozzeri/zagato.php
http://www.allcarcentral.com/ford_pix-1930-1935.html/ accessed in May 2010.

One of the greatest influences on form in the modern world, in this sense, has been Giorgetto Giugiaro. He started out as an automobile stylist, working for FIAT, Carrozzeria Bertone and Ghia, before establishing Italdesign with two other colleagues in 1968. No one could ever come closer to Giugiaro in terms of influencing the direction of automobile styling around the world. His concept of the Volkswagen Golf of 1974 set the pattern for subsequent generations of small, hatchback cars (Heskett 2002). That he designed hatchback because of the culture of traveling is very important in personal car design, more so, as quantity of luggage always differs in various cultures.¹

In this era, technology gave synthetic material, which can be molded and with less limitation, designer could use different forms for car (Noblet 1993).

Body styles have changed in the modern era. Three types dominate today's market: the hatchback, the minivan, and the sport utility vehicle. All are relatively recent concepts, spurred by an aging, active generation who love to be on the road (Beazley 1991).

E1a.4 Discussion

In all the eras, what was significant was that safety, culture, market conditions, art movements and technology concurrently affected automobile styles. Improvements in manufacturing and methods increasingly allowed designers to design with fewer limitations. Technological gains in other disciplines like train and airplane design benefited automobile design by providing a semantic frame for the look and feel of the car. In previous eras we saw semantic expressions of the airplane (Fig. 5.1a.10) and missile (Fig. 5.1a.8) being used in car designs. There were two creative schools of thought regarding semantics. The first school promoted the use of the old familiar product forms like the horse carriage as a frame for the first automobile.

The other creative school was exemplified by the designs of Marco Ricotti. His design of the Alfa Romeo in 1914 still influences present day airplanes (Noblet, 1993 and Borgeson 1990). Vittorio Jano borrowed the form from the 1932 Fairchild J2K (Fig. 5.1a.10) and used it in the 1935 Lancia Astura. The Lancia Astura, in turn, influenced baby carriage designs in 1950.

¹ It was the question of Professor Amarendra Kumar Das that ask about effect of cultural traveling on the car form in my State of the Art Seminar. So I saw hatchback design came from cultural traveling.

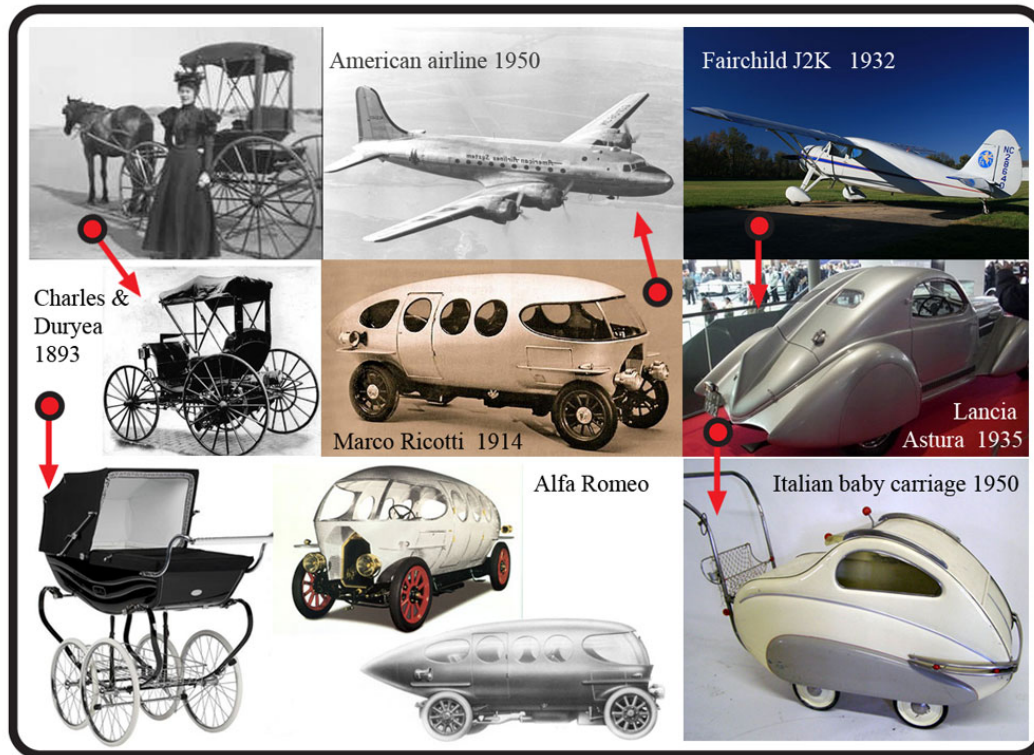


Figure 5.1a.10: Effect of automobiles on other products¹

Lifestyle and cultural influences have transformed automobiles. In the Integration era, American car companies divided designs into men's car and women's car. Designers heavily borrowed from fashion, makeup, color trends and personal products like eyeglasses (Beazley 1998). In the 1950s after long years of war, young American woman wore slacks in shrill tones, casual sweaters and bright headscarves covering colorful hair curlers. Woman wore their hair either short with a light wave or simply pulled back in a pony-tail. Many women also teased their hair into emulating the high beehive that adorned the head of the Persian Queen. Broad-brimmed hats were highly elegant and graceful. Slender shoes with long, pointed toes and heels that were delicate as they were pencil-thin, were also typical of the period (Andressen 1998). Those things had effect on the eyeglasses designing and soon it began to influence Car designs, like in the 1959 Chevrolets as shown in (Fig. 5.1a.11). In an effort to target separate markets, automakers advertised cars that resembled the design of the human model's dress and makeup. (Fig. 5.1a.11)

¹ http://www.autobelle.it/archivio_carrozzeri/zagato.php
http://www.jancia.eu/Index/Jancia/lancia_astura_pictures.htm/ accessed in May 2010.



Figure 5.1a.11: Life style ¹

The Ford Motor Company produced the most feminine car in automobile history (Streetka 2003 in Fig. 5.1a.11). When Streetka was launched, Ford claimed that 80% of the buying public would be female. In 2003, 1% of men bought this car. The car was launched by Kylie Minogue (a well-known American singer). A special pink version of the car was used to promote the Thunderbirds movie. A dress to match the car was made and later sold at a charity auction.

E1a.5 Conclusion

Automobile designers have been applying the expression of speed to their cars ever since they affixed the first engine to a horseless carriage. And as an answer to the question “What factors are responsible for establishing the emotional relationship between a vehicle and its users?”

¹ http://www.allcarcentral.com/ford_pix-1930-1935.html
<http://www.juvandesign.com/automotive/the-winner-moy-concept-car-is-design-of-contest-during-auto/>
<http://www.american-automobiles.com/Mackle-Thompson.html/> accessed in May 2010.

Eras	Italy	France	UK	Germany	US	India	Iran	
Invention	1885			#1				
	1888			#2				
	1893			#3	#4			
	1895	#5			#6			
	1896	#7			#8			
Innovation	1898	#9			#10			
	1904		#11		#12			
	1908				#14			
Manufacturing	1909	#13						
	1910	#15			#16			
	1915	#17				#18		
Capsule	1920	#19			#20			
	1921			#21	#22			
	1925			#23	#24			
	1927			#25	#26			
	1930	#27				#28		
Classic	1932	#29	#30	#31	#32	#33		
	1936	#34	#35	#36	#37	#38		
	1940	#39	#40	#41	#42	#43		
Integration	1947	#44	#45	#46	#47	#48		
	1953	#49	#50	#51	#52	#53		
	1958	#54	#55	#56	#57	#58	#59	
	1965	#60	#61	#62	#63	#64	#65	
Modern	1968	#66	#67	#68	#69	#70	#71	#72
	1980	#73	#74	#75	#76	#77	#78	#79
	1990	#80	#81	#82	#83	#84	#85	#86
	2000	#87	#88	#89	#90	#91	#92	#93
	2010	#94	#95	#96	#97	#98	#99	#100

Figure 5.1a.12: The evolution of the automobile

it is seen in Figure 5.1a.11 and in design of ‘hatchback’¹ that the automobile has evolved over time reflecting the culture and lifestyle of their respective eras. The Invention era was concerned with building an engine that could propel a frame. In the Integration era it was very important for a car to express speed. The manufacturing era saw the industrialist

¹ The design of hatchback has been done because of the culture of traveling as the quantity of luggage always differs in different cultures. Cultural traveling plays a very important role in personal car design

become proficient at mass production. In the Capsule era designers began to pay more attention to creating a body and interior space. The integration era paved the way to the uni-body designs, we see on today's vehicles. Current modern design theory looks at the bigger picture to design cars for individuals. Speed is not the only feeling designers are trying to convey through their automobiles. As for other expressions, one should have one more study to elaborate on the car face. We have entered a time of more awareness towards environmental factors and now cars tend to reflect a gentler lifestyle and aesthetic. Auto designers today use all parts of the car to express a personalized emotional expression for individual lifestyles.

Here, you can see the ability of European and American designers in three periods:

- European designers were innovative and pioneered before 1936 and after 1965.
- Two parts of car evolution were revealed in this time line, which demonstrated U.S. ingenuity and innovation (between 1936 and 1965), (Table 5.1a.1)

Table 5.1a.1: Branches of car evolution

Branch 1: from America to Europe. (Fig. 5.1a.12_pink line)		Branch 2: from America to Europe. (Fig. 5.1a.12 yellow line)	
<i>Car Number (#1- #100)</i>	<i>Country/date</i>	<i>Car Number(#1- #100)</i>	<i>Country/date</i>
#38	(US 1936)	#43	(US 1940)
#41	(UK 1940)	#48	(US 1947)
#44	(Italy 1947)	#51	(UK 1953)
		#55	(France 1958)
		#60	(Italy 1965)

Experiment 1b

Evolution of car face

E1b.1 Evolution of car face

Experiment 1b reports a visual study carried out to understand the evolution of the automobile face. It examines the evolution in the visual style of the Automobile faces from 1885 onwards to understand product semantics that was followed by designers belonging to the particular historical period. This has been documented by undertaking a visual study of the different car faces prevailing in those years and graphically mapping the form changes of the car face design. It is posited that such a time line aids automobile designers understand the markers that influenced the evolution of face design as well as predict the evolution of form in the near future.

E1b.2 Car Evolution eras

The study divided the period commencing from 1885 into different eras. The developments in the design of the car face during each era has been visually mapped and examined to explore evolution of aesthetics on car and analyze how semantic could influence car face during the different eras. These finding and observations help to understand those factors that may have been responsible for establishing the emotional relationship between a vehicle and its users.

E1b.2.1 Invention era

The period 1885 to 1897 can be called the Invention era. If one looks at industrial history one can find similarity amongst products of the era. Although the forms of the different products of this era are different, yet each is characterized by a spirit of 'Invention'. Here the inventor doesn't seem concerned with addressing the needs of the user as much as on the invention and functioning of the product. Products developed seem to be different

parts put together different (Fig. 5.1b.1). During the ‘invention era’ the functionality of the product becomes the prior concern that overshadows the other needs.

In terms of car production, in the period between 1885 to 1897, one cannot find much similarity between cars as most cars have difference face structure (Kay 1997).

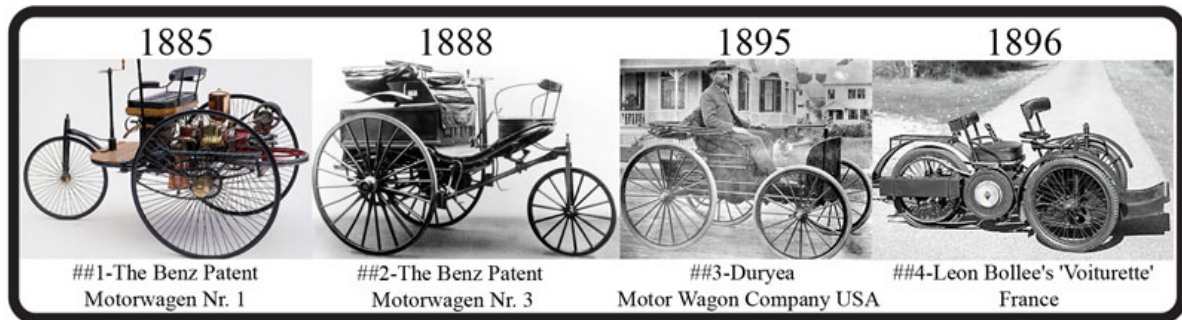


Figure 5.1b.1: Invention era¹

E1b.2.2 Construction groups era

Every product has some ‘functional’ construction groups for resolving the needs of the users. Each construction group includes one or more of the products’ part, and the applicability of those parts address the needs of the user.

During the construction group era, designers slowly recognized the user’s needs, and for resolving these needs parts like *Number plate* , *brand of company*, *lighting*, *car bonnet*, *bumper car*, *air grille*, *lower grille etc* are seen added. These construction groups that constitute the car body include: *radiator’s construction group*, *Shock absorbers construction group*, *starter’s construction group*, *lighting’s construction group*, *mud guard’s construction group*, *plate numbers’s construction group*, *brand’s construction group*, *Windscreen’s construction group*, *car guard’s construction group*, *engine cover’s construction group etc*. Gradually these construction groups came together on the car face and a result in the car face evolving to generate a standard character to the car. (Fig. 5.1b.2)

¹ http://www.autowallpaper.de/Wallpaper/Mercedes/Benz_Patent_Motorwagen/bilder/Benz_Patent_Motorwagen__3.jpg
http://www.live-like-a-german.com/tg_details.php?travel_guide_id=294
<http://www.earlyamericanautomobiles.com/amesburyautos.htm>
http://www.maxmatic.com/threes/rtw_index.htm/ accessed in July 2010.

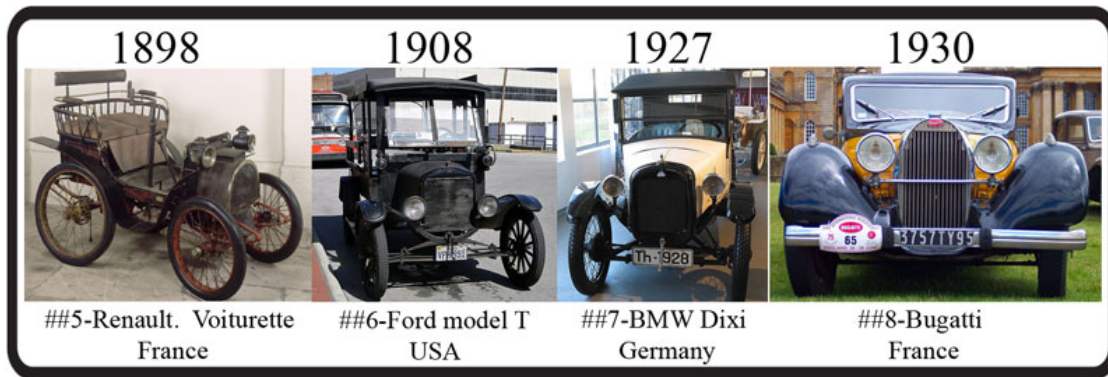


Figure 5.1b.2: Construction groups era¹

Radiator's construction group: This was created for resolving the chilly engine issue. At first the designer set the engine in the front of car to get direct wind, however later the radiator was put in front of the engine. Subsequently by the end of this era it is seen that the grille is put in front of the radiator for effective aesthetic of the car face.

Shock absorber's construction group: This construction group was created for resolving the Shock absorber's need when cars run on uneven roads. It has a spring put between axle and chassis that affected the aesthetics of the car. But soon the car guard followed by the mud-guard was added which curbed the visibility of the springs.

Start's construction group: This construction group was created for starting the car. There was a handle in the frontal portion of the car for the driver to turn on the gasoline engine. As the advent of electric engine came much later, the construction group parts consisted of a handle and a hole under the radiator that were visible and affected the aesthetics of the car.

Lighting's construction group: This construction group resolved the problem of light at night. A frame, lens and a lamp were added to the frontal portion of the car face adding to a new look on the car face.

Mud-guard's construction group: This construction group could control mud. A Fender was added which could guide mud to slip down side.

Number plate's construction group: The need for a number plate was not user driven but rather it was essential for the police and street passer. This construction group had a plate with a text combined with numbers and letters affecting the aesthetics of the car face.

¹ http://www.histoire-image.org/site/etude_comp/etude_comp_detail.php?i=1035
<http://oldcarandtruckpictures.com/ModelTFord/> accessed in July 2010.

Brand's construction group: This construction group was also not driven by the user's need. It began with the company's need to give it a character and identity. For this the construction group put a sign (brand) along with a sculpture, designed exactly on the head of car face in a symmetrical line placed opposite to the number plate creating a positive effect on its aesthetic.

Windscreen's construction group: This construction group intended to protect the driver's face from wind, rain and dust. The windscreen and the frame both had effective impact on the aesthetics. Windscreen being the biggest part on the car face.

Car guard's construction group: This construction group has a special part (Bumper) for protecting the car. In case an accident takes place between a car and an external object the bumper can limit the impact of the accident on the car body leading to less damage on the car face.

Engine cover's construction group: This construction group solved the covering problem. Initially the engine cover was open because of which the emotional expression of the car was relatively complex and ugly. This construction group added considerable amount of surface on the car.

E1b.2.3 Classic era

This era evoked the designers to give a form on the car face inspired by the Classicism style. This resulted in the car forms that were visually balanced and compositionally symmetrical. In this era car forms were rich in texture with metallic luster, high reflectivity and polished metal against the dark surfaces and colors were composed on the car face. Vertical lines and circles in perfect symmetry were signs of this style. The Rolls Royce car is a fine example of the same style (Fig. 5.1b.3 & 5.1b.4). This part explores Classicism in architecture and examines its bearing on car forms of this era.

Classicism in architecture developed during the Italian Renaissance. It lays emphasis on symmetry, proportion, geometry and the regularity of parts as demonstrated in the architecture of Classical antiquity.



Figure 5.1b.3: 1591 Classicism in architecture Villa Rotonda front (Left) 1934 Rolls Royce car UK¹ (Right)

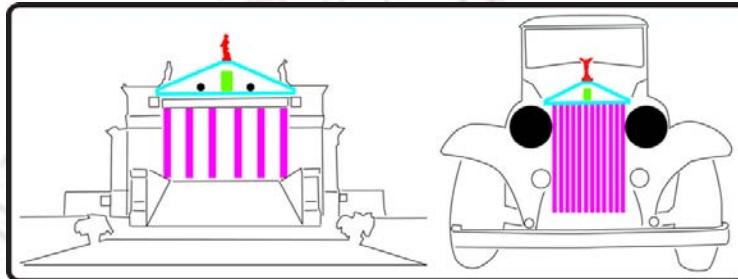


Figure 5.1b.4: Tracing the impact of Classicism in architecture and Rolls Royce

The best examples are seen in the architecture of ancient Rome where one can find symmetrical forms and regular arrangement of columns and lintels, as well as the use of arches, hemispherical domes, niches and aedicule which replaced irregular profiles of medieval buildings (Chitham 2005).

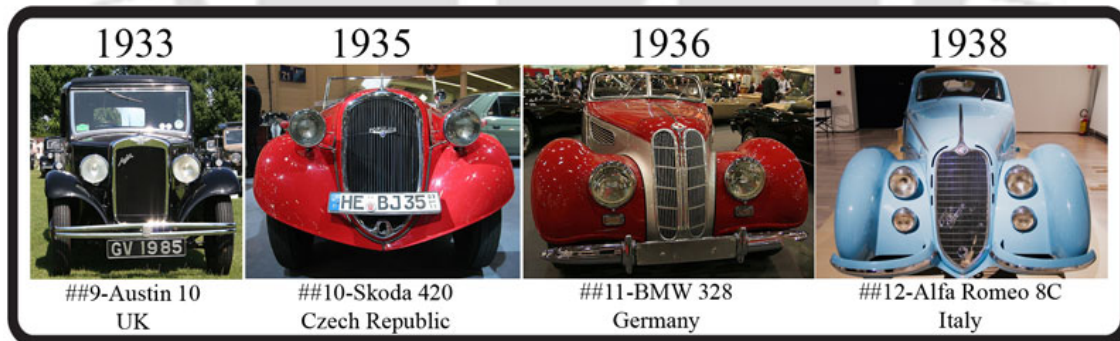


Figure 5.1b.5: Classic era²

In the seventeenth century architects Inigo Jones and Christopher Wren established classicism in England. The architecture style that evolved seems to have influence on

¹ http://en.wikipedia.org/wiki/File:Villa_Rotonda_front.jpg
<http://www.flickr.com/photos/45777493@N06/4683175136/> accessed in July 2010.

² <http://www.flickr.com/photos/nakedcharlton/192841446/>
<http://www.flickr.com/photos/cicciopizzettaro/344090055/> accessed in July 2010.

classicism in car design of this era. The pre-war part of the classic era in car face design began with the Great Depression in 1930, and ended with the recovery after World War II, commonly placed at 1938 (Chitham 2005 and Berger 2001). During this period designers used classicism style to design radiator, windscreen, bumper, lights and fenders. Some parts like lights and engine cover were located in same position as in the previous era but other parts were seen to be get partially integrated into one unified form. The *Start's construction group* was also removed during the classic era, however retaining the hole for the crank in place. (Fig. 5.1b.5) (Halberstam 1986).

E1b.2.4 Integration era

In the integration era all parts were joined completely eliminating the negative space between them. The radiator shifted to the engine space and was replaced by the grille instead. The fan that was not visible was placed between the radiator and engine for cooling. Here a second electrical engine was installed to turn on the gasoline engine, eliminating the need of a handle. Hence the hole of *Start's construction group* was eliminated. The circular shape of lights remained unchanged between 1885 to 1966 however the lights were embedded inside the engine cover and only the lenses were made visible. Mudguards too were completely merged with the engine cover. The compulsory number plate created a problem. The simple rectangular plate attached to the car body was difficult to modify and were retained.



Figure 5.1b.6: Integration era¹

In this era the designers used the prevalent glass technology while designing the windscreen. This technology had lesser limitation and led to a good composition. The

¹ <http://www.flickr.com/photos/rud66/4837324837/>
<http://www.flickr.com/photos/kneebeau/4785077746/in/set-72157594383518195/>
<http://www.flickr.com/photos/imagetaker1/4691132188/> accessed in July 2010.

curved form of the windscreen, merged beautifully with the car body. The car guard (fenders) went closer to the lower grille and pair of indicating lights was added to car face. (Fig. 5.1b.6)

E1b.2.5 Modern era

Modern era is the best period of car designing in car history. In this era designers extensively used a large surface of glass on the car in order to add to the aesthetics. Some manufacturers put small windscreen for showcasing power and strength of the car body while others resorted to big windscreen to ensure good visibility and improved safety while driving. While adhering to prevalent glass technology, designers could use complex forms for windscreen with fewer limitations. This era can also be attributed for bringing sophistication to mirrors and brands. (Fig. 5.1b.7) (Weston 1998).



Figure 5.1b.7: Modern era¹

This era saw the car-guard (bumper) fade with the engine cover making it completely integrated. One can see that car faces became expressive and slowly began resembling human faces or animal faces. However, this is only speculative and such a hypothesis needs to be further researched.

E1b.3 Discussion

Every era was invincible for the evolution of car face. Invention era was concentrated on functionality of the car alone. This era was very weak in terms of car face aesthetics.

¹ <http://www.flickr.com/photos/blondygirl/2735203387/>
<http://www.netcarshow.com/> accessed in July 2010.

Construction group era was a primary movement for car face because in this era designers understood about users' need and subsequently Construction groups emerged for resolving these needs.

Classic era was the first era when designers started to design for visual needs involving aesthetic parameters.

Integration era is a connecting era between classic and modern era. Elements of classic and modern eras together are seen reflected in the car aesthetics during this transition phase.

It is seen that during all these eras the head of the car face was consistently used for branding but it is only during the Integration era that some of designers have put brand symbols on either side of car face without taking the element of symmetry into consideration, For example (Fig. 5.1b.8) in the Raymond Loewy design for the upscale 1962 Studebaker Avanti which received critical acclaim for its sculpted contour, but did not find a niche in a luxury market dominated by the more familiar General Motors Cadillac and Ford Lincoln (Raizman 2003 and Dormer 1995).



Figure 5.1b.8: Brand in Modern era¹

The identities in these brands were of three categories: a) words sign b) graphical sign c) sculpture with human figure, animal figure and objects (Fig. 5.1b.9 & 5.1b.10). Some cars also included all of these elements together; to define the character and identity for the car manufacturer.

¹ http://en.wikipedia.org/wiki/File:1973_Simca_1000_GL.JPG
<http://www.hotautoweb.com/sites/default/files/classic-car-images/691/1963-Studebaker-Avanti-R1-Exterior-03.jpg/> accessed in July 2010.



Figure 5.1b.9: Sculpture in car face¹



Figure 5.1b.10: Brand in car face²

E1b.4 Conclusion

In last few eras car faces occupied an important position as most designers saw that the car face was the best place for conveying emotional expressions. In the modern era one can see the influence of the human face or animal face reflected in the ‘front face’ of the form of the car. This aspect has formed an interesting consideration in evolving good hypotheses for further research outlined in the subsequent chapters.

Further one can evaluate the element of brand sign and their influence on evolving an identity for the car as seen in the classic era.

¹ <http://www.flickr.com/photos/grumnall/2636976192/>
<http://www.flickr.com/photos/sjb4photos/3739859456/>
http://www.flickr.com/photos/cadillac_v16/3689293070/ accessed in July 2010.

² <http://www.flickr.com/photos/em2me/6164233/>
<http://www.flickr.com/photos/30217550@N08/2845521443/>
<http://www.zigwheels.com/Cars/Tata-Motors--Delhi--Price/> accessed in July 2010.

In the last two experiments, we saw the effect of technology, fashion, artistic element and lifestyle on car design, though the impact of culture was much more dominant.

After comparative analysis on car evolution, car forms and car faces, the designers evolved emotional design, especially in the last two eras - integration era and modern era - where designers understood that **car face is the best position for conveying emotional expressions**.

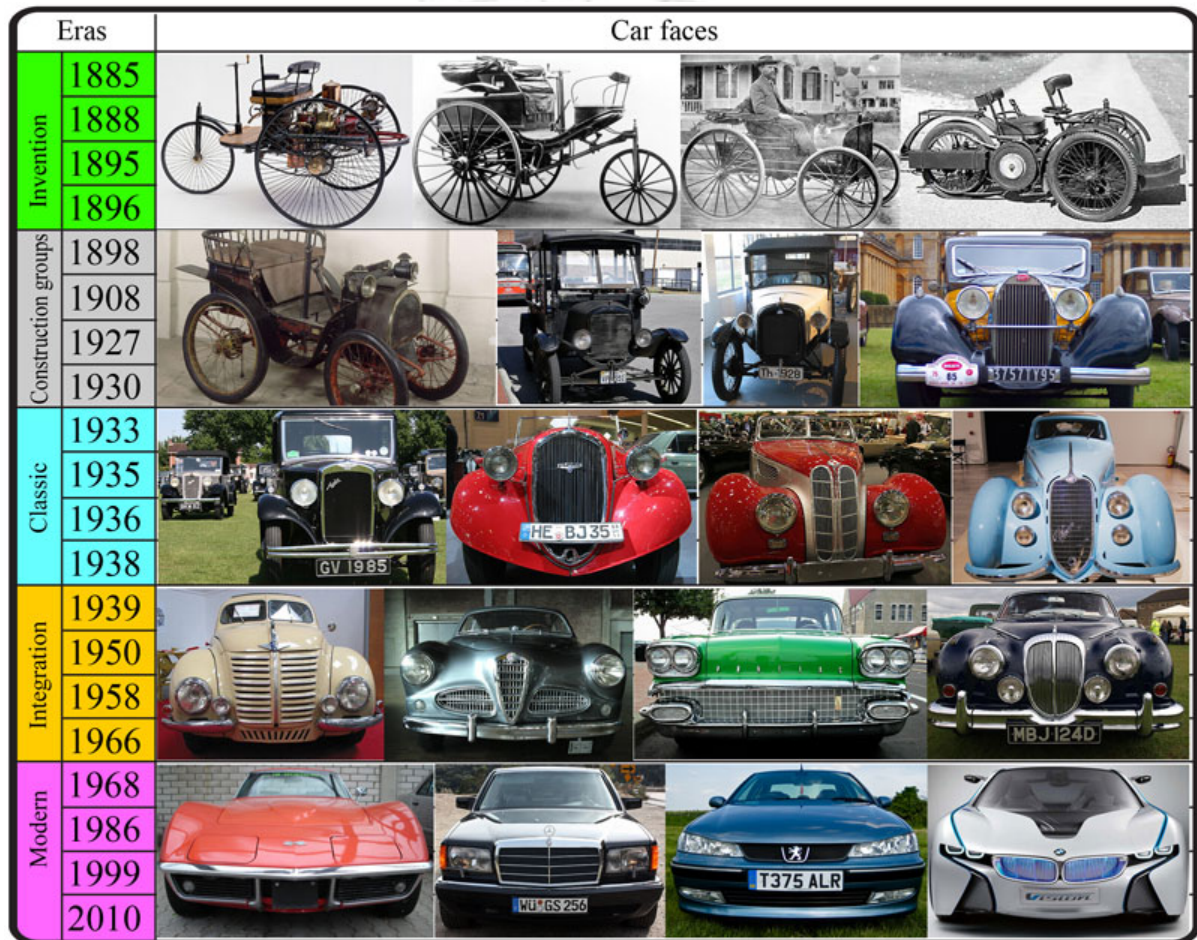


Figure 5.1b.11: Time line of car faces

Experiment 1c

User response in identification of Effective Visual elements of form

The permanent element in making that corresponds to the element of form in art is man's aesthetic sensibility. Sensibility as such we may assume static. What is variable is the interpretation which man gives to the forms of art, which are said to be 'expressive' when they correspond to his immediate feeling. But for the same forms, man can have a different expressive value, not only for different people, but also for different periods of civilization. ... Form, though it can be analyzed into intellectual terms like measure, balance, rhythm and harmony is really intuitive in origin. Read (1972)

E1c.1 Overview

Speech as a means of communication cannot strictly be separated from the whole of human communicative activity, which includes the visual. The visual language is a system of communication using visual elements. The term 'language' in relation to vision is an extension of its use to describe the perception, comprehension and production of visible signs.

Designers use visual elements to make visual meaning. Whether geometric or organic, all forms are built on basic visual elements - dots, lines, surfaces, color and texture volumes (Bowers, 1999). These visual elements come together in a holistic form have relation together and it is not easy to claim which amongst them is more effective than the other. Uncovering and identifying certain aspects on visual design needs more understanding.

In a good design, users can derive a useful meaning from the product. This meaning can be an emotional expression that users sense. A study of the relation between visual elements and user's feeling could help designers understand better what constitutes good Design.

Mowen and Minor (2008) state that a designer is faced with the challenge of making a product appear meaningful to the buyer as it stands amongst many other kinds of similar products. Further, the design is expected to convey different meaning about itself when viewed from different angles or different distances (Federick 2007). It may be noted that when seen from a distance, a product's macro elements change to microelements, bringing about a change in its appearance and the meaning it delivers.

These considerations lead one to the question as to, which amongst the different visual elements existing on car designs, prove important or more effective in the communication of the car expression to the end user. How can these visual elements be identified? Further, are these visual parameters measurable?

Lord Kelvin states:

“When you can measure what you are speaking about and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in number, your knowledge is of a meager and unsatisfactory kind: it may be the beginning of knowledge but you have scarcely in your thoughts, advanced to the stage of science” (Sterling 2005)

It is only after clear understanding of concepts that one can have a measurable test about visual elements in car design.

E1c.2 Design of Experiment

The aim of experiment 1c is to seek possible explanation and identify the visual elements (texture, color, form etc.) that is most suitable for transferring emotional value or emotional communication from product to user – in the car?'. It highlights the visual element that may be effective in car designing and also finds out as to which portion of the car body is best suited for placing any meaning. The design of the experiment first involved generating a set of photographic images of car forms comprising the visual elements of car form. Using this as the reference for enquiry, responses are sought from users to seek their response to the visual form of the car face.

E1c.3 Experiment

The experiment was planned in the following manner:

E1c.3.1 Selection of cars sample:

Shown below are 21 views of car samples (12 cars) shortlisted and used in this preliminary test. (Appendix 1 gives detailed information about these cars). The 21 views (of the 12 cars) samples were chosen by consensus and in discussions with three professional car designers (List of agents and consultants is in the appendix 5).



Figure 5.1c.1: Car 9L



Figure 5.1c.2: Car 9R



Figure 5.1c.3: Car 10L



Figure 5.1c.4: Car 10R



Figure 5.1c.5: Car 11R



Figure 5.1c.6: Car 12L¹



Figure 5.1c.7: Car 12R



Figure 5.1c.8: Car 13L²



Figure 5.1c.9: Car 13R³



Figure 5.1c.10: Car 14L⁴



Figure 5.1c.11: Car 14R



Figure 5.1c.12: Car 15L

¹ <http://jalopnik.com/174948/primp-my-ride-ancel-chickifies-mitsubishis-i-car/> accessed in July 2010.

² http://www.sheargowda.com/wordpress/wp-content/uploads/2008/01/1_lakh_06.jpg/ accessed in July 2010.

³ http://www.canim.net/araba/images/Jeep_Wrangler_105_1024x768.jpg/ accessed in July 2010.

⁴ http://cache.jalopnik.com/assets/resources/2008/01/Mahindra_Axe1.jpg/ accessed in July 2010.



Figure 5.1c.13: Car 15R



Figure 5.1c.14: Car 16L ¹



Figure 5.1c.15: Car 16R ²



Figure 5.1c.16: Car 18L



Figure 5.1c.17: Car 18R



Figure 5.1c.18: Car 19L ³



Figure 5.1c.19: Car 19R ⁴

¹<http://partizan.parsiblog.com/-421371.htm>/accessed in November 2008.

<http://iranianarmy.mihanblog.com/post/archive/1386/12/>accessed in November 2008.

² http://en.wikipedia.org/wiki/File:1998_Suzuki_Jimny_01.jpg/ accessed in July 2010.

³ http://en.wikipedia.org/wiki/File:Daewoo_Matiz.jpg/ accessed in July 2010.

⁴ http://en.wikipedia.org/wiki/File:Chevrolet_Matiz_SE_front.jpg/ accessed in July 2010.

Table 5.1c.1: Identification of Car with associated expression

No	Car No.	Expressions
1	9L	Speedy
2	10L	Speedy
3	11R	Femininity
4	12L	Femininity
5	13L	Tenderness and softness
6	14L	Harshness and violence
7	15L	Harshness and violence
8	16R	Softness
9	13R	Novelty and freshness
10	18L	Speedy
11	19R	Seriousness

E1c.3.2 Planning Questionnaire 1:

This preliminary experiment set out to seek user response to ‘Expressive words’ association vis a vis a set of car forms. The experiment sought to evaluate an overall understanding of user response to visual expression of the car form. In particular questions were planned to gauge those visual elements (texture, color and form...) that the user felt were the most suitable for transferring emotional value or emotional communication on the different profiles / views of the car. Sample Size: In this research, out of a total of 65 subjects belonging to Iran, 40 (61.5%) were men and 25 (38.5%) were women.

E1c.3.3 Structure of Questionnaire 1:

The experimental set up and data collection method were designed to be put on the Internet. The questionnaire¹ was segmented into four steps. (Refer Appendix 2)

Introduction: The questionnaire explained the purpose of data collection.

General information on profile of the user: The questionnaire had 8 questions about Age, Gender, Nationality, Education and Job etc.

Emotional categorizing: This part of the questionnaire was planned to consist of 11 questions pertaining to emotional expression and corresponding categories of expression on the car form.

A set of 21 views of cars that were shortlisted for this study viz. 9L (in two views), 9R (in two views), 10L, 10R, 11R, 12L, 12R, 13L, 13R, 14L, 14R, 15L, 15R, 16L, 16R, 18L,

¹ <http://www.iraniandesign.com- Questionnaire>

18R, 19L and 19R) were presented in pairs. The respondent was asked to select the one that corresponded to the given expression.

The questions were posed as per the sequence below:

-Which car do you think conveys a sense of speed better than the other? (Q9, Q10 and Q18)

-Which car do you think communicates a sense of femininity? (Q11 and Q12)

-Which car do you think conveys a sense of tenderness and softness better than the other?

-Which car do you think conveys a sense of harshness and violence better than the other? (Q14 and Q15)

-Which car do you think conveys more sense of softness?

-Which car do you think conveys a sense of novelty and freshness better than the other?

-Which car do you think conveys a sense of seriousness better than the other?

Submission of responses: In this part of the questionnaire the respondents were required to press the submit button to send their data to database.

E1c.4 Data Analysis

Selected results for questions have been statistically compiled from the data collected and analysis of the data was done by generating Pie charts. Percentages emerged for each pair of car pictures per question.

In Questions 9 “Which car do you think conveys a sense of speed better than the other?” 72.3 percent of subjects selected car 9L as a ‘speedy’ car. It implied that the graphical patterns (2-dimensional design) on sides of the 9L car conveyed the expression of speed for the subjects. Here both samples are of the same model belonging to the same company but differ in terms of the graphical design.

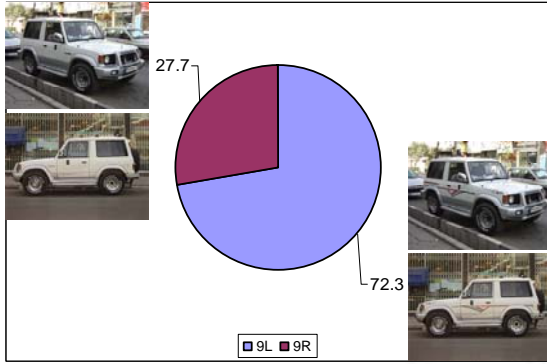


Figure 5.1c.20: Question 9 (n=65)

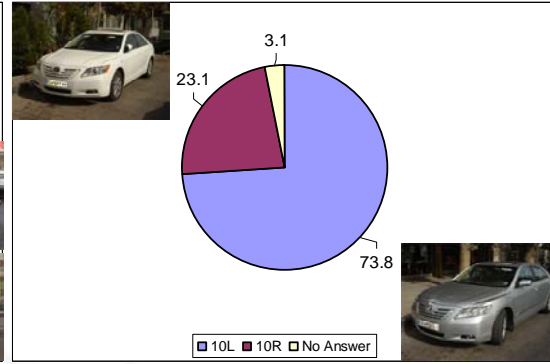


Figure 5.1c.21: Question 10 (n=65)

In Questions 10 “Which car do you think conveys a sense of speed better than the other?” 73.8 percent of subjects selected car 10L as a speedy car. It indicated that the reflection of the silver color in car body conveyed the expression of speed for the subjects. Here both samples are of the same model belonging to the company but differ in terms of the color.

In Questions 11 “Which car do you think communicates a sense of femininity?” 72.3 percent of subjects selected car 11R as a feminine car. Here the light metallic blue color in car body contained a feminine expression for the subjects. Here both samples are of the same model belonging to the company but differ in terms of the color.

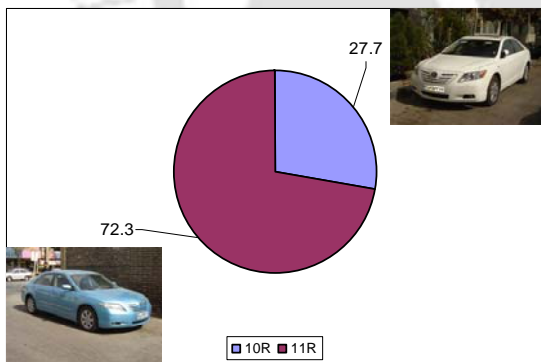


Figure 5.1c.22: Question 11 (n=65)

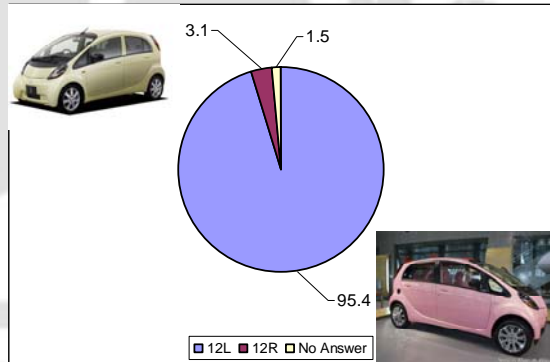


Figure 5.1c.23: Question 12 (n=65)

In Questions 12 “Which car do you think communicates a sense of femininity?” 95.4 percent of subjects selected car 12L as a feminine car which means that the pink color in car body held a feminine expression for the subject. Here also both the samples are of the same model belonging to the company but differ in terms of the color.

In Questions 13 “Which car do you think conveys a sense of tenderness and softness better than the other?” 98.5 percent of subjects selected car 13L. It means that the

curvilinear angels and rounded arches in car body of 13L, indicated a sense of tender and soft expression for the respondents.

In Questions 14 “Which car do you think conveys a sense of harshness and violence better than the other?” 98.5 percent of subjects selected car 14L as one that indicates harshness and violence in cars.

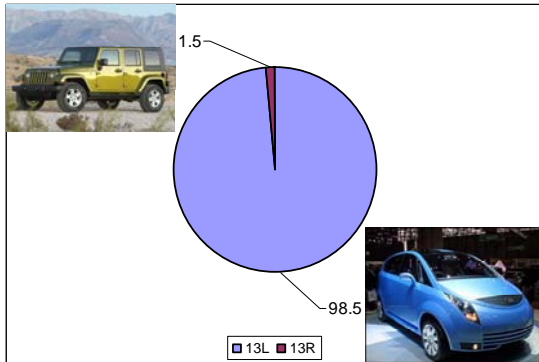


Figure 5.1c.24: Question 13 (n=65)

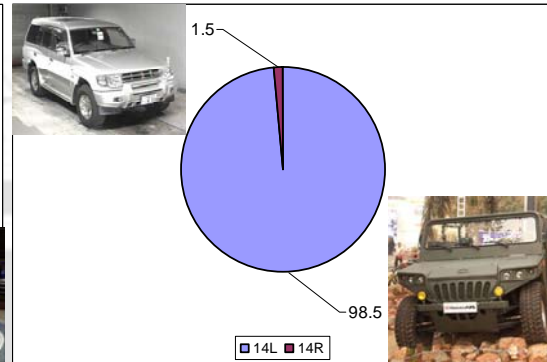


Figure 5.1c.25: Question 14 (n=65)

In Questions 15 “Which car do you think conveys a sense of harshness and violence better than the other?” 95.4 percent of subjects selected car 15L as a violent car, it means the vertical lines of grill can lead to an aggressive expression for subjects. Here both samples are of the same model belonging to the same company but different in grill design.

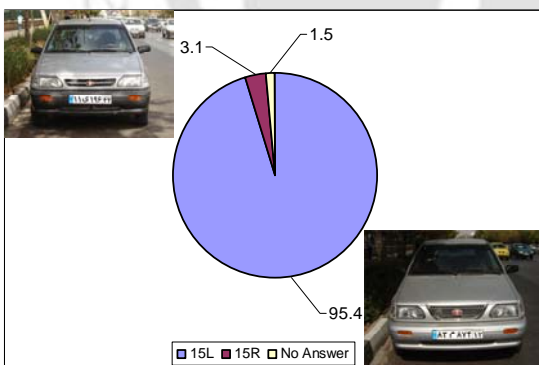


Figure 5.1c.26: Question 15 (n=65)

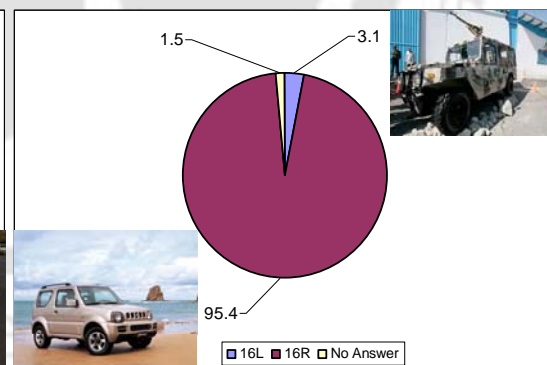


Figure 5.1c.27: Question 16 (n=65)

In Questions 16 “which car do you think conveys a sense of softness?” 95.4 percent of subjects selected car 16R as a soft car which implied that the curvilinear angels and rounded arch in car body expressed softness.

In Questions 17 “Which car do you think conveys a sense of novelty and freshness better than the other?” 92.3 percent of subjects selected car 13R as a novel and fresh car. It

implied that the texture and reflection in car body incited fresh feelings amongst the respondents.



Figure 5.1c.28: Question 17 (n=65)

Figure 5.1c.29: Question 18 (n=65)

In Questions 18 “Which car do you think conveys a sense of speed better than the other?” 81.5 percent of subjects selected car 18L as a speedy car implying that the graphical pattern by the sides of car body expressed speed for the respondents. Here both samples are of the same model belonging to the same company but differ in terms of graphical patterns.

In Questions 19 “Which car do you think conveys a sense of seriousness better than the other?” 87.7 percent of subjects selected car 19R as a serious car, which implied that the car face conveyed the expression of seriousness amongst the respondents. Here both the samples were of the same model but different companies.

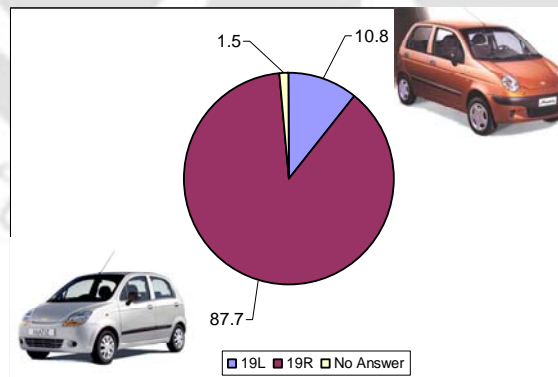


Figure 5.1c.30: Question 19 (n=65)

E1c.5 Discussions and Inferences

From the study it is seen that users are very responsive and sensitive to the different expressive aspects of the visual elements of form. Further the car face proves to be a

significantly important area in conveying expression of the car and has resulted in narrowing the focus of this research on to the car face as the best visual position for placing various meanings as well as expressions on the car form.

It is seen from user response that all visual elements points, lines, volumes, color and texture contribute in a significant and holistic manner to the expressive quality of the car. Aesthetics occurs due to the presence of harmonious relationships between different elements of a composition and due to the quality of visual elements themselves (Federick, 2007). Hence although form becomes an important parameter of expression what needs to be identified further amongst the different visual elements:

1. Is there a hierarchy and order amongst these visual elements that influence the aesthetics.
2. What attributes of the visual elements contribute to the different expressive qualities the car form.

In the next section 2, two experiments were undertaken with the following specific objectives.

2a: To identify the key visual elements on the front face of the car form in order of visual hierarchy and visual order using subjective assessment and technique of Eye tracking; and

2b: To undertake a qualitative analysis of visual elements on the front face of the selected set of car faces to identify attributes that contribute to the expression of the car form following a process of analysis of form.

The detailed process of setting up the experiment, planning and conducting is outlined accordingly.

Chapter 5

Section 2

Conducting the Experiments in Details

5.0 Overview

It was deduced in the earlier section that the overall form of the car along with colour and surface graphics contribute in a significant manner to the expression of the car form. Amongst these visual elements the car front face plays a dominant and significant role that carries the cars expression, followed by the rear side. Based on this assumption the face of the car has been chosen for the different experiments to follow. The aim of these experiments is to identify if there exists a hierarchy in the visual order amongst the different visual elements and the attributes of these visual elements that contribute to the different expressive qualities of the car form. The different techniques /methods highlighted in chapter 3 form the basis to meet these objectives through the following set of experiments below:

- Experiment 2a:
Undertake a qualitative analysis of visual elements on the front face of the selected set of car faces to identify attributes that contribute to the expression of the car form following a process of assessment by a professional designer. To identify and map the key visual elements on the front face of the car form in order of visual hierarchy and visual order using the technique of Eye tracking method.
- Experiment 2b:
Undertaking cross verification of users response to car expression vis a vis key visual elements on the same set of car faces identified in experiment 2a using Co-relation Techniques.
- Experiment 3a:
Draw inferences of user emotional response to car form through a measure of respondents' feeling to a selected set of car faces vis-a-vis expressions of animal and human faces based on Repertory Grid Technique (RGT).
- Experiment 3b:

To study and measure respondents' feeling to a selected set of car faces vis-a-vis expressions of animal and human faces based on Semantic Differential Technique. From the above study summarize inferences of user emotional response to car form.

- Experiment 4:

Study and measure the respondents' emotional reaction to visual key vis a vis car faces using Relation Technique. Discovering the relation between car face vis a vis emotional word expression using Relation Technique.

Drawing conclusions from the above experiments, a heuristic set of guidelines forming the visual key that designers can use in the design of the visual form of the vehicle is deduced.

Planning the Experiments

The detailed process of setting up the experiment, planning and conducting them, analysis and inferences drawn are outlined in the following section.

5.1 Creating the visual database for the empirical experiments

This section comprises of the following:

- Creation of a visual database for the experimental study to be conducted with users based on a semantic framework.
- Creation of a visual database of car front face
- A design of a second questionnaire planned to be put up on the Internet to collect data from the users.

Inferences and insights are summarized for each experiment.

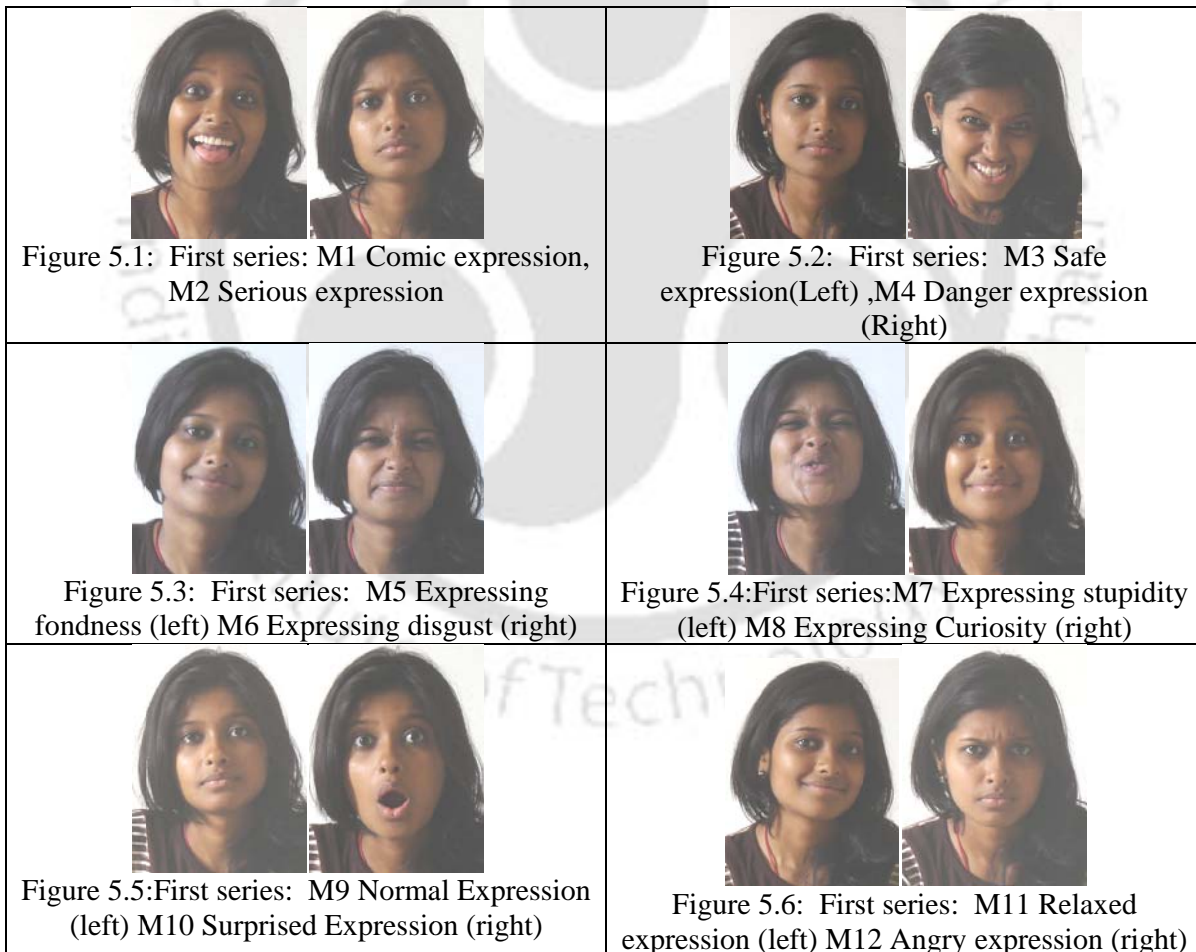
5.1.1 Generating visual database of Human faces expression and word expression

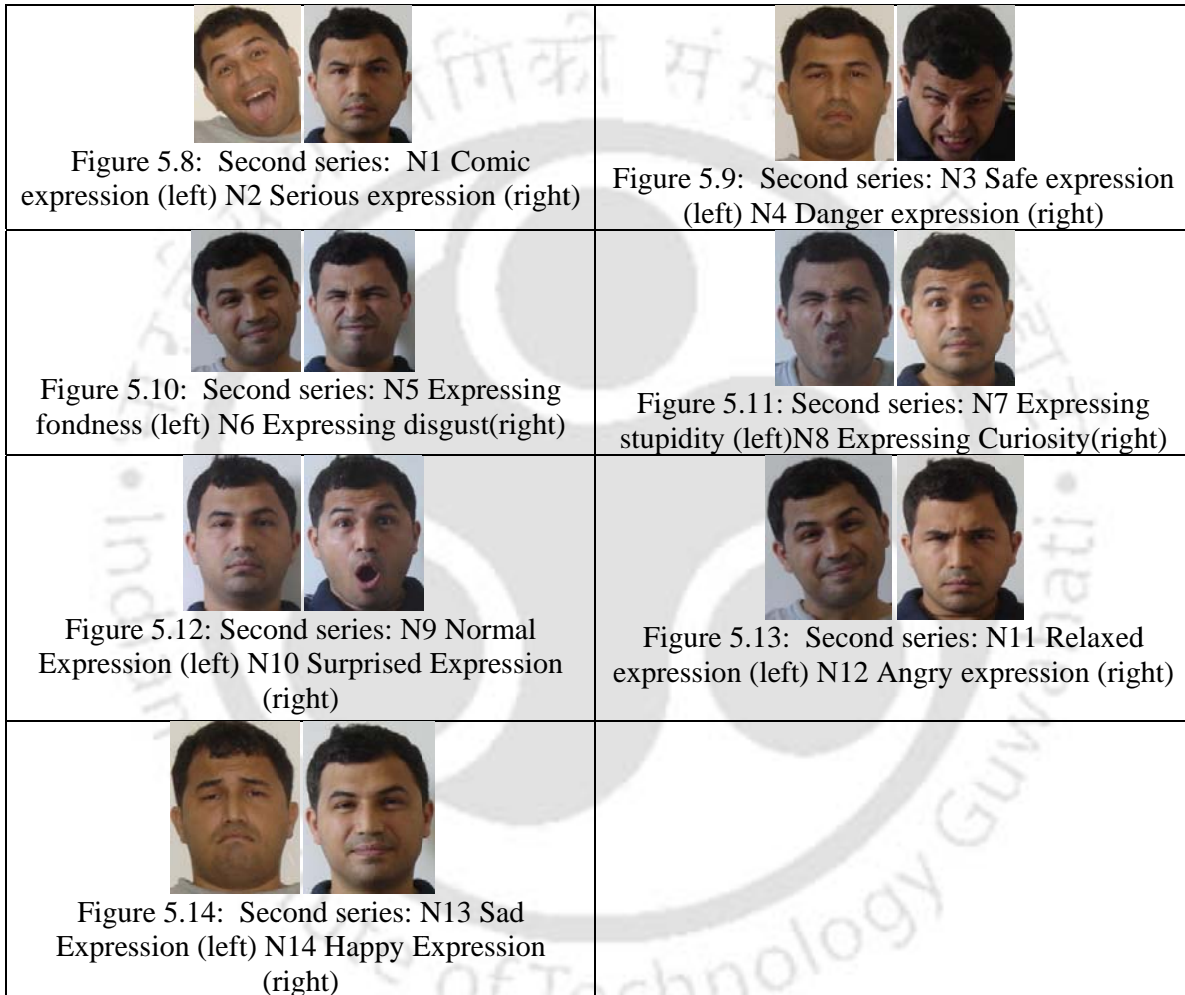
Here, a young Indian female and a young Iranian male model were chosen for generation of facial expression for a set of word expressions and the same was captured photographically to create the visual database for human face expressions. The male and female models were asked to act out a given emotional expression and the reaction was captured on camera (Picture signifying each emotional expression). For instance the model was asked to give

'happy' expression (as a Signifier) and the photo-image captured the reaction (as signified). These two series captured the emotions like comic, serious, safety, danger, disgust, fondness, stupidity, curiosity, normal, surprised, relaxed, anger, sadness and happiness.

The 14 facial expression samples of Indian female (Fig. 5.1 to 5.7) were chosen from a set of 28 images through consensus and discussions between three professional car designers who based their judgment on expressive qualities in car styling, gender representation and emotional expression (List of the consultants are in the appendix 5). The second series consisting of the Iranian male as the subject, (Fig. 5.8 to 5.14) was rejected for the purpose of these experiments.

The contrasting emotions have been placed as a bi-polar pair to meet the requirements of the Co-relation technique, Repertory Grid technique and Semantic Differential technique to represents the element of similarity and contrast poles.









5.1.2 Generating visual database of Animal faces expression and word expression

Following a similar process of selection, in this instance a series of 14 animal face samples were selected (Fig. 5.15 to 5.21) from a total of 40 animal faces of probable samples for a set of word expressions used for conducting experiments. The 14 final animal face samples were chosen based on consensus and discussions between three professional designers who took

into consideration the issues of expressive qualities in car styling, gender representation and emotional expression for the signified.

 <p>Figure 5.15: First series: Z1 – Dog, Comic expression (left) Z2 - Cobra, Serious expression (right)</p>	 <p>Figure 5.16: First series: Z3 - Lamb, Safe expression (left) Z4 - Shark, Danger expression (right)</p>
 <p>Figure 5.17: First series: Z5 - Panda, Expressing fondness (left) Z6 - Fox, Expressing disgust (right)</p>	 <p>Figure 5.18: First series: Z7- Ostrich, Expressing stupidity (left) Z8 - Rabbit, Expressing Curiosity (right)</p>
 <p>Figure 5.19: First series: Z9 - Goose, Normal Expression (left) Z10 - Monkey, Surprised Expression (right)</p>	 <p>Figure 5.20: First series: Z11 – Camel, Relaxed expression (left) Z12 - Cheetah, Angry expression (right)</p>
 <p>Figure 5.21: First series: Z13 – Dog, Sad Expression (left) Z14 – Frog, Happy Expression (right)</p>	

5.1.3 Generating visual database of Car faces sample

The visual database for the car face was created through a selection of images down from www.netcarshow.com (For details refer Appendix1). These were then shortlisted through discussions and consultation with three professional car designers who selected 35 car faces based on their judgment on expressive qualities in car styling, gender representation and emotional expression. These 7 set (each set comprising 5 images) formed the visual database

for the car faces series D1toD5 / F1toF5 / G1 to G5/ H1 to H5 / J1 to J5 / K1 to K5 / L1 to L5 and are shown below.



Figure 5.22: D1, car face manufactured in 2003¹(Left) D2, car face manufactured in 2007²(Right)



Figure 5.23: D3, car face manufactured in 2010³ (Left) D4, car face manufactured in 2011⁴(Right)



Figure 5.24: D5, car face manufactured in 2009⁵ (Left) F1, car face manufactured in 2009⁶(Right)



Figure 5.25: F2, car face manufactured in 2006¹(Left) F3, car face manufactured in 2008²(Right)

¹http://www.netcarshow.com/volkswagen/2003-new_beetle_sport_edition/ accessed in July 2010.

²http://www.netcarshow.com/toyota/2007-ft-hs_concept/ accessed in July 2010.

³<http://www.netcarshow.com/acura/2010-zdx/> accessed in July 2010.

⁴<http://www.netcarshow.com/mini/2011-countryman/> accessed in July 2010.

⁵http://www.netcarshow.com/bugatti/2009-veyron_fbg_par_hermes/ accessed in July 2010.

⁶http://www.netcarshow.com/lexus/2009-lf-ch_concept/ accessed in July 2010.



Figure 5.26: F4, car face manufactured in 2008³(Left) F5, car face manufactured in 2001⁴(Right)



Figure 5.27: G1, car face manufactured in 2010⁵ (Left) G2, car face manufactured in 2010⁶(Right)



Figure 5.28: G3, car face manufactured in 2009⁷(Left) G4, car face manufactured in 2004⁸(Right)



Figure 5.29: G5, car face manufactured in 2008⁹(Left) H1, car face manufactured in 2008¹(Right)

¹http://www.netcarshow.com/mazda/2006-nagare_concept/ accessed in July 2010.

²http://www.netcarshow.com/seat/2008-leon_ecomotive/ accessed in July 2010.

³http://www.netcarshow.com/lexus/2008-lf-a_roadster_concept/ accessed in July 2010.

⁴http://www.netcarshow.com/mercury/2001-cougar_zn/ accessed in July 2010.

⁵http://www.netcarshow.com/wiesmann/2010-roadster_mf5/ accessed in July 2010.

⁶http://www.netcarshow.com/mercedes-benz/2010-glz_350_4matic/ accessed in July 2010.

⁷http://www.netcarshow.com/mitsubishi/2009-i_miev_sport_air_concept/ accessed in July 2010.

⁸http://www.netcarshow.com/dodge/2004-sling_shot_concept/ accessed in July 2010.

⁹http://en.wikipedia.org/wiki/Tata_Nano/ accessed in July 2010.



Figure 5.30: H2, car face manufactured in 2004² (Left) H3, car face manufactured in 2009³(Right)



Figure 5.31: H4, car face manufactured in 2010⁴ (Left) H5, car face manufactured in 2011⁵(Right)



Figure 5.32: J1, car face manufactured in 2009⁶ (Left) J2, car face manufactured in 2012⁷(Right)



Figure 5.33: J3, car face manufactured in 2008⁸ (Left) J4, car face manufactured in 2011⁹(Right)

¹<http://www.netcarshow.com/jaguar/2008-s-type/> accessed in July 2010.

²http://www.netcarshow.com/jaguar/2004-stype_2.7d/ accessed in July 2010.

³http://www.netcarshow.com/toyota/2009-urban_cruiser/ accessed in July 2010.

⁴<http://www.netcarshow.com/toyota/2010-iq3/> accessed in July 2010.

⁵http://www.netcarshow.com/toyota/2011-auris_hsd/ accessed in July 2010.

⁶http://www.netcarshow.com/bmw/2009-efficientdynamics_concept/ accessed in July 2010.

⁷<http://www.netcarshow.com/opel/2012-ampera/> accessed in July 2010.

⁸http://www.netcarshow.com/bmw/2008-m1_concept/ accessed in July 2010.

⁹<http://www.netcarshow.com/bentley/2011-mulsanne/> accessed in July 2010.



Figure 5.34: J5, car face manufactured in 2010¹(Left) K1, car face manufactured in 2005²(Right)



Figure 5.35: K2, car face manufactured in 2007³(Left) K3, car face manufactured in 2011⁴(Right)



Figure 5.36: K4, car face manufactured in 2008⁵(Left) K5, car face manufactured in 2009⁶(Right)



Figure 5.37: L1, car face manufactured in 2009⁷ (Left) L2, car face manufactured in 2007⁸(Right)

¹http://www.netcarshow.com/alfa_romeo/2010-2uettottanta_concept/ accessed in July 2010.

²http://www.netcarshow.com/smart/2005-crosstown_showcar/ accessed in July 2010.

³http://www.netcarshow.com/renault/2007-kangoo_compact_concept/ accessed in July 2010.

⁴<http://www.netcarshow.com/audi/2011-a1/> accessed in July 2010.

⁵http://www.netcarshow.com/peugeot/2008-rc_concept/ accessed in July 2010.

⁶<http://www.netcarshow.com/toyota/2009-iq/> accessed in July 2010.

⁷<http://www.netcarshow.com/ferrari/2009-california/> accessed in July 2010.

⁸http://www.netcarshow.com/lotus/2007-hot_wheels_concept/ accessed in July 2010.



Figure 5.38: L3, car face manufactured in 2007¹ (Left) L4, car face manufactured in 2009²(Right)



Figure 5.39: L5, car face manufactured in 2011³

5.1.4 Creating the Graphical car face samples

It may be noted that most visual and relational elements of form can be used singly or combined in gradation to achieve various effects. The unit form can have variations in gradation of shape, size, color, texture, direction, position, space and gravity (Wong 1993). In this section a visual database has been graphically generated comprising of a series of 20 front faces of cars that have been derived in the form of only line drawings. The objective is to keep the overall profile of the car form constant and have only variations of lines to generate the different visual expressions of the car form. These graphical set of car forms are to be used as a sign to study emotional response to the expression of the car face. These car forms have been generated by extracting key visual elements drawn from the visual database of the selected 35 cars that correspond to expressions such as serious, dangerous, disgust, fondness, curiosity, surprise, relaxed, angry, sadness and happiness. These car profiles are first abstracted from photographs of selected cars and subsequently superimposed on the car face through morphing to generate the intermittent car profiles.

For example car profiles C5 and C15 were derived from car D1 and car H2.

And the intermediate car profile C10 was derived from C5 and C15 through morphing.

¹http://www.netcarshow.com/buick/2007-riviera_concept_coupe/accessed in July 2010.

²http://www.netcarshow.com/bugatti/2009-galibier_concept/accessed in July 2010.

³http://www.netcarshow.com/mercedes-benz/2011-sls_amg_us_version/accessed in July 2010.

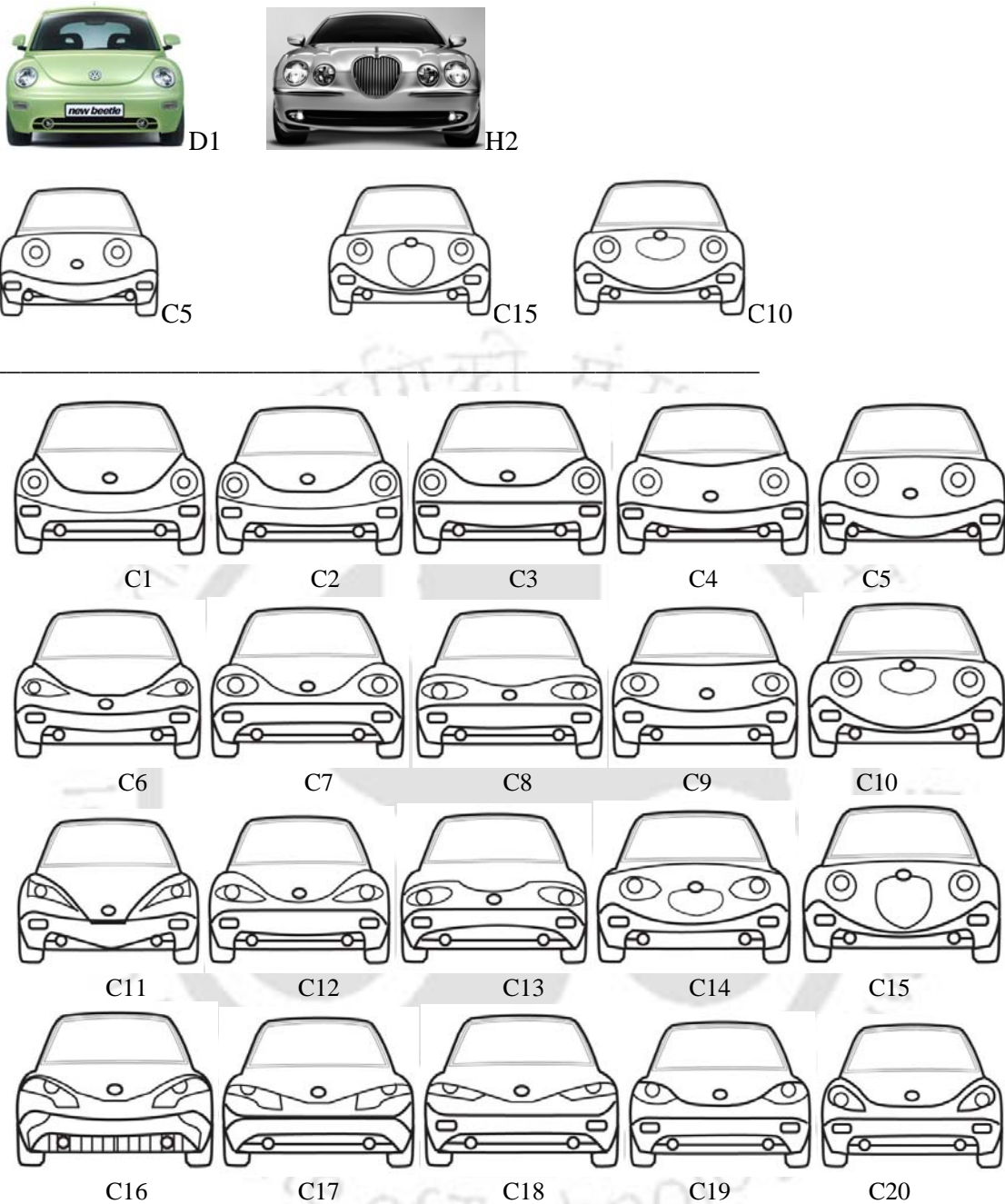


Figure 5.40: Graphical car face: C1, C2, ..., C20 from top, right to left

5.2 Planning Questionnaire 2

The experimental set up and data collection seeking user response to the different experiments was planned through a questionnaire, rich in graphical content, presented on the internet. The questionnaire was divided into nine segments.

Introduction: The questionnaire explained the purpose of data collection (fig. 5.41, Left)

General information: In this part, 4 questions were given seeking information on the profile of the respondent. These were related to Age, Gender, Nationality and Job. (fig. 5.41, Right)



Figure 5.41: Questionnaire: introduction (Left) General information (Right).¹

Help: A sample question comprising of geometric shapes was introduced to help familiarize the respondents to the questionnaire. (fig. 5.42, Right)

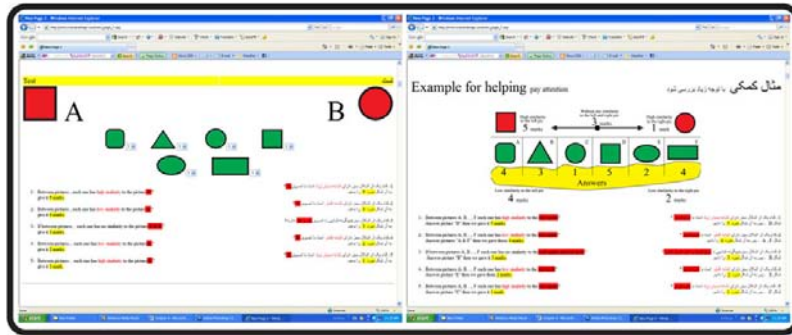


Figure 5.42: Questionnaire put on the internet: Testing (Left) Help (Right).

Test: Before moving on to the prime questions, the questionnaire had a test question to answer (using similar set of geometric shapes). This was to help the researcher to confirm whether the respondent understood categorizing and rating based on similarity or contrast. It was decided that the data would be considered invalid if the respondent failed in this initial test question. (fig. 5.42, Left)

Human face: The questionnaire had 7 questions related to categorizing and comparative rating based on similarity or contrast. 7 pairs of human expressions were presented one after the other and each bi-polar expression was evaluated for similarity or contrast for 7 cars faces (H2, D1, J1, F1, L5, K4 & G5) (fig. 5.43, Left). Responses were analysed using Repertory Grid technique and Semantic Differential technique.

Animal face: The same procedure was followed choosing bi-polar expressions for animal face expressions in place of human faces. (H2, D1, J1, F1, L5, K4 & G5) (fig. 5.43, Right)

¹ <http://www.iraniandesign.com- Questionnaire>

Responses were analysed using Repertory Grid technique and Semantic Differential technique.



Figure 5.43: Questionnaire on the internet: Part of human face expression (Left) Part of animal face expression (Right).

Car categorizing: The questionnaire had 7 questions pertaining to categorizing and rating based on similarity. Here the respondent had to rate 7 pairs of human expressions placed one after the other using (Co-relation Technique. In all 35 cars were shortlisted and presented in sets of 5 cars each question. (H1, H2,...H5, D1, D2,...D5, J1, J2,...J5, F1, F2,...F5, L1, L2,...L5, K1, K2,...K5, G1, G2,...G5) (fig. 5.44)



Figure 5.44: Questionnaire in the internet: car categorizing

Emotional categorizing: This part of the questionnaire had 9 questions pertaining to favorite car face and emotional expression. It also had 20 car faces (C1, C2,...C20) from which the user had to select one for each word expression. (fig. 5.45, Left)

Color and submit: This questionnaire had 2 questions, first one, about favorite color for car and second one requesting the user's email id. The respondent was required to press submit button to send their data to database. (fig. 5.45, Right)

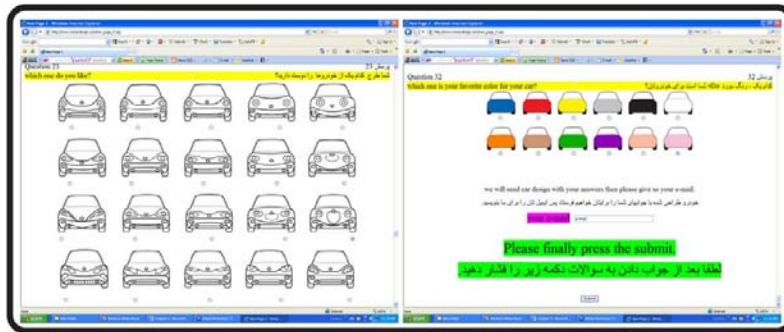
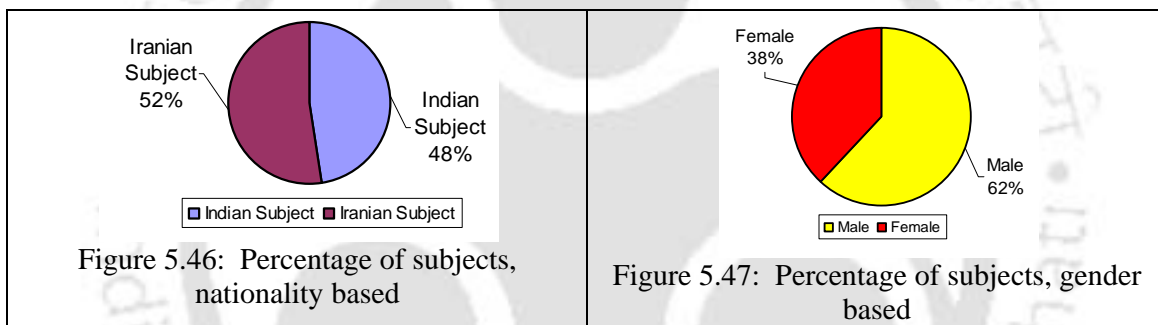


Figure 5.45: Questionnaire in the internet: categorize for Emotional expressions (Left) Color, e-mail and submission (Right).

5.3 Profile of respondents and sample size

All the subjects were from the two Asian countries, India and Iran. Out of the total 126 subjects, there were 60 respondents (48%) from India and 66 respondents (52%) from Iran.

Figure 5.46,



5.4 Gender and Ages:

In this research out of a total of 126 subjects involved in this stage of the experiment, 78 respondents (62%) were men (age 18-54) and 48 respondents (38%) were women (age 18-50).

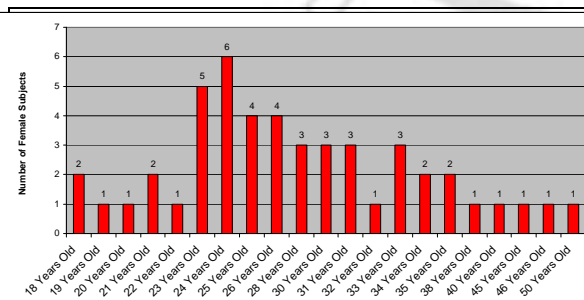


Figure 5.48: Age of female subjects

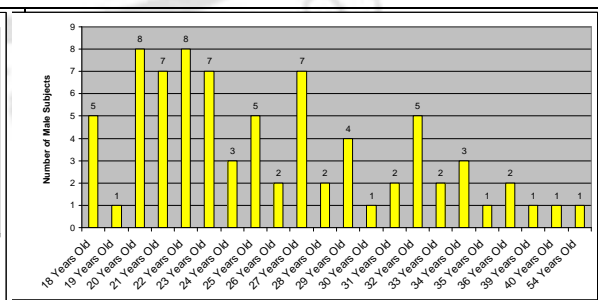


Figure 5.49: Age of male subjects¹

¹ In this research all of the analyzing in experiments 1c, 2b, 3a, 3b, and 4 have been calculated by SPSS software and drawing the graph has been by Excel software.

Experiment 2a

Visual Analysis of car form

E2a.1A brief note on theory of visual perception of form

‘Beauty is the culmination of harmonious relationships among the various elements composed together.’ (Federick 2007)

Aesthetic considerations in products can cover all of psychology, emotions and perception of human mind during purchase or consumption of a product. Sometimes the user develops a positive or negative feeling for a product. Despite harboring such feelings most fail to recognize the reason behind it. The inability to comprehend is common because people cannot analyze all parts pertaining to a complex view of product and then extract meaning out of it.

An understanding of Gestalt’s laws of visual perception is important for understanding how a user perceives visual form by organizing its components into a meaningful whole. Familiarity with the Gestalts theory enhances the designer’s ability to design products more meaningfully. Composition in design refers to the arrangement of visual elements along with color, volume, line, point and other elements. In any product the nature of the composition depends on the interrelation between the positive space (form) and negative space. The movements of the eyes constantly seek important locations when viewing the product. For example Whistler (19th century), suggests that –

‘Painting is not primarily an imitation of the external world, but rather, an arrangement of shapes and colors on a flat surface.’

He believes that those locations on which viewer’s eyes move are important in the composition. In the figure below technique of Analysis of visual form highlights the approach that designers’ take in analyzing form unlike end users who show limitations in being able to do so.

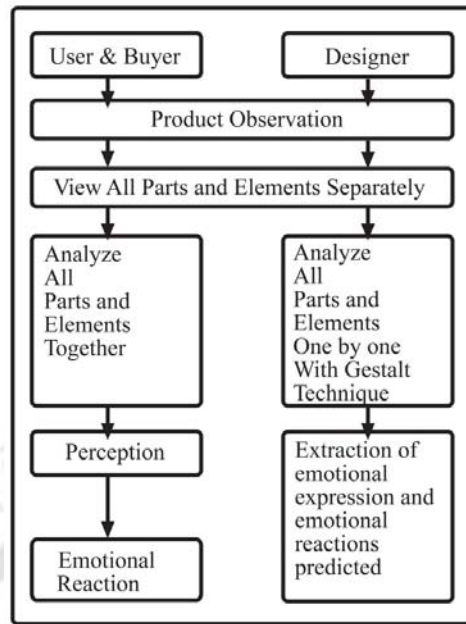


Figure 5.2a.1: Difference between user and designers observation

It is only since 1960s that technical development involving scientific instruments have given visual analysis methods a scientific temper. It is possible to record the continuous registration of eye movement during reading (Taylor 1965); in picture viewing (Yarbus 1967); later in visual problem solving (Hunziker 1970); and also during driving (Cohen 1983) using headset-cameras that are now available. Today eye-tracking method is fairly well established as a means for visual analysis in Design.

Here the following two techniques viz. analysis of visual form and Eye Tracking Method have been used to analyze all parts one by one and to assess user response to the visual form of car faces.

E2a.2 Experiment

The objective of this experiment is to extract graphical keys through the process of analyzing visual elements and understanding the underlying harmonious relationships among them. The study will examine all the visual elements and their attributes including geometric proportion, golden ratio in the selected set of car faces. Through this analysis it aims to correlate visual elements to verbal expressions that will form a basis for subsequent experiments to follow.

E2a.2.1 Experimentation Processes

The experimental analysis was done applying two techniques.

- Visual Analysis of car form by Professional Designer
- Visual Analysis of car form using Eye Tracking Device

Visual Analysis of car form by Professional Designer

All 35 car faces selected for this study were analyzed by a professional Designer for verification of pattern of visual hierarchy; study of golden proportions and geometric ratio embedded in each car form.

The selected 35 car faces were analyzed from seven visual points of view.

- 1) Micro components analysis: Analyzed all parts and elements of the car form.
- 2) Point and dot Analysis: Analyzed visual elements 'dots and points' on the outline of the product contours.
- 3) Line Analysis: Analyzed visual 'line elements' that formed the outline of the product contours.
- 4) Plain and surface Analysis: This view only analyzed the outline of the different surfaces of the product contour.
- 5) Volume Analysis: Here only the outline of different volumes of the product contour were analyzed.
- 6) Color Analysis: In this view, the color analysis was undertaken within the outline of the product contour.
- 7) Texture Analysis: Here the analysis of texture within the outline of the product contour was done.

Following this visual analysis of the over all form of the car was done using the method of visual recall:

1. The eyes are closed and after a pause quickly opened to run over the image presented on a screen for the duration of 5 seconds.
2. Following this observations are made through recall analyzing the sequence in which the eye tended to move (Line of path) over the different form elements comprising the car form.
3. This sequence of identifying visual hierarchy through recall is repeated 4-5 times.
4. The order of visual hierarchy of the visual elements is noted and is recorded for each car form.

Visual Analysis of car form using Eye-tracking Method

A. Brief note on eye tracking:

Eye tracking method is a scientific method of measurement which is used in research in psychology, visual study in product design etc. In this scientific method using eye tracking instruments, researcher can get answers to questions such as, what does viewer relinquish? Where does viewer look? When does viewer's eye move? This system use technology which can study the movement of pupil, and this data is then fed to a computer which has a tailor made software as part of the system to processes the data.

Eye tracking method was therefore adapted to cross verify the results of the previous experiment.

B. Participants:

This test was also undertaken by the professional designer as part of an exercise at confirmation of eye movement analysis done by the traditional method of visual recall.

C. Stimulus Material:

In this step again all 35 car faces selected for this study were analyzed for cross verification of the earlier analysis.

D. Apparatus:

Eye tracking study was conducted using the SMI-I View-X- HED eye-tracking system. The eye tracker is monocular (Right eye) with sampling rate of 50 Hz. SMI-eye-tracking system has two hardware – a head part bearing cameras and IR-sensor which is fixable on the head of viewer, and, a laptop workstation for storing and analyzing the video data. After recording and saving the video data of participant, area of interest (AOI) study was carried out using Be-gaze 0.3 software. Analysis of AOI commonly used in eye-tracking research to delineate sections of stimulus within which filtered eye movements such as fixations are counted.

E. Method:

The test was done using the following method:

1. Samples: 35 car forms were selected for viewing on screen. Each image was presented for 10 seconds.
2. Calibration: To calibrate the eye-tracking glasses, five markers were used in calibration mode, as it requires a five-point calibration. The experimenter first asked the participant to stay at a distance of 1 meter from computer screen on which the car image was to be shown and the five-point calibration process was started. During the

- calibration process the participant is instructed to hold their head steady and see on a particular marker. The calibration is thus completed.
3. The experimenter runs the eye tracker machine and presents each car form on the screen for 10 seconds.
 4. After all the car forms are seen, the machine generates a movie with hot spots which shows the path and sequence of location which correspond to the respondent's eye movement along a graph for each car face which shows the area that respondent look at, indicating the order of visual hierarchy of viewing.



Figure 5.2a.2: Eye tracking

Golden ratio analysis: For this purpose a visual analysis of the car forms was undertaken by a professional designer to verify if geometric and mathematical rules such as golden ratio were observed embedded in the inter-relation between the visual elements in the car form.

Geometric proportion analysis: For this purpose a visual analysis of the car forms was undertaken by a professional designer to verify if geometric and mathematical rules were observed embedded in the inter-relation between the visual elements in the car form.



Figure 5.2a.3: Car face's samples for study

E2a.3 Data Analysis and discussions

In the following section assessment of the visual forms by professional designer and their comparison using eye tracking method; golden proportions and geometrical ratios on the selected set of car faces is being presented for the series F1 to F5 and the process for drawing the visual key derived from this study is outlined.(Refer Appendix 7 for the detailed analysis of 30 car forms comprising of the series L/K/J/H/G/D car forms)

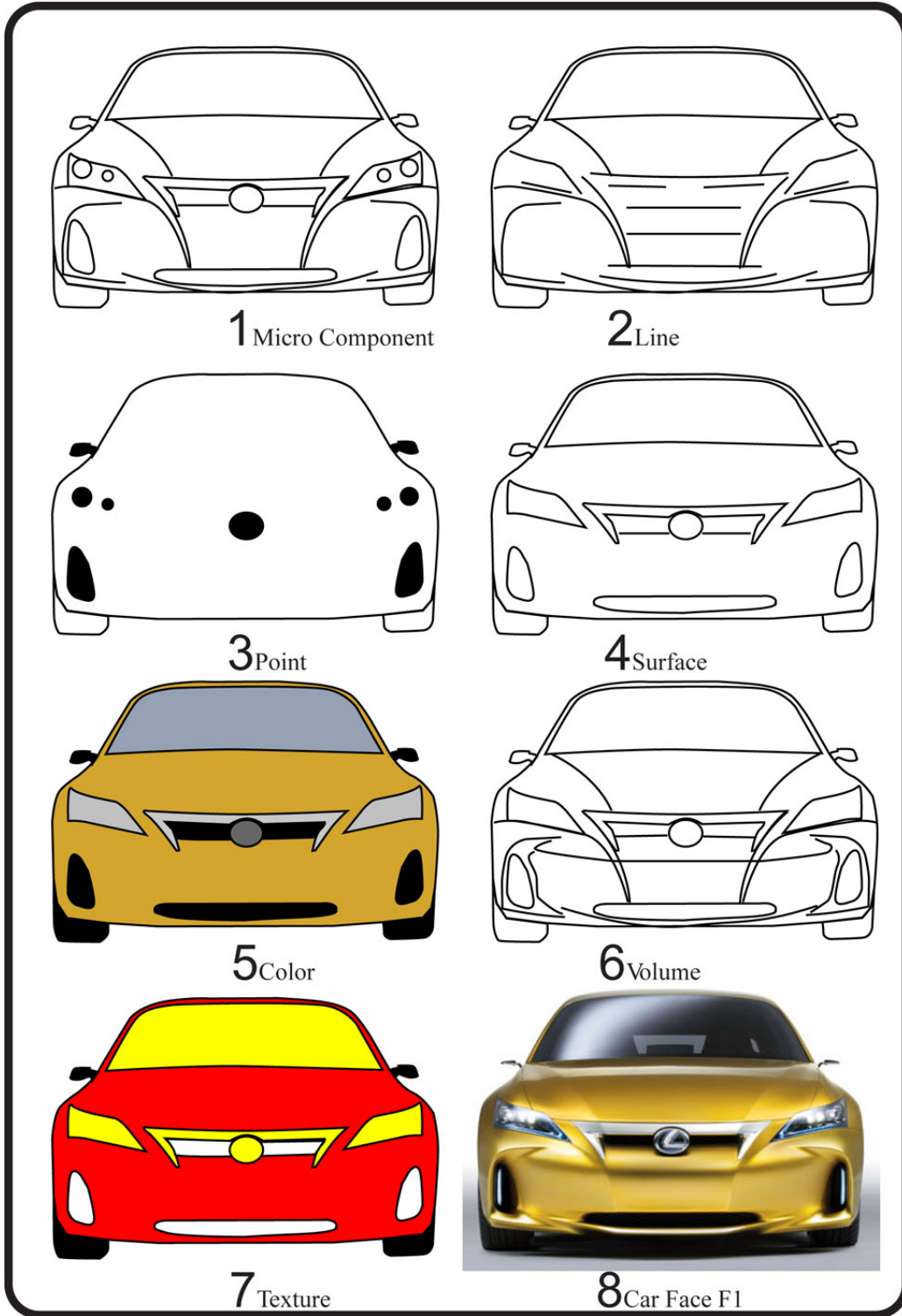


Figure 5.2a.4: Visual analysis for F1

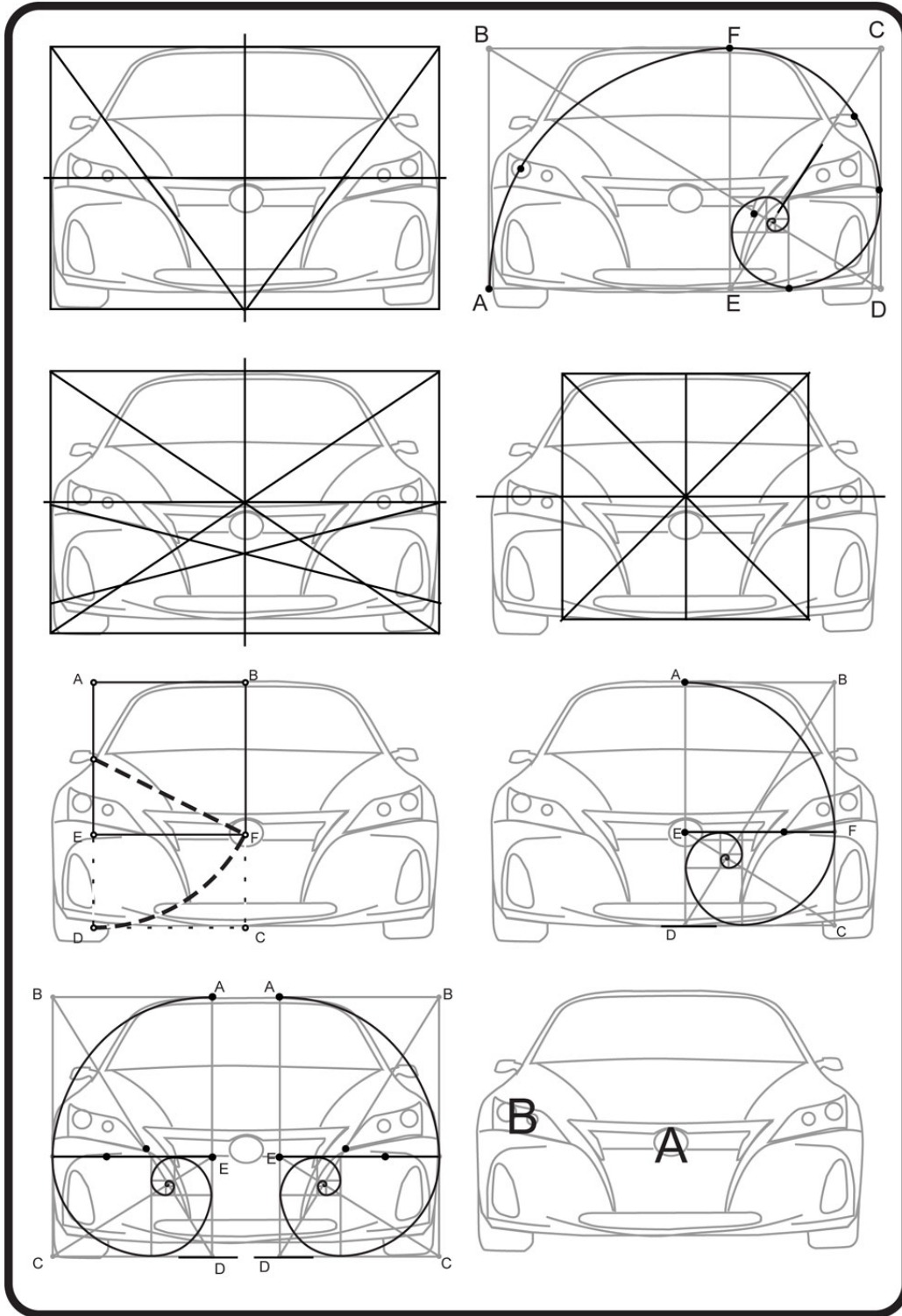


Figure 5.2a.5: Golden ratio and Visual Hierarchy analysis for F1

Luxurious form integrates complex forms and arcs and fitments to convey an expression - expensive and elegance. Exemplifying on the relation of forms, F1 draws the attention and focus of the onlookers on the grille and logo position. In part 3 (point) and 4 (surface) it is evident that the logo is positioned at the center because in part 2 (line) all arcs have a similar distance and direction with this point. It shows that this is the central position, and evolution of F1's position begins from this point. Especially the oval shape can draw the user's attention. The oval shape also establishes harmony with the grille because of its long line. Professional users can identify this car even without the logo because of the distinct headlight and grille. Grille frame, logo and headlights with special silver plating express the glory of the car as one can see in part 7 (texture). The car-guard (bumper) was later integrated with the body which ushered a new style of car designs in modern era. Added to this the lower grille gave way to a good composition apart from the negative spaces that were present on both sides of the car face. In part 2(line) top arch lines of light express anger and parts 6 (volume) and 2 (line) express dislike. The blank space of the grille appears congested and can be read as a negative form, Here in this case the prevalence of the blank space led to a startling contrast of space and color and gave the logo a prominent position in the centre of the car face (Wong, 1993). Eventually the car appeared as if it was expressing disgust and anger.

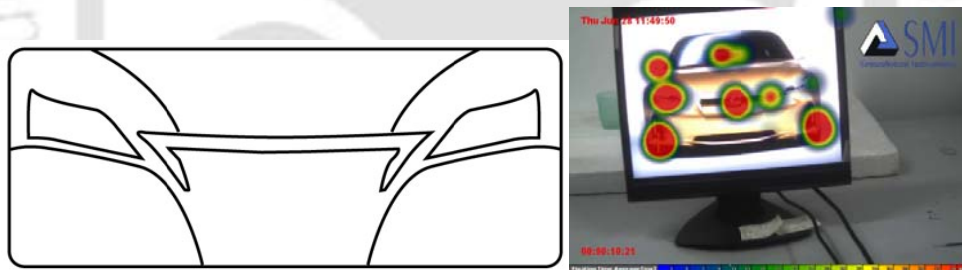


Figure 5.2a.6: Graphical key of F1 (Left), Results of Eye tracking analysis of F1 (Right)

Proportion analysis reveals that the, F1 is powerful in both geometric and golden ratio. The visual hierarchy analysis shows, that the eye first goes to the location of logo “A” because of the direction of lines on the hood, the existence of the golden ratio area and also because of its presence between a contrast of color (grille and frame of grille). It then moves from logo “A” to lights “B” because of the texture, color and form. It may therefore be concluded that the icon logo “A” is a very attractive search icon within the peripheral field of vision. This result is reconfirmed using eye tracking method of analysis.

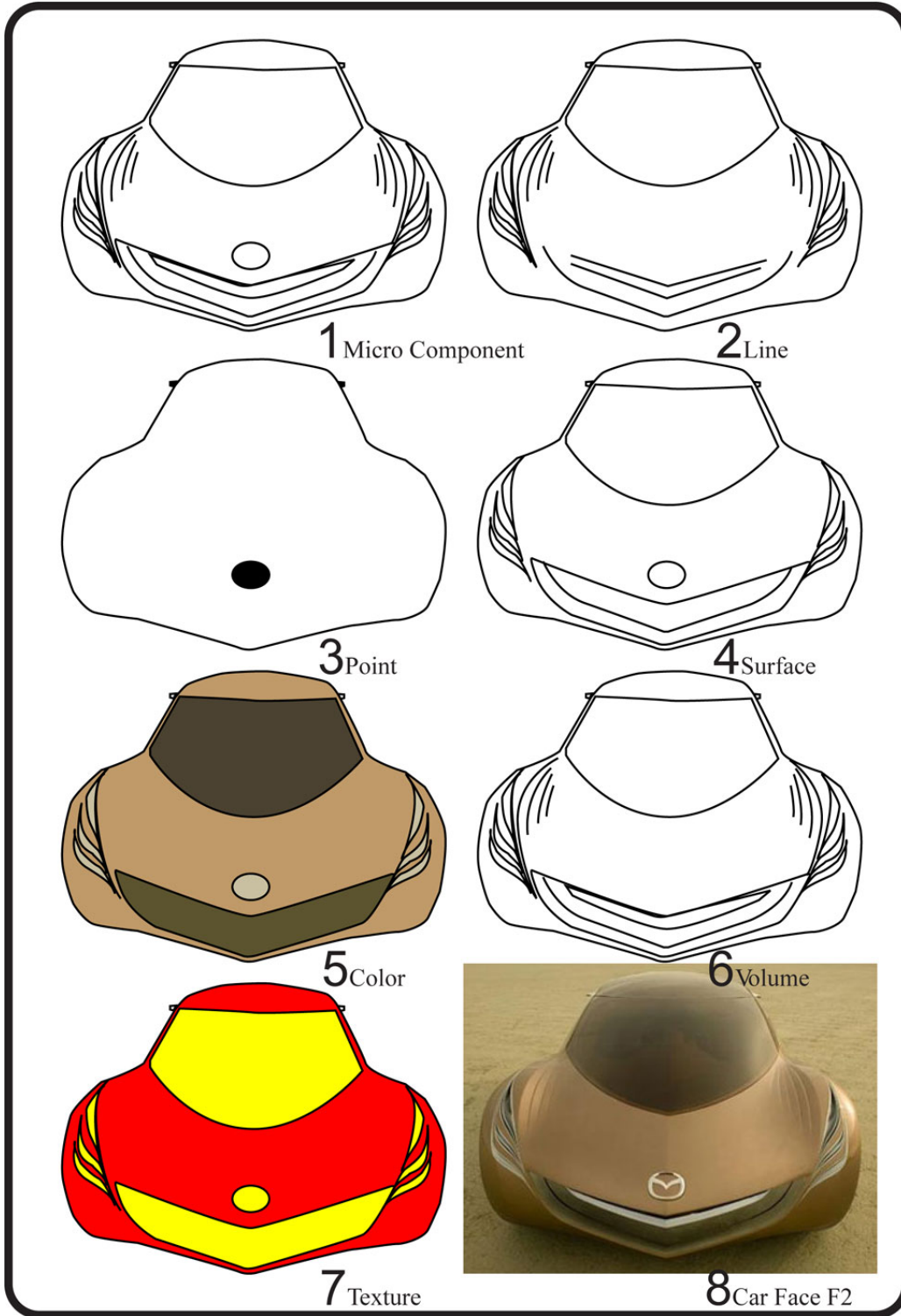


Figure 5.2a.7: Visual analysis for F2

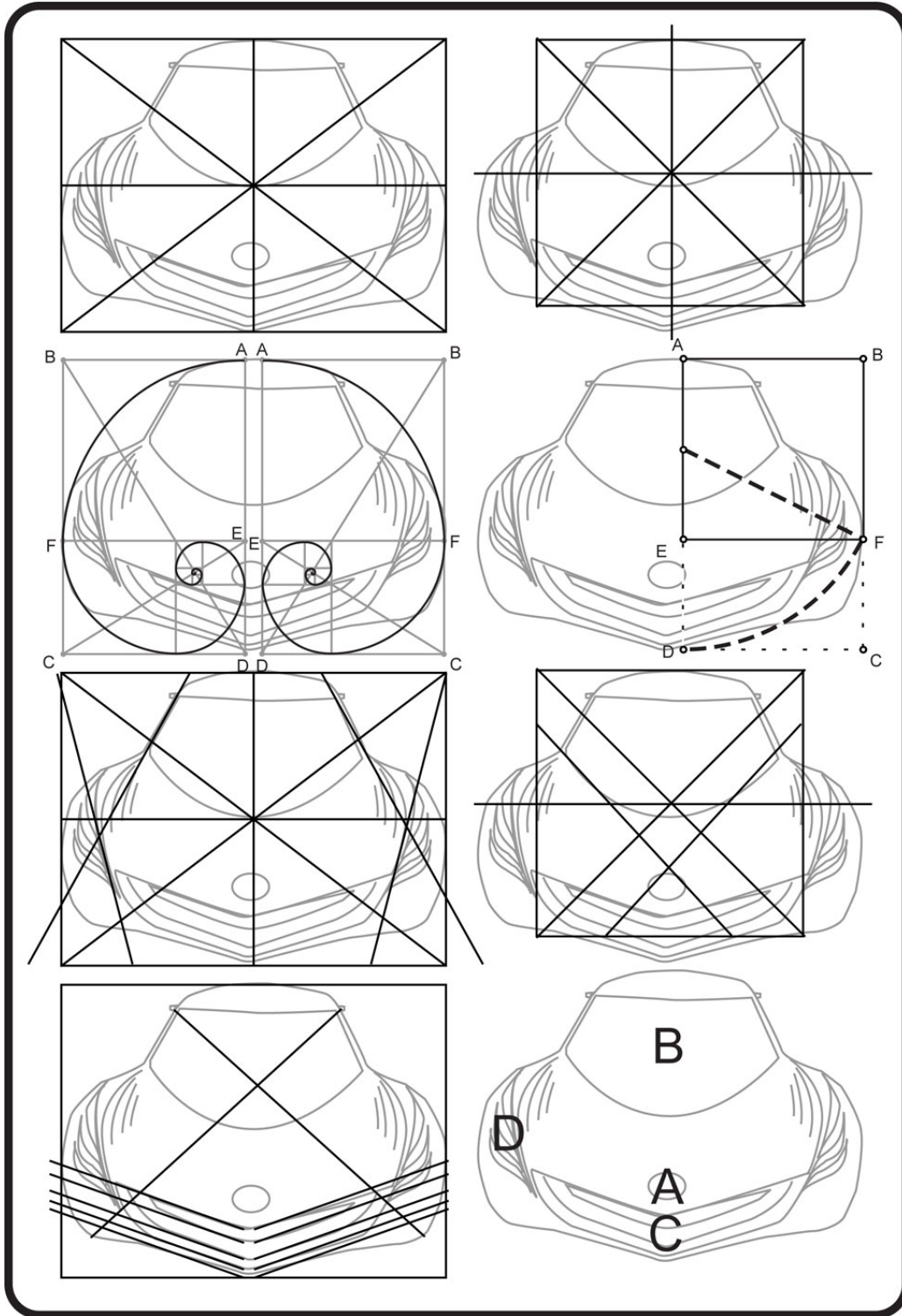


Figure 5.2a.8: Golden ratio and Visual Hierarchy analysis for F2

In part 7 (texture) fittings with special silver plating and in part 6 (volume) forms with complex arcs glorifies the car giving the feeling that the car is expensive. Due to the plating on the grille, lights and logo, a sense of sophistication is also revealed. The Oval shape catches the attention of the eye and brings it to the central point of the car face. Here F2 has a symmetrical line with a good effect on the aesthetics of design. This line begins from the hood (in front of windscreen), and then proceeds to the logo, grille and guard. In the subsequent parts 4 (surface), 5 (color), 7 (texture) the car lights reflect an angry expression while the grille expresses speed thereby adding to the confusion of the user. In parts 2 (line), 6 (volume) the presence of the speed and anger expression is powerful.



Figure 5.2a.9: Graphical key of F2 (Left), Eye tracking analysis of F2 (Right)

Proportion analysis reveals that, F2 is weak in terms of the golden ratio. The visual hierarchy analysis by the designer also reveals that, first the eye gets hooked to the logo “A” of the car face, just because of the direction of lines on the hood and lights as well as the presence of contrast of texture and color (Between logo and hood). Then the eye jump from logo “A” to the windscreen “B”, grille “C” and lights “D” (because of the form). It may be therefore be concluded that the icon logo “A” is quite an eye catching icon within the peripheral field of vision. The result of machine eye tracking analysis shows the eye jump from logo “A” to the grille “C”, lights “D” and the windscreen “B”. In terms of sequences it is 25% in concurrence with the result of visual assessment undertaken by the designer but in terms of importance of elements both result shows same locations as seen in the above figure.

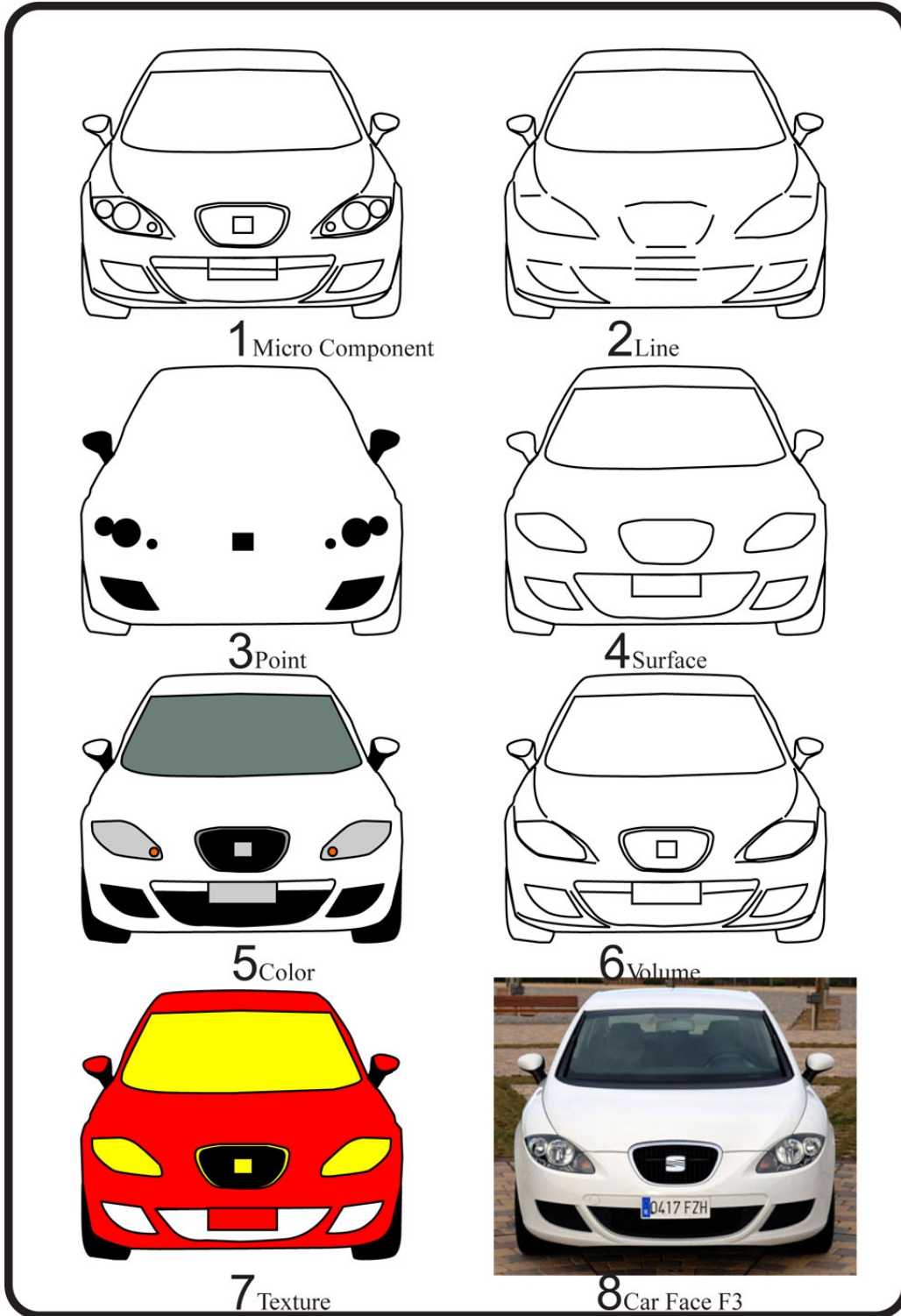


Figure 5.2a.10: Visual analysis for F3

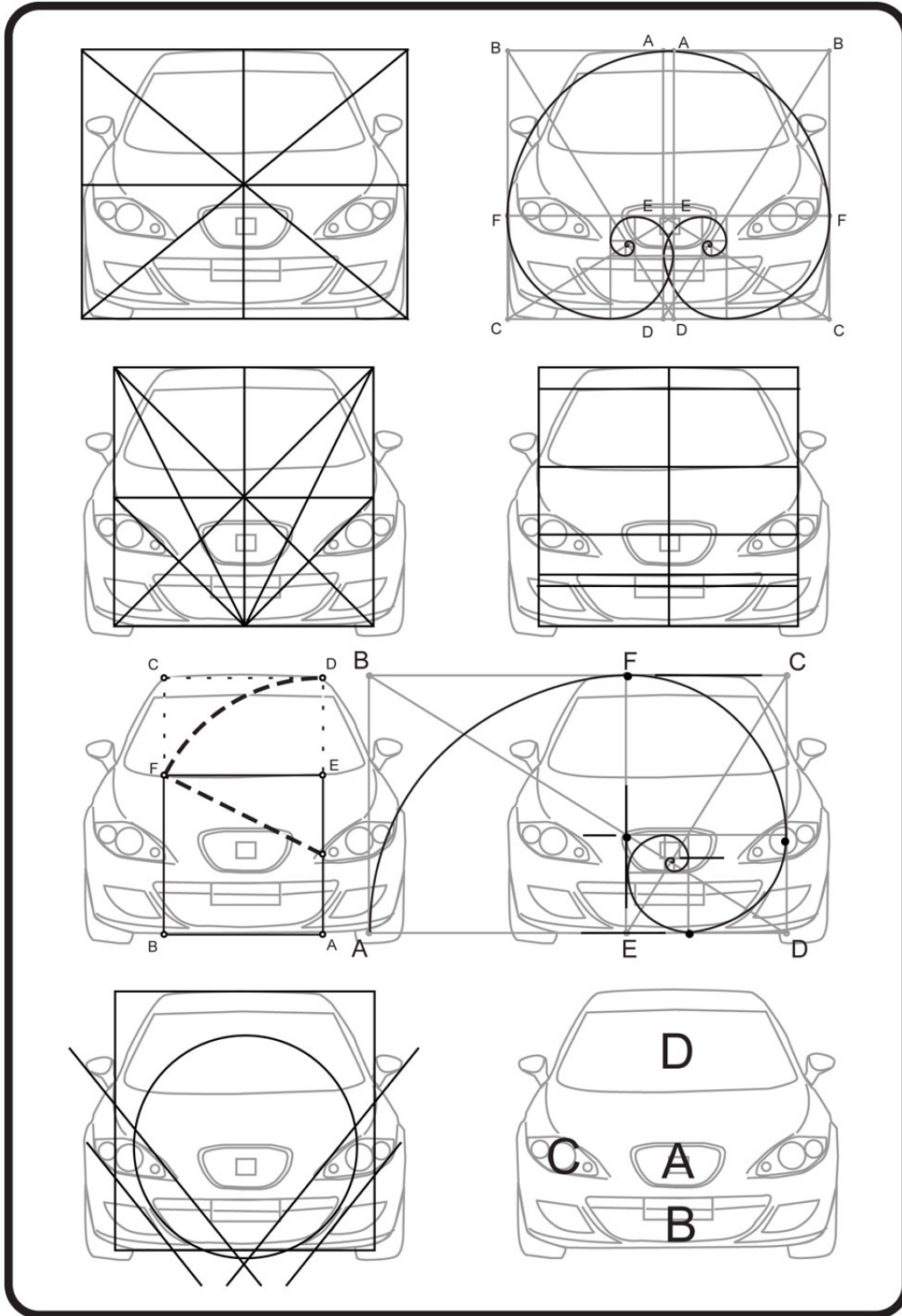


Figure 5.2a.11: Golden ratio and Visual Hierarchy analysis for F3

In part 7 (texture) the silver plating frame of grille express glory while the honeycomb net of grille makes a good contrast with body, in part 5(color) the small red lights give way to an angry expression in the design but the part 2 (line) form of lower grille indicates a happy, smiling expression. The car face has contrast of color leading to a good composition. The placement of the logo at the end adds to the happy expression of the car.

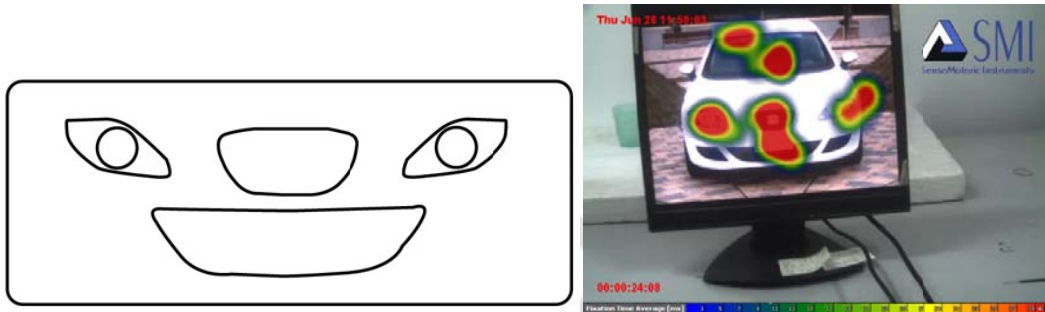


Figure 5.2a.12: Graphical key of F3 (Left), Eye tracking analysis of F3 (Right)

Proportion analysis reveals that, F3 is powerful in terms of geometric and golden ratio. The visual hierarchy analysis also reveals that, first the eye gets hooked to the logo “A” of the car face, due to the direction of lines on the body and lights as well as the presence of contrast of color (Between logo, grille and body). Then the eye jump from logo “A” to the lower grille “B”, lights “C” and windscreen “D” (because of the color and form). It may hence be concluded that the icon logo “A” is a very attractive search icon within the peripheral field of vision. The result of eye tracking method of analysis shows the eye jump from logo “A” to the lower grille “B”, logo “A”, lights “C” and windscreen “D”. In terms of sequences there is 100% concurrence with the result of visual analysis and in terms of importance of elements both result shows same locations which is visible in the above figure.

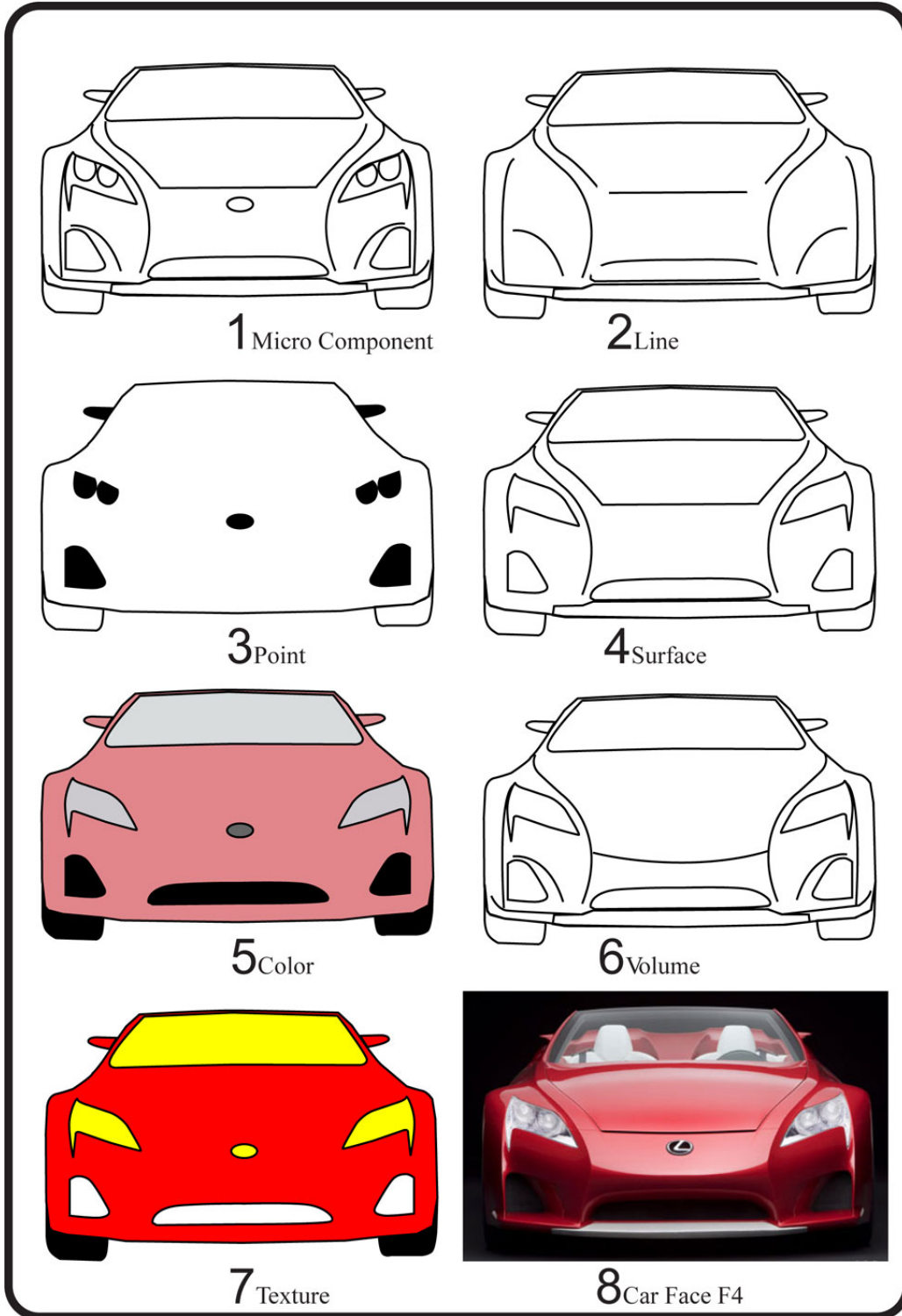


Figure 5.2a.13: Visual analysis for F4

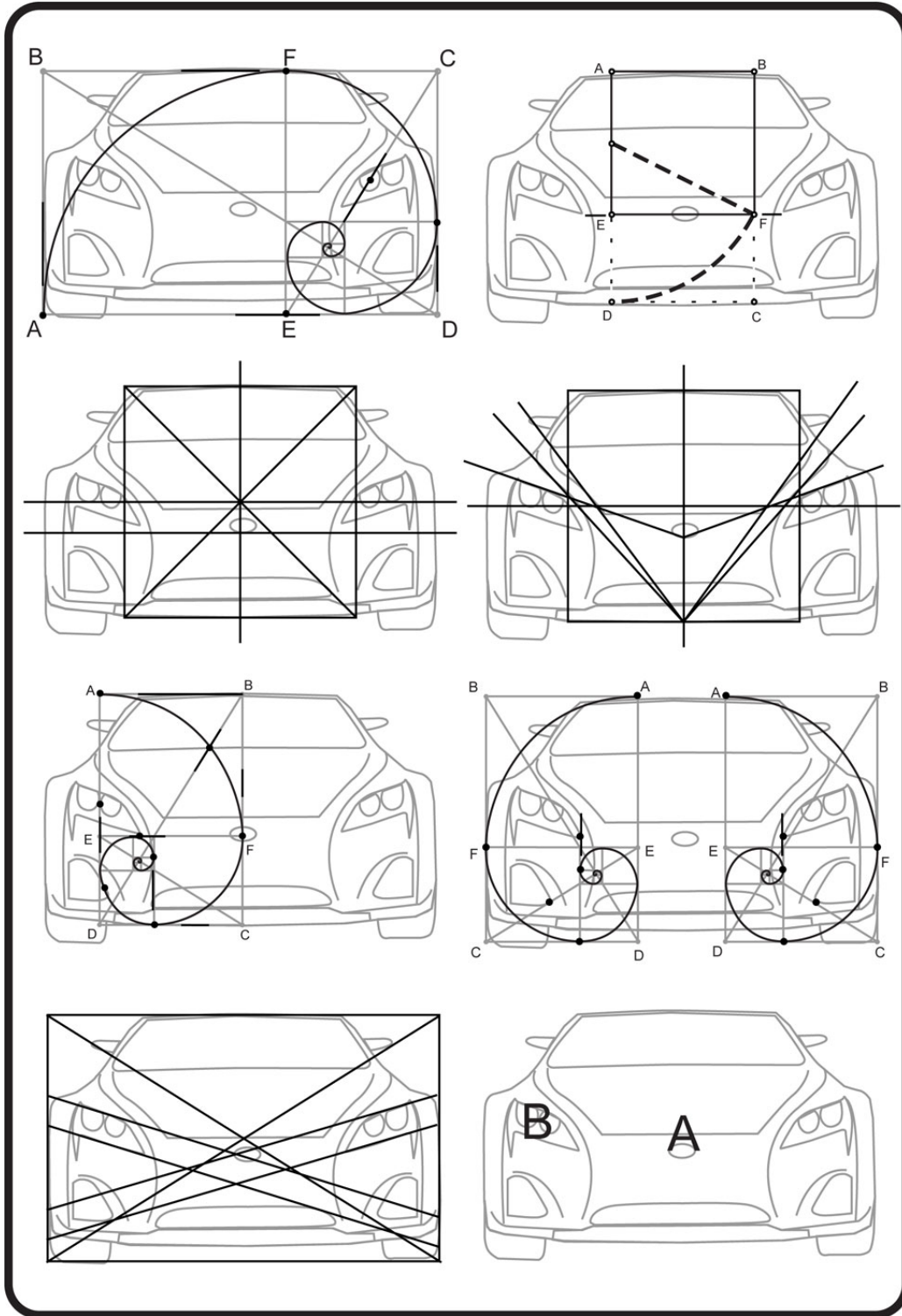


Figure 5.2a.14: Golden ratio and Visual Hierarchy analysis for F4

Parts 3 (point), 5 (color) and 7 (texture) indicate that the placement of the logo at the center is the central part from which the other parts eventually take form; hence it becomes very prominent for the designer. Here, the oval shape of the logo becomes the central point of focus, which steals the attention of the user and lets it remain there for quite sometime. The placement of the grille here also becomes effective. The long grille joints the left and right forms together. Part 5 (color) and 6 (volume) indicates the dangerous expression of devouring or eating. This is also exemplified by the lines in part 2 (line). Part 4 (surface), 5 (volume), 5 (color) and 7 (texture) lead to expressions like dislike or disgust while part 3 (point) has serious expression. As a contrast to the previous expression Part 6 (volume) reflects happiness. In this car, we see a good composition due to the contrast of space in grille. Space which is more like an expression of disgust.



Figure 5.2a.15: Graphical key of F4 (Left), Eye tracking analysis of F4 (Right)

Proportion analysis reveals that, F4 is powerful in terms of both geometric and golden ratio. The visual hierarchy analysis shows, that first eye movement goes to the location of logo “A” because of the direction of lines on the hood, the existence of the golden ratio area and also because of its presence between a contrast of color (logo and hood). The eye tracks from logo “A” to lights “B” because of the color. It maybe hence be concluded that the icon logo “A” is a very attractive search icon within the peripheral field of vision. The result of eye tracking method of analysis shows the eye jump from logo “A” to lights “B”. In terms of sequences there is 100% concurrence with the result of visual analysis and in terms of importance of elements both result shows same locations which is visible in the above figure.

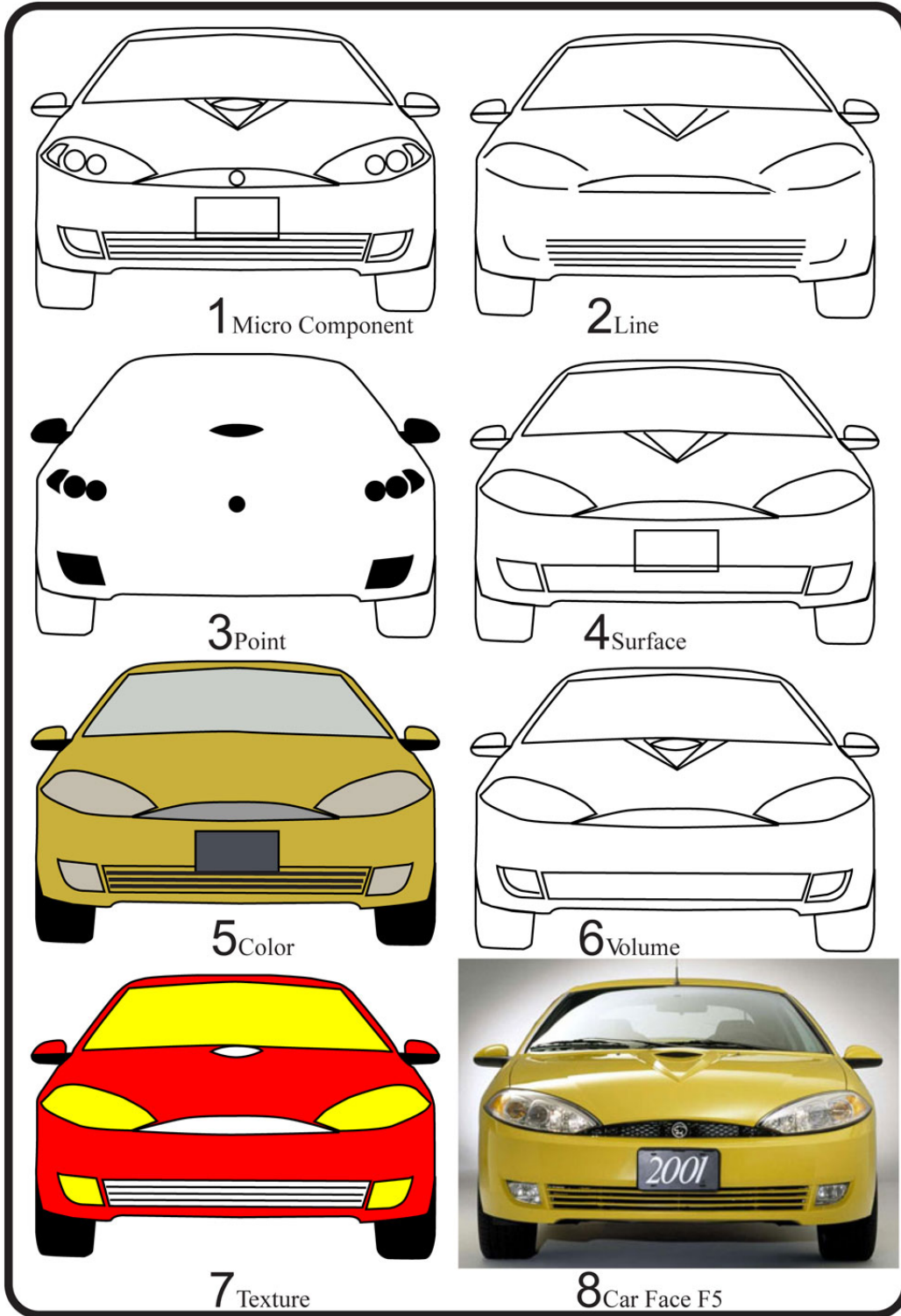


Figure 5.2a.16: Visual analysis for F5

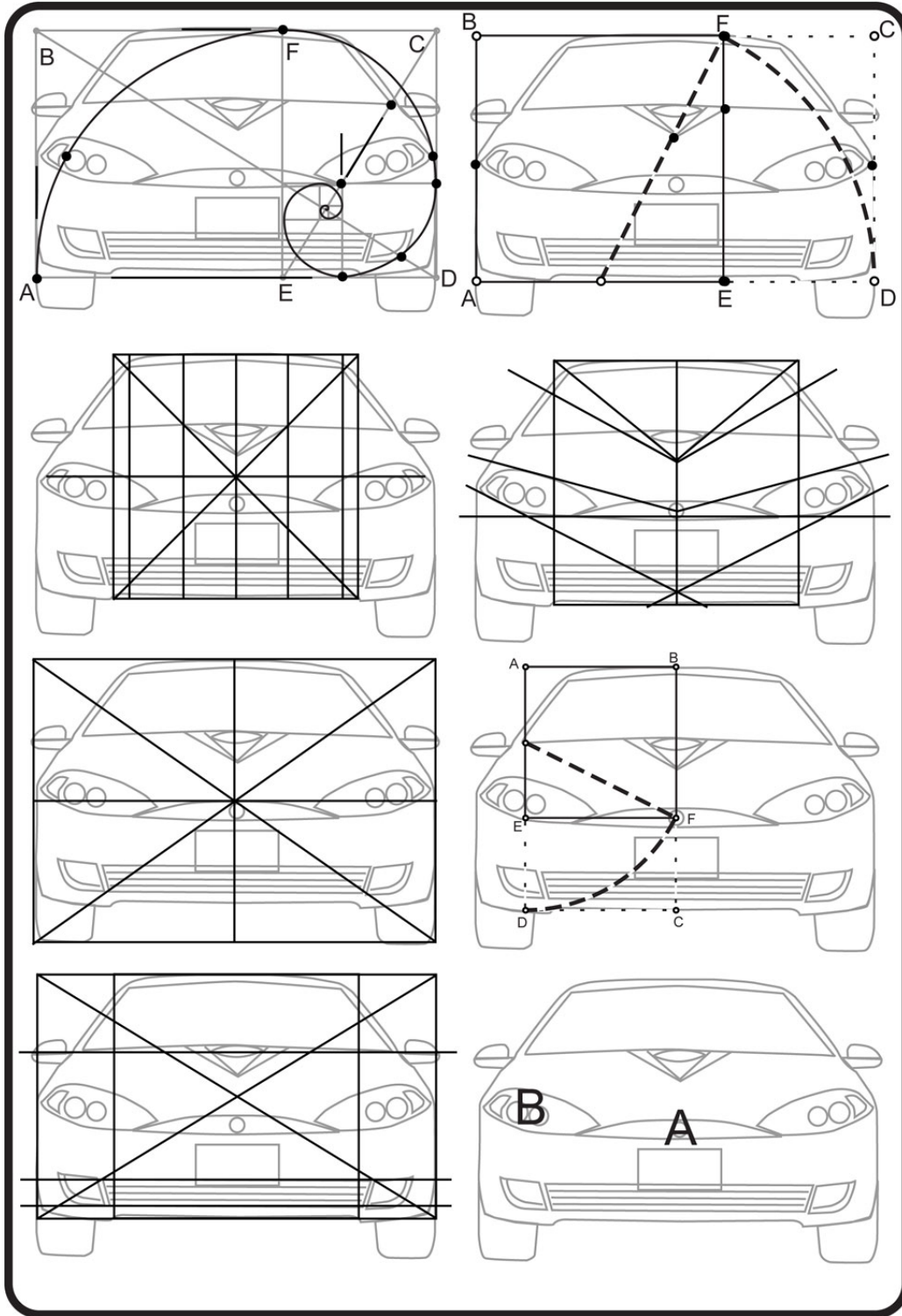


Figure 5.2a.17: Golden ratio and Visual Hierarchy analysis for F5

Honeycombed net appears complementary with the lights and appears as if it brings elements together. With the aid of the honeycomb net, the designer shows serious and angry expression visible in part 2 (line), 5 (color) and 7 (texture) but not in part 4 (surface) and 6 (volume). Parallel lines on the lower grille can join fog lights in part 2 (line) and reflect a very calm expression in contrast to the serious angry ones, as visible in parts 2 (line), 5 (color) and 7 (texture). The line under the lights and grille also expresses happiness. So all of this combined together leads to a grim expression but not very serious.

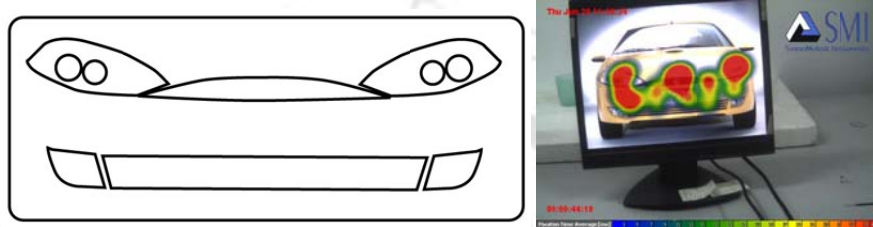


Figure 5.2a.18: Graphical key of F5 (Left), Eye tracking analysis of F5 (Right)

Proportion analysis reveals that F5 is powerful in terms of both geometric and golden ratio. The visual hierarchy analysis reveals, that the first eye traverses to the location of grille “A” as per the golden ratio area and also because of its presence between a contrast of colors and textures (grille, hood and mud guard). The eye wanders from grille “A” to lights “B” because of the color. It may hence be concluded that the grille “A” is a very attractive search icon within the peripheral field of vision. The result of eye tracking method of analysis shows the eye jump from logo “A” to lights “B”. In terms of sequences it is 100% similar with the result of visual analysis and in terms of importance of elements both result shows same locations which is visible in the above figure.

Summary of all 35 car faces

The chart below gives a summary based on the analysis for the complete set of 35 car forms selected for the study.

Table 5.2a.1: Identification of car forms with word expression

No.	Car	Result of analysis of visual form- signifier	No.	Car	Result of analysis of visual form- signifier
1	F1	Disgust, Anger	19	H4	Serious
2	F2	Anger, Speed	20	H5	Happy and normal
3	F3	Happy	21	L1	Danger
4	F4	Disgust	22	L2	Danger
5	F5	Serious	23	L3	Danger
6	D1	Happy	24	L4	Danger
7	D2	Happy	25	L5	Danger
8	D3	Happy	26	K1	Comic
9	D4	Sad	27	K2	Comic
10	D5	Sad	28	K3	Serious

11	G1	Anger, Stupid	29	K4	Serious
12	G2	Serious	30	K5	Serious
13	G3	Danger	31	J1	Anger
14	G4	Curious	32	J2	Anger
15	G5	Happy, Curious	33	J3	Anger
16	H1	Surprise	34	J4	Anger
17	H2	Surprise	35	J5	Anger
18	H3	Serious			



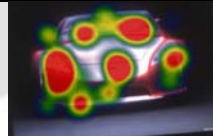



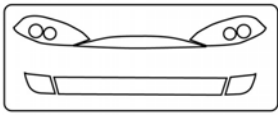


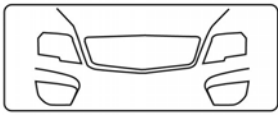


E2a.4 Discussions and Conclusions

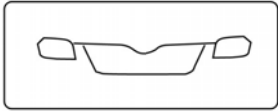













Based on the analysis of the car face undertaken in this section, a primary set of graphical keys have been derived. It may be noted that attempt has been made to eliminate weaker elements and retain only useful elements which effectively express emotional reactions in deriving the graphical key (Table 5.2a.1). The analyses relevant for finding graphical keys along with their specific meanings (Table 5.2a.1) have been able to uncover a meaningful set of forms.




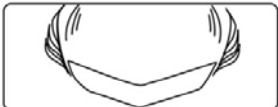

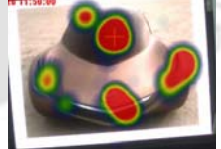





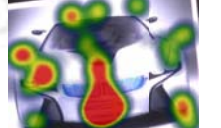



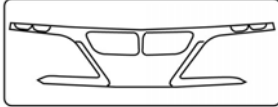


Concluding this part, all the 35 car faces have been divided into 12 groups (Table 5.2a.2).




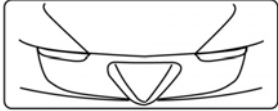


Here it may be noted that the graphical key derived as an outcome of visual analysis is undertaken by researcher. The graphical keys derived are being critically verified for consistency and confirmation through user testing undertaken in experiment 2b.




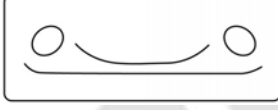







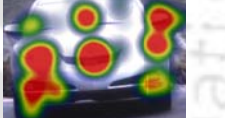
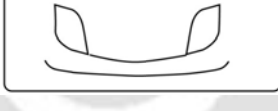


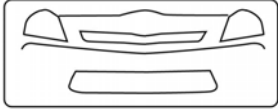


Table 5.2a.2: Graphical keys

	Expressions	Graphical key	Samples	Eye tracking
1	Disgust	F1 and F4		
	F4			
	F1			
2	Serious	F5, G2, H3, H4, K3, K4 and K5		
	F5			
	G2			




	H3			
	H4			
	K3			
	K4			
	K5			

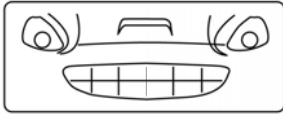














3	Anger	F1, F2, G1, J1, J2, J3, J4 and J5		
	F1			
	F2			
	G1			
	J1			
	J2			
	J3			

	J4			
	J5			

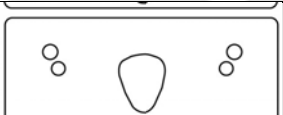

5	Happy	F3, D1, D2, D3, G5 and H5		
	F3			
	D1			
	D2			
	D3			
	G5			
	H5			

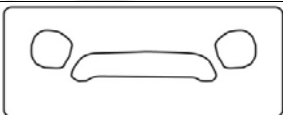





6	Speed	F2		
	F2			

7	Danger	G3, L1, L2, L3, L4 and L5		
	G3			

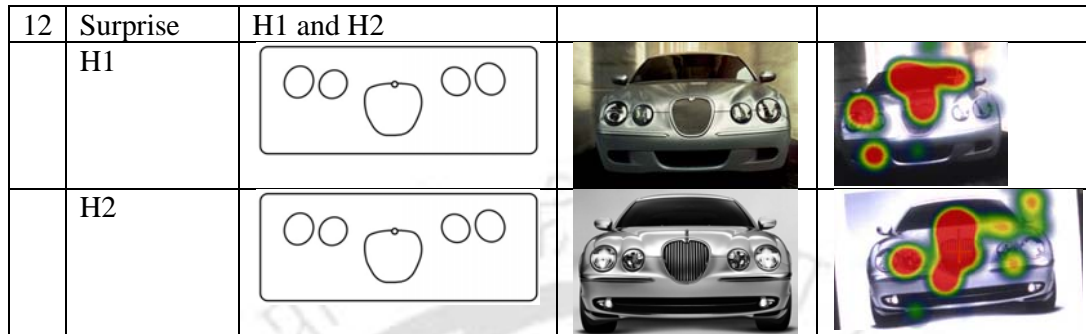
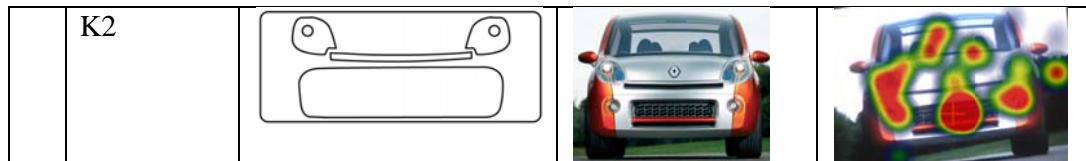
	L1			
	L2			
	L3			
	L4			
	L5			

8	Relaxed and normal	H5		
	H5			

9	Stupid	G1		
	G1			

10	Sad	D4 and D5		
	D4			
	D5			

11	Comic	K1 and K2		
	K1			



Here in terms of importance of location of elements the results of visual hierarchy (traditional method) and eye tracking analysis have been same because both of them showed same locations (which are visible in the above figure) then it shows the graphical key elements derived from proper locations.

Table 5.2a.3: Summary of Results

No.	Word Meaning	Car faces
1	Disgust	F1 and F4
2	Serious	F5, G2, H3, H4, K3, K4 and K5
3	Anger	F1, F2, G1, J1, J2, J3, J4 and J5
4	Curious	G4 and G5
5	Happy	F3, D1, D2, D3, G5 and H5
6	Speed	F2
7	Danger	G3, L1, L2, L3, L4 and L5
8	Relaxed and normal	H5
9	Stupid	G1
10	Sad	D4 and D5
11	Comic	K1 and K2
12	Surprise	H1 and H2

Result of this experiment (graphical keys along their expression words which came out from experiment 2a) made our hypothesis (because of that it has done just by researcher) which will be tested with Iranian and Indian respondents in Experiment 2b, Experiment 3a, Experiment 3b and Experiment 4 , then these experiments are planned based on using these graphical key elements with their expression words.

Experiment 2b

A study of User's Judgments of car design ¹

E2b.1 Need for investigation in the context of business opportunities and globalization

Focusing on the auto industry, good business opportunities emerging amongst culturally rich and diverse developing countries. India, China and Brazil have opened their economy to global players. Domestic markets in these countries are making way for foreign competition, stimulating greater awareness of international market opportunities as well as creating the need for having international competence. These markets need to be probed to understand their cultural needs. The success in these emerging global markets may depend on initiatives in local knowledge accumulation and an understanding of socio-cultural differences between end users. Global Design initiatives will have to consider these added cultural dimensions and make inclusive considerations beyond the presently adapted approaches of product planning if they plan to succeed in evolving design strategies. There is a need for assessments to formulate appropriate product policy and design.

In this part of research an attempt has been made to propose an alternative insight/strategy to globalization. It suggests designers to search for 'glocal meaning' to the product form. In this approach the designer focuses upon collecting information and knowledge about local cultures, especially discovering commonalities between them (Krippendorff 2006).

¹ Towards meeting publication requirements for a doctoral research, it must be here mentioned that this researcher has published the results of this experiment as a research paper titled "Automobile design: A co-relation technique to assessment of human emotion, visual expression and product form." in the DPPI 11, the 5th Conference on Designing Pleasurable Products and Interfaces organized between June 12th – 25th, 2011, Milan, Italy.

However it must be said that, new technologies allow us to design a car with less limitation to solve all users' needs. Hence in designing products involving low or high technology, a designer must take into consideration emotional and visual aspects of local cultures.

Based on these deliberations it becomes pertinent to enquire if a designer belonging to a particular culture can design for another culture. In a broader quest to seek answers to this question experiment 2b was planned. The aim of this experiment was to evaluate if a common ground exists for the visual form of products such as a car for shared perceptions and understanding amongst end users of peoples of two diverse cultures. It was hypothesized that this understanding would help designers to better understand the parameters for the form of the car design. This experiment can also be a means to validate the conclusions drawn in experiment 2a.

E2b.2 Plan of the Experiment

To validate the result of experiment 2a, a semantic framework (Figure 5.2b.1) was considered in which co-relation was sought between human facial expression of emotion (the Signifier) and was evaluated for correspondence or contrast against the visual form expression of the Car front face (the Signified). In case car face (the signified) could show a co-relation corresponding to a human facial expression (emotion- the signifier), we can summarize that the hypothesis of this part is true and the result of experiment 2a is valid.

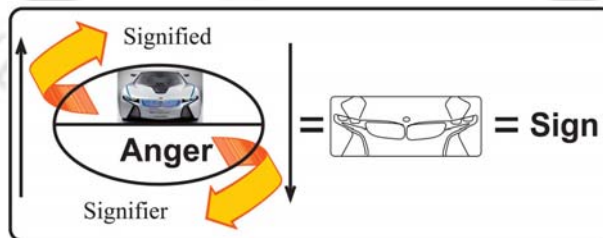


Figure 5.2b.1: Semantic framework

E2b.2.1 Methodology

The methodology followed involved the following steps:

1. Initially the set of 14 words derived from experiment 2a for different emotions were shortlisted (as signifier). This was used for creating the visual database for

front face of cars based on human facial expression (Figure 5.2b.3) of a particular emotion.

- a. A short listing of the emotional reaction (the signifiers) that are reflected in a set of front face of cars (the signified) were selected from the web site www.netcarshow.com. This correspondence between facial expression and car face expression were tabulated and formed the hypothesis (Table 5.2a.1) for the experiment.
 - b. Cross verification and evaluation of the visual form of car face for their representation of an emotion was undertaken by an expert group of three trained car stylist.
2. Creating two set off facial expressions (the signifier) that depict the 14 emotional expression word (the signified) (Figure 5.2b.2).
(For example the female model and the male model were asked to react to the word 'happy' (the signified) and a photograph of their expression taken.
 3. Identification of co-relationship between car face and the corresponding emotion (Table 5.2b.1)
 4. Formation of Visual sets (L,K,J,H,G,F,D) arranged in a set of 5 car form, in such a way that they are placed along with contrasting expression of human expression on either end. (Figure 5.2b.2)
 5. This resulted in creating the complete visual database comprising 35 car face, 5 in a set, and 7 sets in all, that capture 14 facial expressions for user response testing (Figure 5.2b.2)

Conducting the User response Test through an online survey (Figure 5.2b.4).

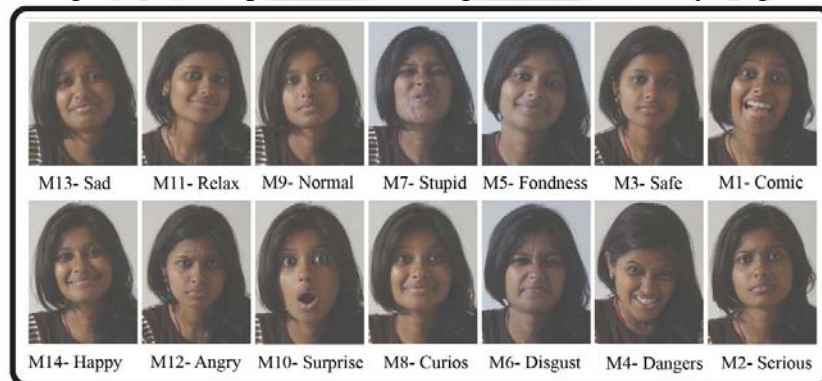


Figure 5.2b.2: Human faces: 'Similarities' face reactions (Top row) 'contrasting' face reactions (Bottom row).



Figure 5.2b.3: Car face samples.

Table 5.2b.1: Relationships

List 1	List 2	List 3
Human	Car series	Human
Human, Normal (M9)	H series	Human, Surprise (M 10)
Human, Sad (M13)	D series	Human, Happy (M14)
Human, Relax (M11)	J series	Human, Anger (M12)
Human, Fondness (M5)	F series	Human, Disgust (M6)
Human, Safe (M3)	L series	Human, Dangers (M4)
Human, Comic (M1)	K series	Human, Serious (M2)
Human, Stupid (M7)	G series	Human, Curious (M8)

E2b.2.2 Experimentation Processes

The experimental set up and data collection were presented online (Figure 5.2b.4). The Questionnaire 2 explained the purpose of data collection with an example to introduce the

respondent to the method of filling up with their responses. The questionnaire had an explanation for each question set. There were 7 questions.

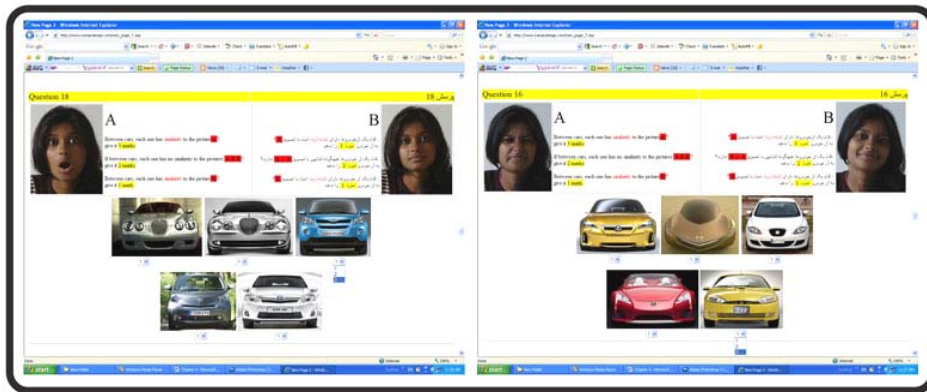


Figure 5.2b.4: Questionnaire in the internet. (Question 16 till 22)

Using the grid that had all five pictures of car faces, human pictures in sets of two at either end were shown on the internet. Subjects were asked to verbally rate (1 for contrast, 2 for being impartial (we have displayed it with a circle and slant) and 3 for similarity). Depending on the rating pattern groups were marked on the internet. This was repeated for all the seven human pairs of expression and all the seven series of car faces (F, G, H, J, D, and K & L) one by one.

Sample Size

The total sample size of the survey was 126 respondents.

78 respondents (62%) were men (age 18-54) and 48 respondents (38%) were women (age 18-50).

All the subjects were Asians. Out of the total of 126 respondents there were 60 people (48%) from India and 66 people (52%) from Iran.

E2b.3 Results

This data collected by co-relation technique (Figure 5.2b.5 ... Figure 5.2b.18 and Table 5.2b.2 ... Table 5.2b.8) was analyzed for frequency from a cross-cultural perspective to examine the correspondence and differences in the responses to the same car form in the two cultural context – Indian and Iranian.. The detailed findings are being summarized for each series.

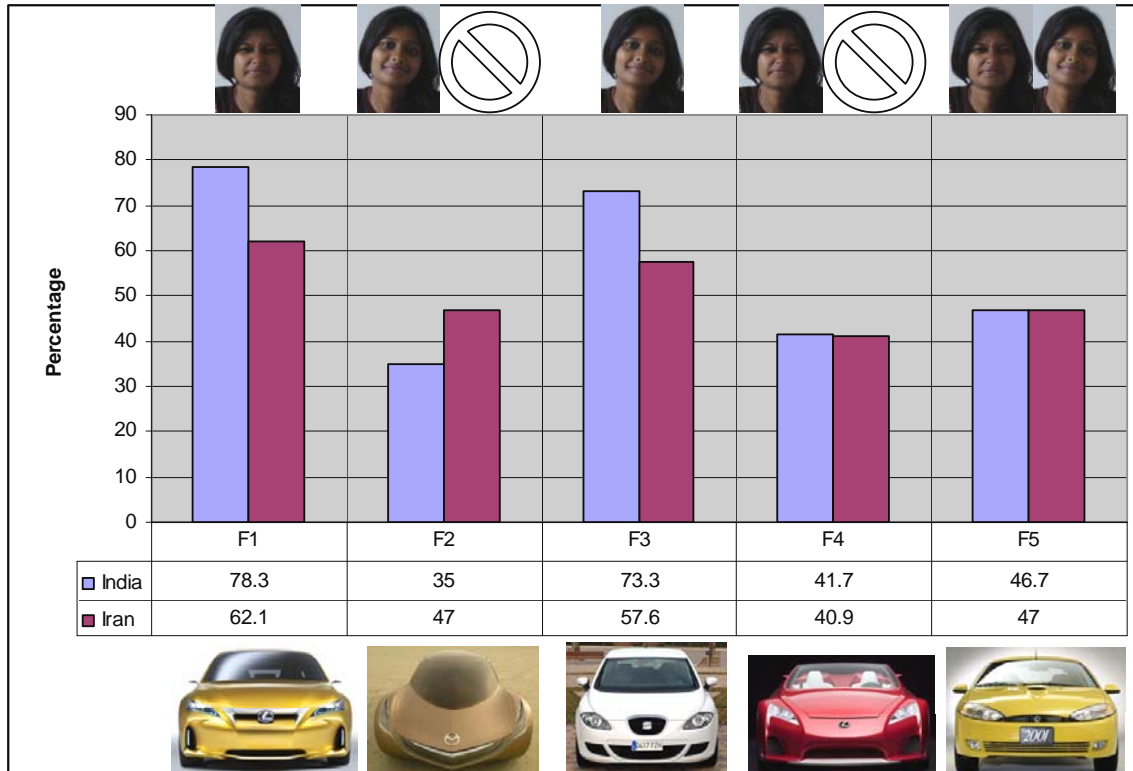


Figure 5.2b.5: Percentage of Indian and Iranian people's response for Question 16, Group F

In F series (Figure 5.2b.5) for human face with disgust expression and human face with fondness expression at either end.

-In car F1, respondents belonging to both the cultures have expressed similar response stating that the car F1 has expression implying disgust. The same was found as per the result of visual analysis (result of experiment 2a)

-In F2, visual analysis as well as respondents from both cultures did not show the same response.

- In response to F3, respondents belonging to both cultures have a similar response to the expression denoting fondness. The same was found as per the result of visual analysis (result of experiment 2a)

-In F4, visual analysis in experiment 2a and Indian respondents state that F4 has an expression of disgust, whereas the same was not the case for the Iranian respondents.

-In F5, visual analysis in experiment 2a and respondents belonging to both cultures have differed in their response.

Dendrogram diagram shows the above result and also Table 5.2b.2 the final result for F series.

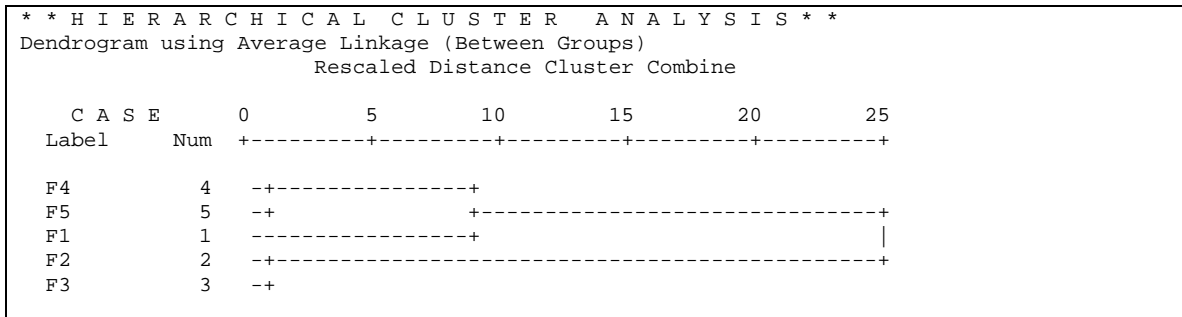


Figure 5.2b.6: Dendrogram of Iranian and Indian culture on F series

Table 5.2b.2: Final result for F series

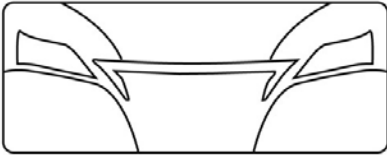
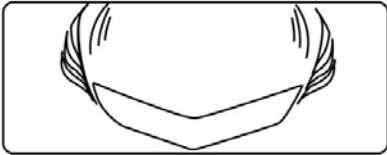
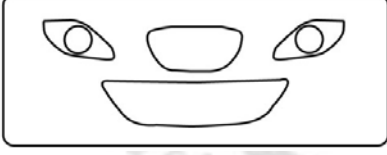
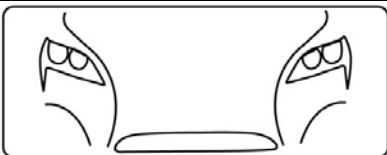
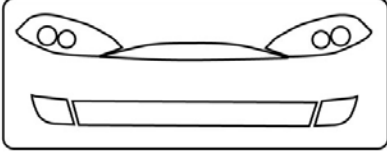
	Graphical Key	Hypothesis	Iranian	Indian	Validation of Hypothesis
F1		Disgust, Anger expression	Disgust, expression	Disgust, expression	Valid
F2		Anger, Speed expression	-	Fondness expression	
F3		Happy expression	Fondness expression	Fondness expression	Valid
F4		Disgust expression	-	Disgust expression	
F5		Serious expression	Fondness expression	Disgust expression	



Figure 5.2b.7: Percentage of Indian and Iranian people's response for Question 17, Group G In G series (Figure 5.2b.7) there are human face with expression of curiosity and human face with expression of stupidity placed at either ends.

-For car G1, respondents belonging to both the cultures have expressed similar response stating that the car G1 has expression implying 'Stupidity'. The same was found as per the result of visual analysis (result of experiment 2a).

-In G2, both cultures did not show the same response.

-In G3 case, respondents belonging to both the cultures have expressed similar response stating that the car G3 has an expression resembling a stupid reaction, but this result does not match as per the visual analysis (result of experiment 2a).

-In G4 case, respondents belonging to both the cultures have expressed similar response stating that the car G4 has an expression of curiosity. Same was found as per the result of visual analysis (result of experiment 2a).

-In G5, visual analysis in experiment 2a and Indian subjects arrived at a similar result that G5 has a Curious expression, but the Iranian subjects did not agree.

Dendrogram diagram shows the above result and also Table 5.2b.3 the final result for G series.

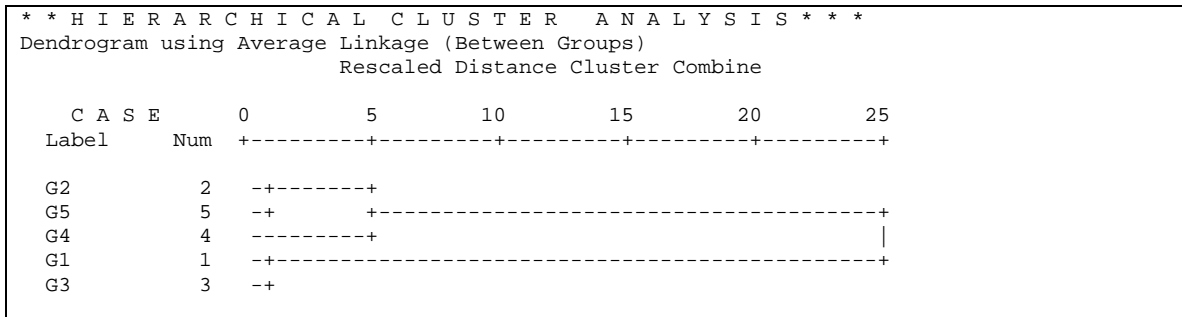


Figure 5.2b.8: Dendrogram of Iranian and Indian culture on G series

Table 5.2b.3: Final result for G series

	Graphical Key	Hypothesis	Iranian	Indian	Validity
G1		Angry expression	-	-	
		Stupid expression	Stupid expression	Stupid expression	Valid
G2		Serious expression	-	curios expression	
G3		Danger expression	Stupid expression	Stupid expression	
G4		curios expression	curios expression	curios expression	Valid
G5		Happy, Curious expression	curios expression	curios expression	Valid



Figure 5.2b.9: Percentage of Indian and Iranian people's response for Question 18, Group H

In H series (Figure 5.2b.9) we have human face with surprise expression and human face with Normal expression placed at either ends.

-In H1 and H2 cases, respondents belonging to both the cultures have expressed similar response stating that the car H1 and H2 have a surprised expression. The same was found as per the result of visual analysis (result of experiment 2a).

-In H3 case, respondents belonging to both the cultures have expressed similar response stating that the car H3 has a normal expression. But this result does not match with that of visual analysis (result of experiment 2a).

-In H4, both cultures had different result

-In H5 case, respondents belonging to both the cultures have expressed similar response stating that the car H5 has a normal expression. The same was found as per the result of visual analysis (result of experiment 2a).

Dendrogram diagram shows the above result and also Table 5.2b.4 has final result for H series.

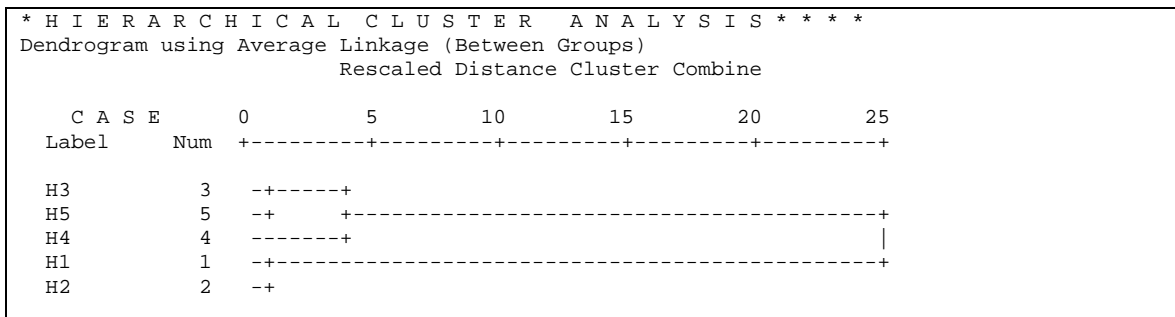
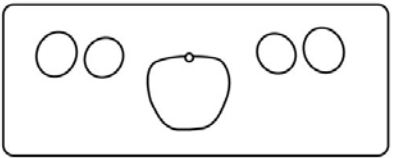
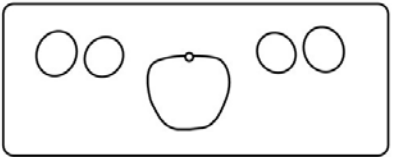
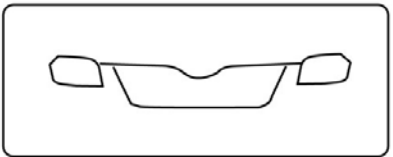
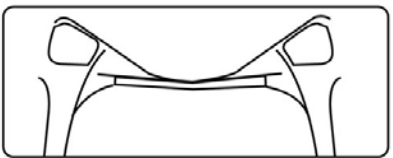
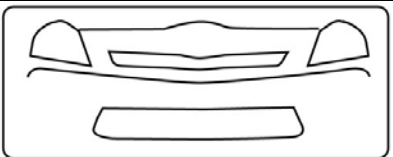


Figure 5.2b.10: Dendrogram of Iranian and Indian culture on H series

Table 5.2b.4: Final result for H series

	Graphical Key	Hypothesis	Iranian	Indian	Validity
H1		Surprise expression	Surprise expression	Surprise expression	Valid
H2		Surprise expression	Surprise expression	Surprise expression	Valid
H3		Serious expression	Normal expression	Normal expression	
H4		Serious expression	-	Normal expression	
H5		Normal , happy expression	Normal expression	Normal expression	Valid

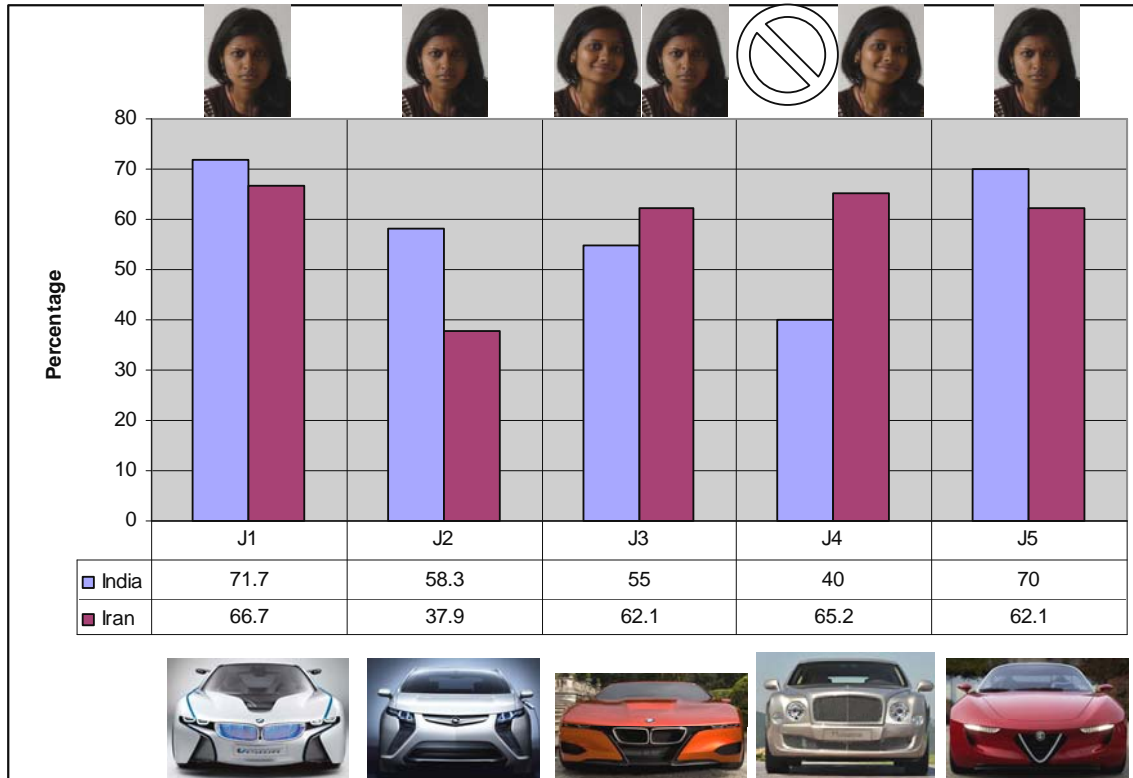


Figure 5.2b.11: Percentage of Indian and Iranian people's response for Question19, Group J

In J series (Figure 5.2b.11) we have human face with angry expression and human face with relaxed expression placed at either end.

-In J1 and J2 cases, respondents belonging to both the cultures have expressed similar response stating that the car J1 and J2 have an angry expression. The same was found as per the result of visual analysis (result of experiment 2a).

-In J3, visual analysis in experiment 2a and Iranian subjects stated that J3 has an angry expression, but Indian subjects did not agree to it.

-In J4, visual analysis in experiment 2a and Iranian subjects stated that J4 has a relaxed expression, but Indian subjects differed on this.

-In J5 case, respondents belonging to both the cultures have expressed similar response stating that the car J5 has an angry expression. The same was found as per the result of visual analysis (result of experiment 2a).

Dendrogram diagram shows the above result and also Table 5.2b.5 has final result for J series.

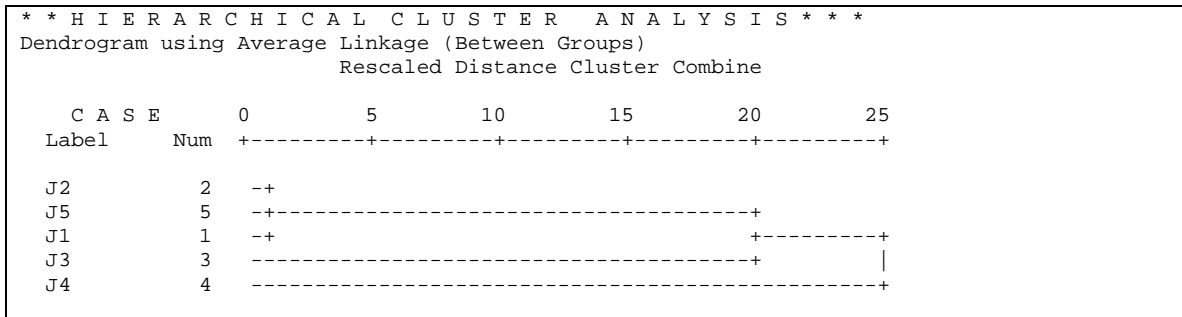

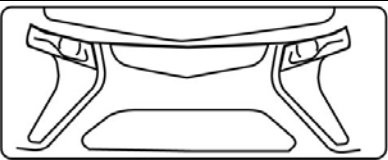
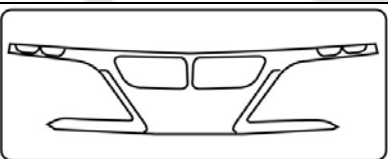
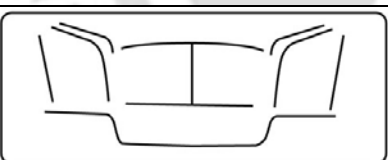
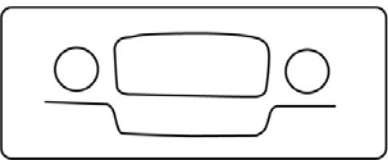
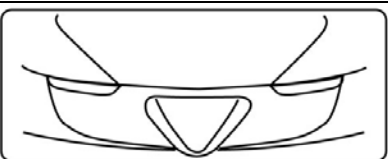


Figure 5.2b.12: Dendrogram of Iranian and Indian culture on J series

Table 5.2b.5: Final result for J series

	Graphical Key	Hypothesis	Iranian	Indian	Validity
J1		Angry expression	Angry expression	Angry expression	Valid
J2		Angry expression	Angry expression	Angry expression	Valid
J3		Angry expression	Angry expression	Relax expression	
J4		Angry expression	-	-	
			Relax expression	-	
J5		Angry expression	Angry expression	Angry expression	Valid

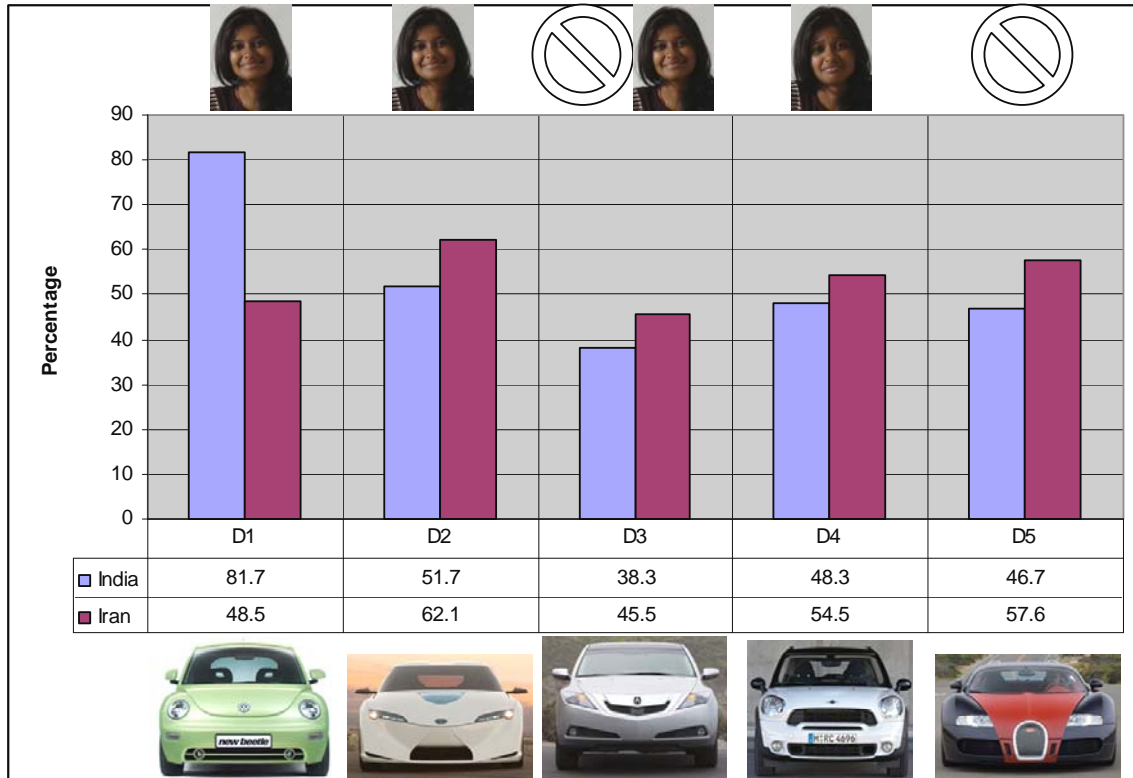


Figure 5.2b.13: Percentage of Indian and Iranian people's response for Question20, Group D

In D series (Figure 5.2b.13) we have human face with happy expression and human face with sad expression placed at either end.

In D1 and D2 cases, respondents belonging to both the cultures have expressed similar response stating that the car D1 and D2 have a happy expression. The same was found as per the result of visual analysis (result of experiment 2a).

-In D3 case, visual analysis in experiment 2a and Iranian subjects stated that D3 has a happy expression, but Indian subjects did not agree to it.

-In D4 case, respondents belonging to both the cultures have expressed similar response stating that the car D4 has a sad expression. The same was found as per the result of visual analysis (result of experiment 2a).

-In D5 case, respondents belonging to both the cultures have expressed similar response stating that the car D5 is not close to Sad or Happy expressions. But the result of visual analysis (experiment 2a) stated that D5 has a sad expression.

Dendrogram diagram shows the above result and also Table 5.2b.6 has final result for D series.

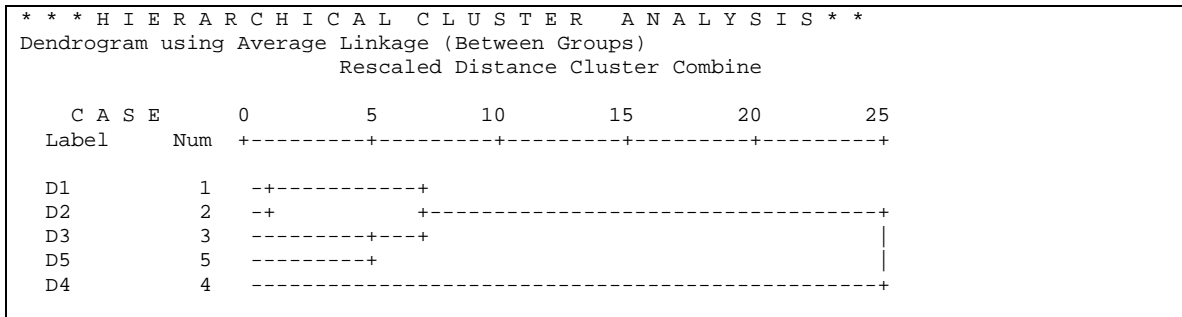


Figure 5.2b.14: Dendrogram of Iranian and Indian culture on D series

Table 5.2b.6: Final result for D series

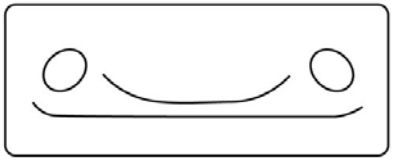
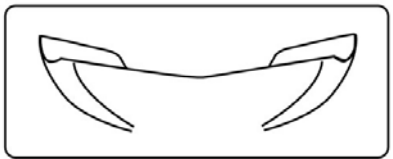
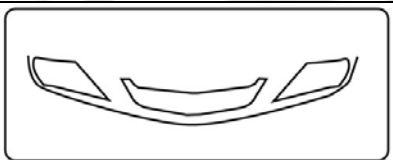
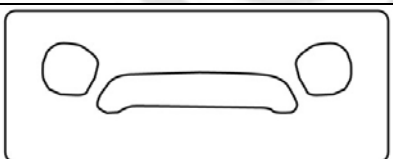
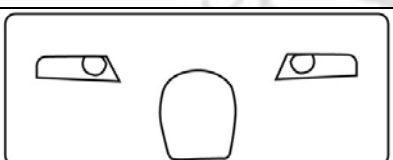
	Graphical Key	Hypothesis	Iranian	Indian	Validity
D1		Happy expression	Happy expression	Happy expression	Valid
D2		Happy expression	Happy expression	Happy expression	Valid
D3		Happy expression	Happy expression	-	
D4		Sad expression	Sad expression	Sad expression	Valid
D5		Sad expression	-	-	



Figure 5.2b.15: Percentage of Indian and Iranian people's response for Question 21, Group K

In K series (Figure 5.2b.15) we have human face with serious expression and human face with comic expression placed at either end.

-In K1 and K2 cases, respondents belonging to both the cultures have expressed similar response stating that the car K1 and K2 have a comic expression. The same was found as per the result of visual analysis (result of experiment 2a).

-In K3 case, respondents belonging to both the cultures have expressed similar response stating that the car K3 has a serious expression. The same was found as per the result of visual analysis (result of experiment 2a).

-In K4 case, respondents belonging to both the cultures have expressed similar response stating that the car K4 is not close to either serious or comic expression. However the result of visual analysis (experiment 2a) stated that K4 has a serious expression.

-In K5 case, respondents belonging to both the cultures have expressed similar response stating that the car K5 is not close to either serious or comic expression. However the result of visual analysis (experiment 2a) stated that K5 has a serious expression.

Dendrogram diagram shows the above result and also Table 5.2b.7 has final result for K series.

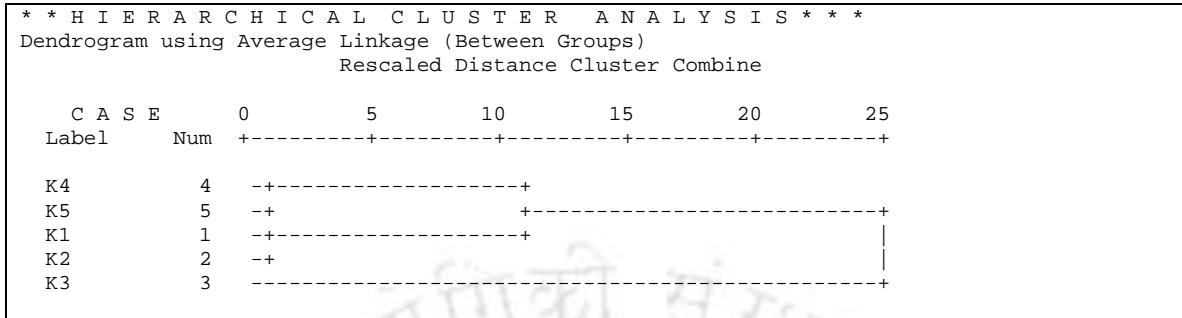


Figure 5.2b.16: Dendrogram of Iranian and Indian culture on K series

Table 5.2b.7: final result for K series

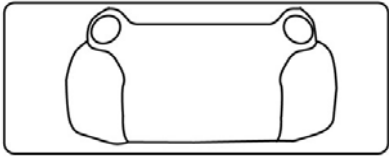
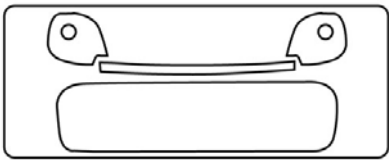
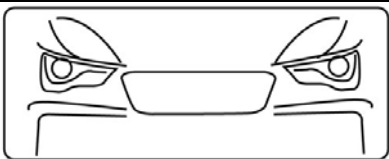

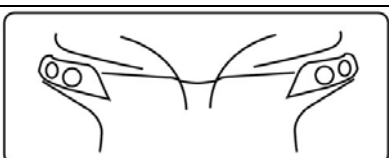
	Graphical Key	Hypothesis	Iranian	Indian	Validity
K1		Comic expression	Comic expression	Comic expression	Valid
K2		Comic expression	Comic expression	Comic expression	Valid
K3		Serious expression	serious expression	serious expression	Valid
K4		Serious expression	-	-	
K5		Serious expression	-	-	



Figure 5.2b.17: Percentage of Indian and Iranian people's response for Question 22 , Group L

In L series (Figure 5.2b.17) we have human face with a dangerous expression and human face with a safe expression placed at either end.

-In L1, visual analysis in experiment 2a and Indian subjects stated that L1 has a dangerous expression but Iranian subjects did not agree to it

-In L2 and L4 cases, respondents belonging to both the cultures have expressed similar response stating that the car L2 and L4 have a dangerous expression. The same was found as per the result of visual analysis (result of experiment 2a).

-In L3, visual analysis in experiment 2a and Indian subjects were shown that L3 has a dangerous expression, but Iranian subjects did not agree to it.

-In L5 case, respondents belonging to both the cultures have expressed similar response stating that the car L5 has a safe expression. But the visual analysis showed an opposite result.

Dendrogram diagram shows the above result and also Table 5.2b.8 has final result for L series.

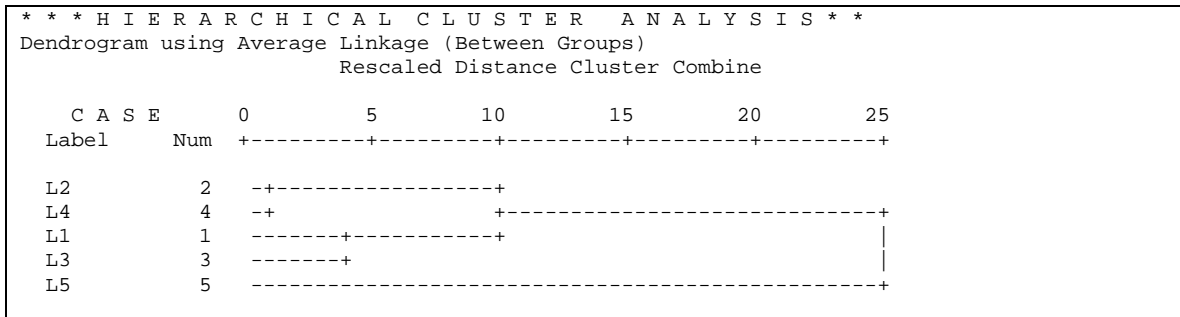
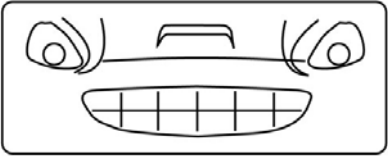
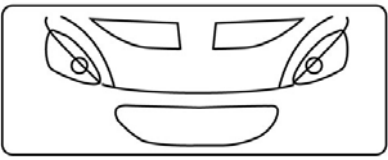


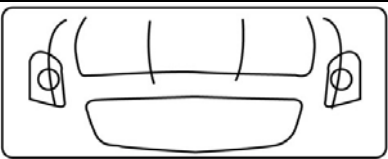


Figure 5.2b.18: Dendrogram of Iranian and Indian culture on L series

Table 5.2b.8: Final result for L series

	Graphical Key	Hypothesis	Iranian	Indian	Validity
L1		Danger expression	-	Danger expression	
L2		Danger expression	Danger expression	Danger expression	Valid
L3		Danger expression	Safe expression	Danger expression	
L4		Danger expression	Danger expression	Danger expression	Valid
L5		Danger expression	Safe expression	Safe expression	

E2b.4 Discussion

Based on the above co relational technique and the final results of the user’s responses we can summarize that, all car forms resemble a particular emotion.

In this part, results of 35 car faces based on co-relational technique are summarized from a cross cultural perspective where respondents from both India and Iran are in agreement

to the expression of the face of the car and their corresponding emotion. Those results that match with the findings of experiment 2a are screened and shortlisted where both Indian and Iranian subjects have common agreement (Table 5.2b.9). This implies that car samples in table 5.2b.9 and their corresponding word expressions are the ones in which respondents in both these cultures are in agreement vis-a-vis results of visual analysis. This insight can now be used in drawing a graphical visual key with their expression for the next experiment to follow.

Table 5.2b.9: Final result of experiment 2a and experiment 2b

No.	Car	Result of visual analysis (Experiment 2a)	Result of co-relation analysis (Experiment 2b)	Useful for visual key
1	F1	Disgust, Anger	Disgust	Confident
2	F3	Happy	Fondness	Confident
3	D1	Happy	Happy	Confident
4	D2	Happy	Happy	Confident
5	D4	Sad	Sad	Confident
6	G1	Anger, Stupid	Stupid	Confident
7	G4	Curious	Curious	Confident
8	G5	Happy, Curious	Curios	Confident
9	H1	Surprise	Surprise	Confident
10	H2	Surprise	Surprise	Confident
11	H5	Happy and normal	Normal	Confident
12	L2	Danger	Danger	Confident
13	L4	Danger	Danger	Confident
14	K1	Comic	Comic	Confident
15	K2	Comic	Comic	Confident
16	K3	Serious	Serious	Confident
17	J1	Anger	Anger	Confident
18	J2	Anger	Anger	Confident
19	J5	Anger	Anger	Confident

E2b.5 Conclusion

It can therefore be seen from the results of such a co relational analysis that exciting insights can be drawn to figure out the similarities and differences of perceptions which are influenced by culture specific tastes, likes and understanding. Such clarity of understanding of design parameters helps designers to make intelligent choices in designing global products that meet needs in local contexts. Designers in one culture can design for another cultural context quite successfully with the aid of such an understanding and insight. And as a second hypothesis (validity of experiment 2a), we can say 19 car faces were valid confirming that a semantic framework can be an appropriate basis for such a study.

Experiment 3a

Study of bio-form Differences using Repertory Grid

Technique: Generating Expression for modern automotives' face from user response to animal or human emotional expressions

E3a.1 Bio- form

Human beings have always derived ideas and inspiration from nature. If we look at historical evolution, we have many examples of animals and insects that construct shelters and use and devise objects (Cross 2006). One of the oldest can be Sphinx (Figure 5.3a.1). A sphinx is an ancient mythological creature that is depicted as a recumbent feline with a human head and sometimes some part of a powerful animal like eagle wing (Wildung 1997). Generally the role of sphinxes is associated with architectural structures such as royal tombs or religious temples. The oldest known sphinx was dated to 9500 B.C. This kind of composite is found in our traditions. Another example is Raymond Loewy's pencil sharper that he designed in 1933 with a form inspired from nature (Hauffe 1998).



Figure 5.3a.1: Sphinx: Winged sphinx from the palace of Darius the Great during Persian Empire, 480 BC. ¹ (Left) Indian sphinx depicted on the Shri Varadaraja Perumal temple in Tribhuvana, India ² (Right)

¹http://en.wikipedia.org/wiki/File:Sphinx_Darius_Louvre.jpg/ accessed in October 2010.

²<http://en.wikipedia.org/wiki/File:Purushamrigatribhuvanai01.JPG/> accessed in October 2010.

In design of flight tools, flying of the birds has been inspirational for flying machine over the last thousand years. Leonardo Da Vinci designed a flying machine using a bat as the model way back in 1505 (Zollner 2003 and Gelb 2009).

Inspiring is one of important part of designing. Designers can create form with different methods. One of them is bio inspiring (Wake 2000). Aerodynamic form for example, is an important invention inspired from speedy animals - higher speed, less friction and less fuel consumption are benefits of aerodynamic. If you look at the bullet train one can see how a designer got the idea from the kingfisher's beak (Figure 5.3a.2)¹. This kind of nature inspiring is useful for solving aesthetic, technical, economic and ergonomic problem of products (Mansoorian 2004, Benyus 1997). Bio-inspiring is specially a good method for embedding emotional cues in products. This part of research presents a bio-design method for product designing.

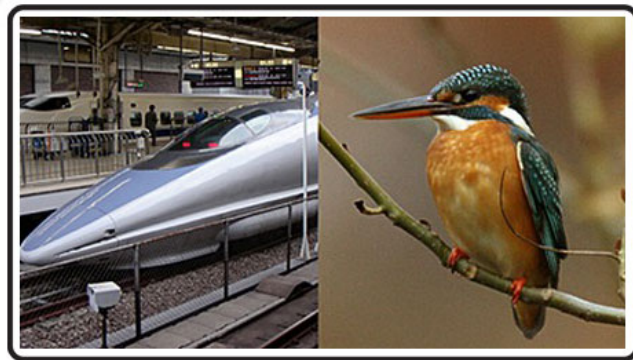


Figure 5.3a.2: The nose-cone of a Japanese 500-series Shinkansen bullet train is modeled after a kingfisher's beak: bullet train (Left) kingfisher beak (Right)

In ecologies of biological species, every species has a unique emotional expression of its own. Humans are aware of this characteristic and because of which every animal may signify a special meaning for the user (Krippendorff 2006). In the field of design too, making a resemblance is possible. For example in the image of the roaring Tiger (Figure 5.3a.3) one can see the resemblance, especially how the jaguar trembles when the tiger roars (Itten 1975) using graphical lines and spots that create the image for two wild animals. Designers' open the door to the product (Heskett 2002) with some message. However there are also instances when users do not understand the message properly due to complexity (Mowen and Minorn 2008, Schiffman and Kanuk 2007).

¹<http://blog.hanrahanmeyers.com/2009/10/hma-research-biomimicry-and-designfont.html>/accessed in October 2010.



Figure 5.3a.3: Roaring Tiger
Graefe, Berlin, (1928)



Figure 5.3a.4: The GINA Light Visionary Model¹

We can raise our eyebrows, wrinkle our forehead and we can express ourselves (Zwaga et al.1999). Designers are able to understand the emotional needs of the users and transfer meaning from car's form to the user through the car face. To achieve this designers search for all the emotional expression of users' need and attempt to put these features in writing the program for a graphical application for the computer. The users can ask for different emotional expression from the central computer of the car that enables the mechanism to change the car form. In the recent past companies like BMW have attempted designing cars with several emotional expressions that allow users to change the form of the car to express different emotional expressions (Figure 5.3a.4). This car builds a bridge between vision and reality by presenting a number of features with a striking similarity with those found on production vehicles. This is possible as the car has a skin (flexible) like body material instead of solid metallic body like steel. But this solution is for future use. In the present automobile trend designers belonging to different culture should be able to determine exactly what users want to reflect with the car face (Wake 2000).

E3a.1.1 Bio-Design method

In this section attempt is made to seek if bio-design method (design inspired from nature) can form a basis for design of the car form. Can the designer transfer expression and meaning using a semantic framework in which meaning and expressions from nature (the signified) are drawn and transferred on to the products (the sign).

In our world the sources of inspiration are limitless (Kaplicky 1999). This experiment explores a Bio-design method to help designers in giving form to the car, drawing ideas from nature.

¹ http://www.netcarshow.com/bmw/2008-gina_light_visionary_model_concept/ accessed in October 2010.

However it must be stated that the method has evolved over many iterations and discussions with a team of three car designer with whom this researcher had regular discussions over four different experimental trials. The proposed approach is a combination derived from the above trials and can be applied to the overall consideration in design viz. aesthetics, economic, technical and physiological. In this experiment however, the method has been applied only for aesthetic consideration.

The method involves the following steps indicated below:

1. *Definition of Problem:* A designer must know about the product and also about the problem. The method could be segmented into the following three parts:
 - a. User's problem
 - b. Definition of the Problem: (in this section designers can use product's name to explain and define the problem)
 - c. Professional description of problem: (in this section designer should not use product's name for explaining or defining the problem).

The Six Honest Serving Men technique¹ is very useful in this regard for the definition of the problem which requires that all the information be identified and way to move forward be agreed upon. For example, when a strategy or a plan is developed, it acts as a checklist for ensuring that the content of the communication is comprehensive. The advantage of this technique is that it encourages open questioning. An individual can apply this technique with prompts from the group or as a general brainstorm. It can be useful if the designer is having trouble identifying what the group knows or understands about a problem, or if the problem is very emotive. 1) Ask clarifying questions until the problem is specifically identified. 2) Use a mind mapping technique to explore response to each of the questions² (Kipling 1987).

- Who is it about? Who is the first degree user? Who is second degree user?

¹ The "Five W's" (and one H) were memorialized by Rudyard Kipling in his "Just So Stories"(1902), in which a poem accompanying the tale of "The Elephant's Child" opens with:

I keep six honest serving-men (They taught me all I knew);
Their names are What and Why and When
And How and Where and Who.

² The responses to the question "How?" can lead to an action plan depending on what the issue or the problem is

- What happened (what is the problem)?
 - When did the problem happen?
 - Where did the problem happen?
 - Why did the problem happen?
 - How did the problem happen?
2. *Recognition of Existential Philosophy and Needs:* Products often pose two kinds of need, the first one is an Existential one as the designer or inventor creates the product. This can be easily termed the foremost need and the second one is ‘secondary needs’ where designers put some construction groups to address secondary needs. Each construction group can resolve one set of needs, and the different groups can in this process address all the different needs of the product. Now the designer must in the first place identify all needs. For this the designer may use Sigma360 analysis which will enable him to answer the following questions 1) Analysis of full cycle activity of the users for one time usage of the product. 2) Analysis of full cycle activity of the users for one time usage of the product in 24 hours. 3) Analysis of full cycle activity of product usage by the user in one week.
3. *Categorizing of Construction Group and Functions:* In this step, designers should categorize the needs (construction groups) and function to these fields - Aesthetics, Economic, Technical and Physiology. Usually when designers put a need in the aesthetics category, it means, designer look for Pattern, Volume, Color, Measure, Form, Shape, Order, Texture, Sign, Sound, Odor, Geometric ratio, and ... when a designer puts a need in the economic category, it means the designer is looking for System, Subsystem, Form, Space, Size, Order, Material, Organization, Economic relation, and ... when designer puts a need in technical category, it means the designer is looking for Mechanism, Material, Form, Manufacture, Mechanical relation, Physical relation, Automation and ... when a designer puts a need in Physiology category, it means the designer is looking for System, Motion, Action, Mechanism, Material, Biological relation, Physical relation, Form, Measure and ...
4. *Living Creatures Selection:* Now in this step, designers select an animal or plant or insect for analysis and extraction of form, system, material, mechanism, color and ...

to solve the problem and address the user's need. In this selection designers should essentially pick out the common animal from nature of ones own culture if global design is important.

- *Substitute and Succession, Merging and Combine, Splitting, Adapt, Magnify Miniaturize, Put to other use, Summarize and Eliminate, Elaborate, Rearrange, Reverse:* In this step designers derive a pure idea from an animal or plant or insect but it is not useful to superimpose it on the product directly. The designer must 1) Substitute and/or Succeed 2) Merge and Combine 3) Split 4) Adapt 5) Magnify 6) Miniaturize, 7) Put to other use 8) Summarize and Eliminate 9) Elaborate 10) Rearrange 11) Reverse, ', these headings make up for a checklist of possible product modifications for stimulating ideas.
- **Substitute and Succeed:** Can help designers to put an idea several times in a single product.
- **Merge and Combine:** Can combine ideas together and formulate a new idea or new product.
- **Split:** Can enable the designer to divide an idea and put it in products in different positions.
- **Adapt:** Designers cannot put idea on the product directly because it has to adapt with the location, function, and ... so it needs to have adaptation.
- **Magnify:** Sometimes designers use an idea in a bigger size to match with the user's need.
- **Miniaturize:** Sometimes designers use idea in a smaller size to match with user's need.
- **Put to other use:** Sometimes the base of idea does not have relation with user's need in product.
- **Summarize and Eliminate:** A designer should always take an abstract from pure idea to use it in a product.
- **Elaborate:** Some times designers need to add some more mechanism and parts for arriving at a good result.

- Rearrange: Designers can put together parts with different arrangements. Some times abnormal arrangement leads to a better result.
- Reverse: Sometimes designers can put every thing opposite for arriving at better results.

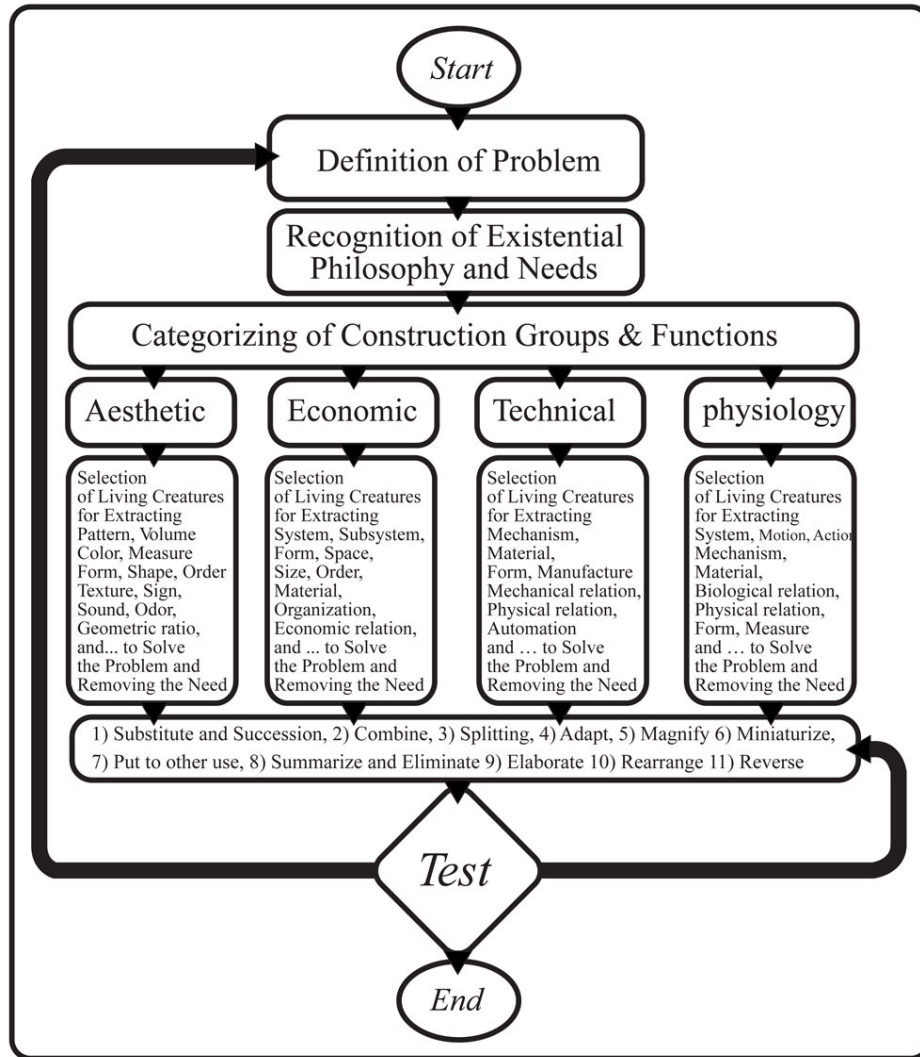


Figure 5.3a.5: Bio-design method

While thinking about possible product modifications it is all too easy to concentrate only on the obvious ones and overlook others. For example, while trying to make a product in a smaller scale such as a necklace, drawing inspiration from big animal, one should make it smaller, eliminating some of its features. The use of a checklist forces one to go through all the possible modifications of the product to help solve the problem. But one should be wary that, using product

modification checklists can be a mind-numbing experience, especially with complex or multiple component products. But if it helps to solve the problem, the gain is worth the pain. It might also save a lot of frustration and wasted time in the long run. (Jaafarnia 2005 and Baxter 1995)

5. *Test*: In this step designers try to test the product (design) to check if the problem is solved or not. If designers cannot solve the problem, remove the needs and understand the problem, than the need for designing should take a back seat. If the problem needs more ideas, then one should resort to the 'Definition of Problem'. Otherwise designing is over.

E3a.2 Plan of the Experiment

Hypothesis

This part of the research presents a study that attempts to draw a co-relation between car faces and human faces; and car faces and animal faces and verify whether bio-design method in the design of the car can be a successful approach. Several questions arise. What actually takes place during the selection of a car? During the process of selection does a user's understanding of a car face differ from that of designers'? The willingness to explain these differences leads to the issue of individual meanings. For a designer of products, understanding semantic processes as they take place in the perception of users mind - forms the basis of embedding product features with meaning while conceptualizing (Krippendorff 2006).

Can a viewer cognize an organic form like human faces on a car's face? When does a user relate a car face to a human facial expression (reaction) and when does a user relate a car face to an animal face expression? Do car faces express human expression or animal expression? Is a negative expression of a car's face derived from an animal? Does the positive expression of a car's face come from human reaction?

This experiment attempts to understand these issues by studying the users' response to car faces expressions, animal facial expression and human facial expression using the Repertory Grid Technique (RGT) and co- relation techniques.

These reactions have been specifically studied for respondents belonging to Indian and Iranian cultures.

Table 5.3a.1: Hypotheses relationships

List 1		List 2	List 3	
Animals	Human	Cars	Animals	Human
Goose, Normal	Human, Normal	H2 series	Monkey, Surprise	Human, Surprise
Dog, Sad	Human, Sad	D1 series	Frog, Happy	Human, Happy
Camel, Relax	Human, Relax	J1 series	Cheetah, Anger	Human, Anger
Panda, Fondness	Human, Fondness	F1 series	Fox, Disgust	Human, Disgust
Lamb, Safe	Human, Safe	L5 series	Shark, Dangers	Human, Dangers
Dog, Comic	Human, Comic	K4 series	Cobra, Serious	Human, Serious
Ostrich, Stupid	Human, Stupid	G5 series	Rabbit, Curios	Human, Curios

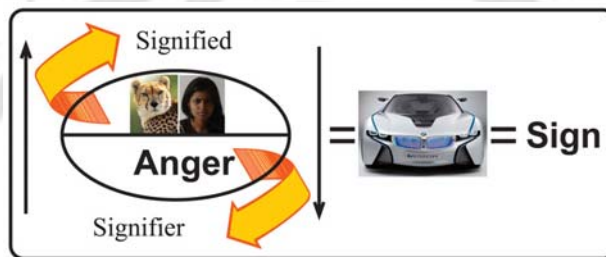


Figure 5.3a.6: Hypothesis of Experiment 3a

To examine the above hypothesis, a semantic framework was considered for form analysis drawing co-relation between signified (human and animals expressions) and its sign (Car front face). This was evaluated for correspondence or contrast in the visual form expression of the object to seek possible explanations and answers to the above questions like whether ‘emotional expression can represent animal or human emotional reactions more in car faces’ and ‘which attributes play an important role’. Repertoire Grid Technique (RGT) and Co-relation techniques were used for categorizing and mapping data from user’s selection for the purpose of analysis.

E3a.2.1 Methodology

The methodology followed could be divided into the following steps:

1. Initially a set of 14 words for different emotions were selected as a signifier (Table 5.3a.1). This was used for creating the visual database for human emotion and animals expressions and front face of cars (signified) (Figure 5.3a.7)
 - a. Short listing of the emotional reactions (signifiers) that are reflected in a set of front face of cars (signs) selected from the web site www.netcarshow.com

- b. Cross verification and evaluation of the visual form of car face for their representation of an emotion by an expert group of trained car stylist.
2. Creating two set of facial expressions that depict the 14 emotion (Figure 5.3a.8 and Figure 5.3a.9) (In the first case we ask our model to react to the word ‘happy’ (Signifier) and we take a photo of the expression (signified) or in the second case we search for a picture of animal’s reaction (signified), based on emotional expression word (signifier))
3. Identification of RGT correspondence between car face and emotional reaction (Table 5.3a.1)
4. Formation of Visual set of 7 car form (Series L5, K4, J1, H2, G5, F1, D1) arranged in a set in such a way that they are placed along with contrasting bi polar expression of human placed on either side. (Figure 5.3a.8 and Figure 5.3a.9)
5. Creating complete visual database comprising 7 car face, capturing 14 emotional set, for user’s response testing (Figure 5.3a.8 and Figure 5.3a.9)
6. Conducting the user response Test through an online survey (Figure 5.3a.10).

Sample Size

The total sample size of the survey was 126 respondents.

78 respondents (62%) were men (age 18-54) and 48 respondents (38%) were women (age 18-50).

All the subjects were Asians. Out of the total of 126 respondents there were 60 people (48%) from India and 66 people (52%) from Iran.

Objects

Seven car face samples (Figure 5.3a.7) including a series of 14 probable samples of animal faces were (Figure 5.3a.8) chosen from a total of 40 animal faces have been used for the experiments; and a series of 14 female face sample (Figure 5.3a.9) chosen from a total of 2 series (14 female & 14 male faces) have also been included. Samples were chosen by consensus and discussions by three professional designers based on the transport education value and gender representation of emotional expression.

The people and animals were selected for similarity of emotional reactions (list 1); car face samples (List 2); human and animal pictures were selected for contrasting emotional reactions (List 3) in Table 5.3a.1.

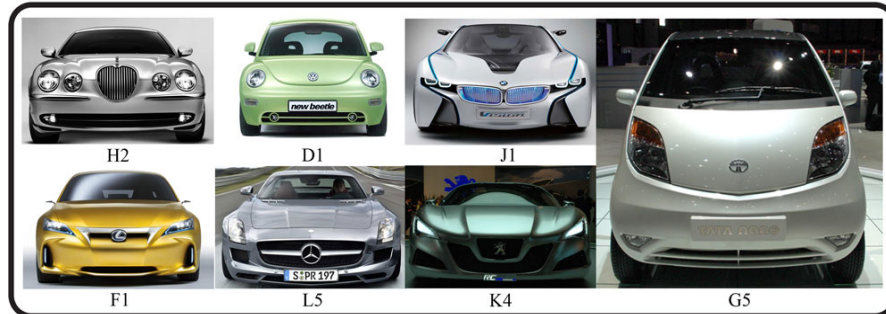


Figure 5.3a.7: Car faces samples.



Figure 5.3a.8: Animals faces: 'Similar' face reactions (Top row) 'contrasting' face reactions (Bottom row).

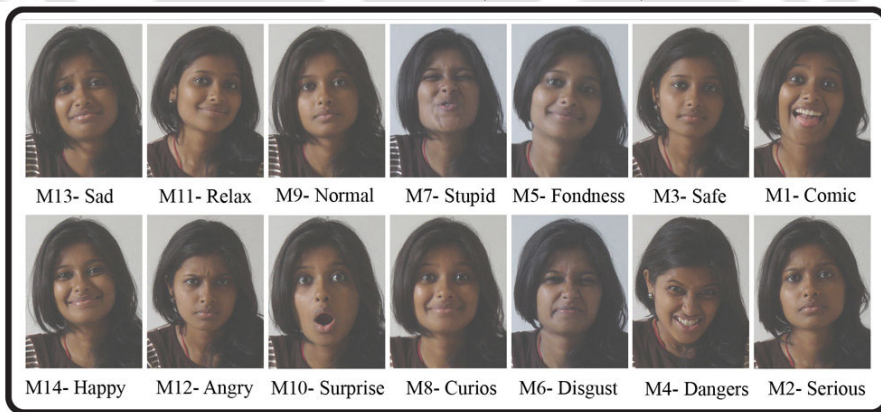


Figure 5.3a.9: Human faces: 'Similar' face reactions (Top row) 'contrasting' face reactions (Bottom row).

E3a.2.2 Experimentation Processes

The experimental set up and data collection presented above are the same as depicted online (Figure 5.3a.10). The questionnaire explained the purpose of data collection and with the aid of an example; it introduced the respondent to the method of filling up the

questionnaire with their response. The questionnaire had an explanation for each question set. There were a total of 7 questions.




Figure 5.3a.10: Questionnaire in the internet.


Using the grid that had all five pictures of car face, human and animal pictures in sets of two placed at either ends were shown on the internet. Subjects were asked to rate - 1 for the best contrast, 2 for contrast, 3 for being impartial, 4 for similarity and 5 for the best similarity. Depending on the ratings patterns, groups were marked on the internet. This was repeated for the entire seven human and animal pairs on base 7 car faces (L5, K4, J1, H2, G5, F1, and D1) one by one.


E3a.3 Results

This data collected by RGT (Figure 5.3a.11 till Figure 5.3a.14) was analyzed for frequency of groupings, for a given car by using web grid clustering technique for both the Indian and Iranian respondents.

In Figure 5.3a.11 (for Indian subjects) the first row with bipolar expression of disgust - fondness for human face, were placed at either end.

 *Green colored squares - indicate high degree of similarity or agreement of user response to the chosen expression.*

 *Red colored squares - indicate highest contrast or disagreement of user response to the chosen expression*

 *White colored squares – indicate impartial or neutral response user response to the chosen expression*

Similarity 5	H2	D1	J1	F1	L5	K4	G5	Contrast 1
Disgust	4	1	4	5	3	4	1	Fondness
Curios	5	5	3	3	4	3	5	Stupid
Surprise	5	3	3	2	4	3	3	Normal
Anger	3	1	5	4	3	4	1	Relax
Happy	3	5	4	2	4	2	5	Sad
Serious	3	3	2	4	3	3	1	Comic
Dangers	3	1	5	4	4	5	1	Safe

Figure 5.3a.11: Sample sheet shows ratings as a result of RGT with human bases (Indian people).

Similarity 5	H2	D1	J1	F1	L5	K4	G5	Contrast 1
Disgust	2	1	3	5	3	3	1	Fondness
Curios	5	5	3	1	3	3	5	Stupid
Surprise	5	1	3	3	4	3	2	Normal
Anger	3	1	5	4	3	5	1	Relax
Happy	3	5	3	3	4	3	5	Sad
Serious	3	3	5	3	1	3	1	Comic
Dangers	3	1	5	4	3	5	3	Safe

Figure 5.3a.12: Sample sheet shows ratings as a result of RGT with human bases (Iranian people).

Car F1 with 5 marks (green) indicating highest similarity with the human face with disgust expression.

While three Cars H2, J1 and K4 with 4 marks (green) in the first row make up for the second group indicating similarity with the human face with disgust expression.

Car L5 with 3 marks (white) forms another group indicating impartiality and dissimilation, while two cars D1 and G5 with 1 mark (red) indicated highest contrast from human face with disgust expression.

In Figure 5.3a.12 (for Iranian subjects) the first row with bipolar expression of disgust - fondness for human face, were placed at either end.

Car F1 with 5 marks (green) indicating highest similarity with the human face with disgust expression.

Cars L5, J1 and K4 with 3 marks (white) forms another group indicating impartiality and dissimilation, car H2 with 2 marks (red) indicated contrast from human face with disgust expression and while two cars D1 and G5 with 1 mark (red) indicated highest contrast from human face with disgust expression.

Now comparing the two set of responses, sample F1 has as a similarity with the disgust expression and the two samples (G5 and D1) are in stark contrast to the disgust expression and as a similar to human face with fondness expression. This was the same response made by both the cultures.

In Figure 5.3a.13 (Indian subjects) the first row with bipolar for fox face with disgust expression and panda face with fondness expression were placed at either end.

Car F1 with 5 marks (green) indicating highest similarity with the fox face with disgust expression.

While two Cars J1 and K4 with 4 marks (green) in the first row make up for the second group indicating similarity with the fox face with disgust expression.

Car L5 with 3 marks (white) forms another group indicating impartiality and dissimilation, while three cars H2, D1 and G5 with 1 mark (red) indicated highest contrast from the fox face with disgust expression.

In Figure 5.3a.14 (Iranian subjects) the first row with bipolar for fox face with disgust expression and panda face with fondness expression were placed at either end.

Car F1 with 5 marks (green) indicating highest similarity with the fox face with disgust expression.

While two Cars J1 and K4 with 4 marks (green) in the first row make up for the second group indicating similarity with the fox face with disgust expression.

Car L5 with 3 marks (white) forms another group indicating impartiality and dissimulation, car H2 with 2 marks (red) indicated contrast from fox face with disgust expression and while two cars D1 and G5 with 1 mark (red) indicated highest contrast from the fox face with disgust expression.

Now in two last analyses, sample F1 being similar to fox with disgust expression and the two samples (G5 and D1) as a contrast to fox with disgust expression and as a similar to panda face with fondness expression were the same response as generated by both the cultures.

Similarity 5	H2	D1	J1	F1	L5	K4	G5	Contrast 1
	1	1	4	5	3	4	1	
	4	5	1	1	3	1	5	
	5	1	3	3	3	3	1	
	4	3	5	3	4	4	3	
	4	5	4	4	2	3	5	
	3	1	4	4	3	5	1	
	4	1	4	4	5	4	1	

Figure 5.3a.13: Sample sheet shows ratings as a result of RGT with animals bases (Indian people)

















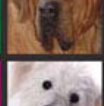



Similarity 5	H2 	D1 	J1 	F1 	L5 	K4 	G5 	Contrast 1
	2	1	4	5	3	4	1	
	3	1	3	3	1	3	5	
	5	3	3	3	3	3	1	
	3	3	5	4	3	4	3	
	1	5	3	3	3	3	4	
	3	1	4	4	3	5	1	
	3	1	5	3	4	5	1	

Figure 5.3a.14: Sample sheet shows ratings as a result of RGT with animals bases (Iranian people)

E3a.4 Data Analysis and discussions

Further statistical analysis of the RGT data was done using web grid clustering technique (Fransella and Bannister 2003). This resulted in clustering of the various cars together that shared degrees of similarity and contrast as categorized by the subjects. Using Multidimensional Scaling (MDS) is one of the ways for the researcher for doing quantitative analysis on RGT data. MDS is a statistical technique that displays the structure of distance-like data as a geometrical picture. It creates the perceptual maps of the distances between the images as reported by the users through ratings of the elements. MDS uncovers underlying relationship between the given objects based on a series of similarity or distance calculations. It takes an input matrix giving dissimilarities between pairs of items and outputs a coordinate matrix whose configuration minimize a loss function called strain (Kruskal and Wish 1977).

Groupings emerged for each pair of human reactions or animals per row from both the two Indian and Iranian culture. It would also be interesting to find out the similarity – contrast relationship between all cars and all human reactions and animals put together in front of the two Indian and Iranian cultures. This would give the researcher a higher level clustering and also indicate relationships not just row wise between two human or animal faces and the cars but with all the faces and all the cars taken at one go. At the end of the analysis a hierarchical tree structure emerged indicating nested relationships of various groups. The resulting clusters (Hierarchical Cluster Analysis) and nested relationship of web grid cluster statistical analysis is shown in Figure 5.3a.15 till Figure 5.3a.18. The tree diagram at the top of Figures are the cluster map indicating degrees (in numbers between zero till 25 mark: zero mark indicating highest similarity and 25 marks indicating highest dissimilarity) of similarity and contrast between the various car faces. For example last two cars (G5 & D1) in Figure 5.3a.15 were associated, with one mark had the highest degree of similarity together. This indicates that the subjects could see a particular characteristic in the two car faces of the particular human reactions. G5 and D1 were associated with all human reaction faces. Their faces had the best kind of expression. Their faces completely resembled the contrasting human reaction. Cars (L5 & H2) indicated clusters with one mark similarity together.

The tree cluster is indicative of the semantic similarities (mainly based on emotional expression as indicated by corresponding human reaction faces) shared by the various car faces as understood by the respondents. The last two cars (G5 & D1) had (25 marks) the highest degree of dissimilarity with cars (J1, F1, K4, L5 and H2) as determined by the respondents. The more the distance between the tree branches, the more dissimilar is the emotional expression of car faces between themselves. Also results from multidimensional scaling (MDS) show a similar pattern. Similar analysis can be carried out to all the Figure 5.3a.16, Figure 5.3a.17 and Figure 5.3a.18.

**** H I E R A R C H I C A L C L U S T E R A N A L Y S I S ****

Dendrogram using Average Linkage (Between Groups)
Rescaled Distance Cluster Combine

C A S E	0	5	10	15	20	25
Label	Num	+-----+-----+-----+-----+-----+				
G5	6	-----+-----+-----+-----+-----+				
D1	7	-----+-----+-----+-----+-----+				
L5	4	-----+-----+-----+-----+-----+				
H2	5	-----+-----+-----+-----+-----+				
F1	2	-----+-----+-----+-----+-----+				
K4	3	-----+-----+-----+-----+-----+				
J1	1	-----+-----+-----+-----+-----+				

Similarity	J1	F1	K4	L5	H2	G5	D1	Contrast
5								1
Stupid	3	3	3	2	1	1	1	Curious
Disgust	4	5	4	3	4	1	1	Fearfulness
Anger	5	4	4	3	3	1	1	Relax
Sad	2	4	4	2	3	1	1	Happy
Serious	2	4	3	3	3	1	3	Comic
Dangers	5	4	5	4	3	1	1	Safe
Surprise	3	2	3	4	5	3	3	Normal

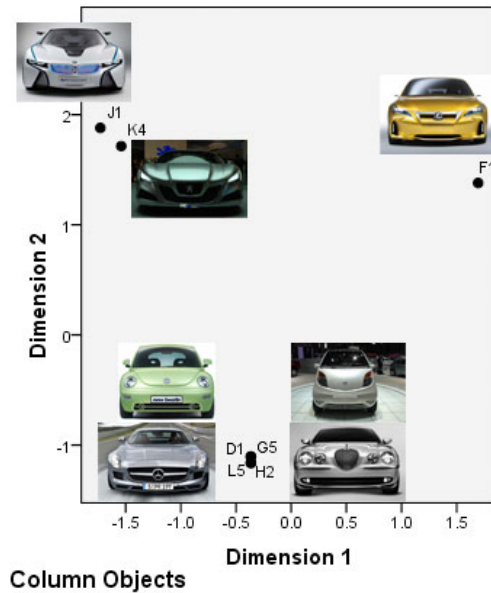
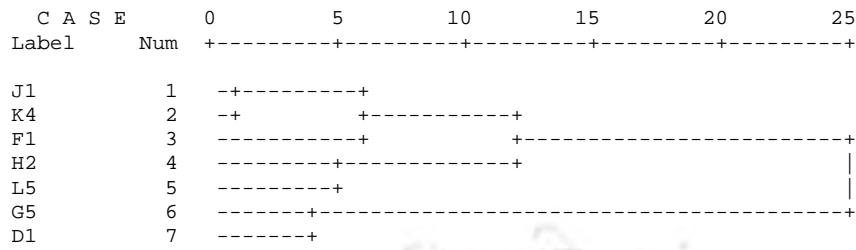


Figure 5.3a.15: Sample sheet shows ratings as a result of RGT with human bases (Indian people).

* * H I E R A R C H I C A L C L U S T E R A N A L Y S I S * *
 Dendrogram using Average Linkage (Between Groups)
 Rescaled Distance Cluster Combine



Similarity	J1	K4	F1	H2	L5	G5	D1	Contrast
5								1
Stupid	3	3	5	1	3	1	1	Curious
Disgust	3	3	5	2	3	1	1	Fondness
Surprise	3	3	3	5	4	2	1	Normal
Serious	5	3	3	3	1	1	3	Comic
Sad	3	3	3	3	2	1	1	Happy
Anger	5	5	4	3	3	1	1	Relax
Dangers	5	5	4	3	3	3	1	Safe

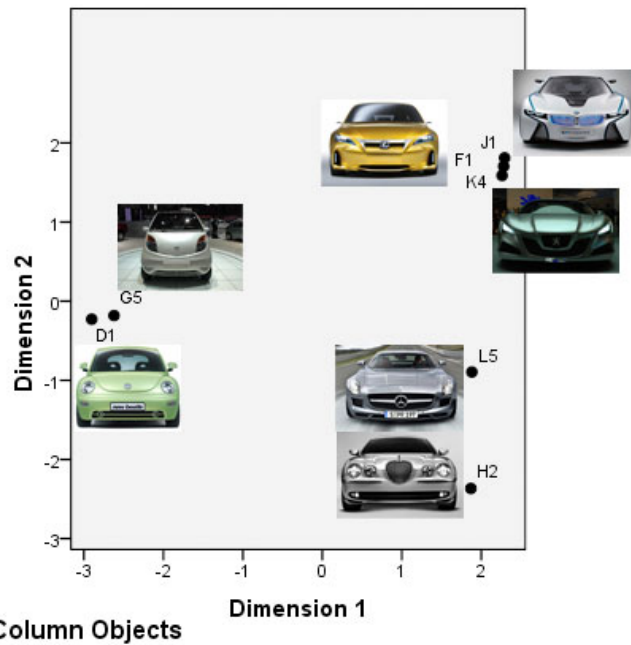


Figure 5.3a.16: Sample sheet shows ratings as a result of RGT with human bases (Iranian people).

** H I E R A R C H I C A L C L U S T E R A N A L Y S I S **
 Dendrogram using Average Linkage (Between Groups)
 Rescaled Distance Cluster Combine

CASE	0	5	10	15	20	25
Label	Num	+-----+-----+-----+-----+-----+				
D1	7	-----+-----+-----+-----+-----+				
G5	6	-----+-----+-----+-----+-----+				
K4	5	-----+-----+-----+-----+-----+				
J1	4	-----+-----+-----+-----+-----+				
F1	3	-----+-----+-----+-----+-----+				
L5	2	-----+-----+-----+-----+-----+				
H2	1	-----+-----+-----+-----+-----+				

Similarity	H2	L5	F1	J1	K4	G5	D1	Contrast
5								1
	2	4	2	2	3	1	1	
	2	3	5	5	5	1	1	
	1	3	5	4	4	1	1	
	4	5	4	4	4	1	1	
	3	3	4	4	5	1	1	
	5	3	3	3	3	1	1	
	4	4	3	5	4	3	3	

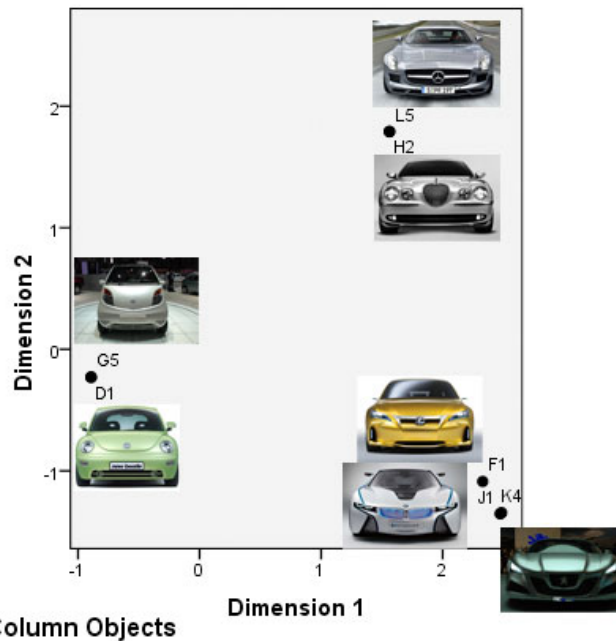


Figure 5.3a.17: Sample sheet shows ratings as a result of RGT with animals bases (Indian people).

*** HIERARCHICAL CLUSTER ANALYSIS ***
 Dendrogram using Average Linkage (Between Groups)
 Rescaled Distance Cluster Combine

CASE	0	5	10	15	20	25
Label	Num	+-----+-----+-----+-----+-----+				
J1	1	-+----+				
K4	2	-+ +-----+				
F1	3	-----+ +-----+				
L5	4	-----+-----+-----+				
H2	5	-----+-----+-----+-----+				
D1	6	-----+-----+-----+-----+-----+				
G5	7	-----+-----+-----+-----+-----+				

Similarity	J1	K4	F1	L5	H2	D1	G5	Contrast
5								1
	4	4	5	3	2	1	1	
	3	3	3	3	5	1	2	
	4	5	4	3	3	1	1	
	5	5	3	4	3	1	1	
	3	3	3	5	3	5	1	
	3	3	3	3	5	3	1	
	5	4	4	3	3	3	3	

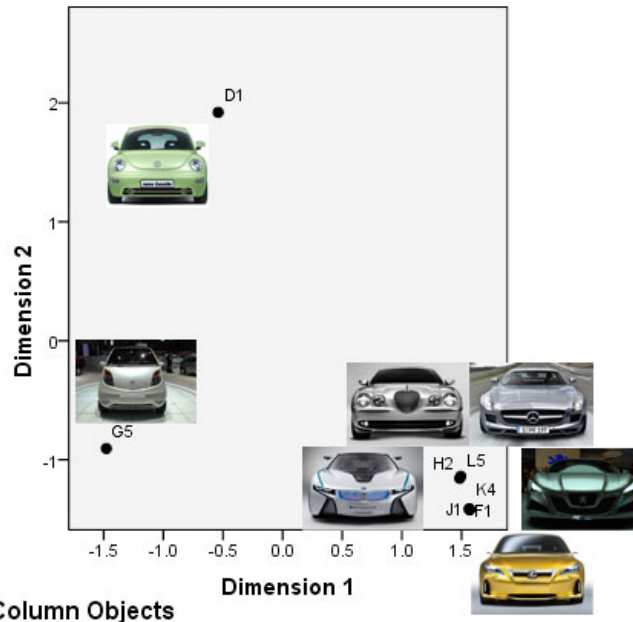


Figure 5.3a.18: Sample sheet shows ratings as a result of RGT with animals bases (Iranian people).

We have observed that the subjects in both the cultures could identify and associate a car face to a corresponding human facial expression. Comparing the responses in which the respondents associated the car face to the human faces with Disgust and Fondness expressions the following groupings was noticed:

For Indian subjects (Figure 5.3a.19): (F1) ; (K4, H2, J1) ; (L5); (G5, D1)

For Iranian subjects (Figure 5.3a.19): (F1) ; (L5, K4, J1) ; (H2); (G5, D1)

As seen in Figure 5.3a.19, Car F1 corresponded with the human face with an expression of disgust and was found similar in both the cultures. The emotional labels such as disgust were hypothetically assigned as part 'predicted grouping' by the researchers.

34.8% of Iranian subjects and 43.3% of Indian subjects categorized car F1 with the human face with Disgust expression. Other than F, no other car was grouped by the subjects with Disgust expression.

43.9% and 66.7% of Iranian subjects and 63.3% and 66.7% of Indian subjects identified the cars G5 and D1 with the human face with Fondness expression. No other car was grouped by any of the subjects along with G5 and D1 for Fondness expression. Designers need to be sensitive to the degrees of embedding emotional expression. Similar analysis can be carried out to all the other Figures till Figure 5.3a.32

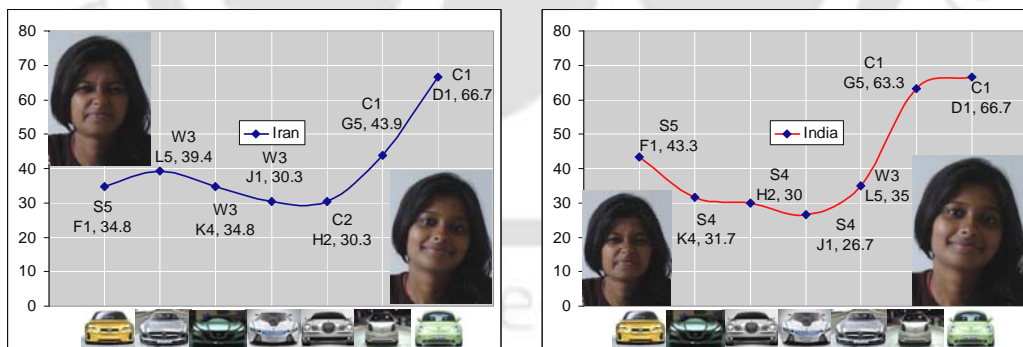


Figure 5.3a.19: After analysis Q2: Iranian people (Left) Indian people (Right)

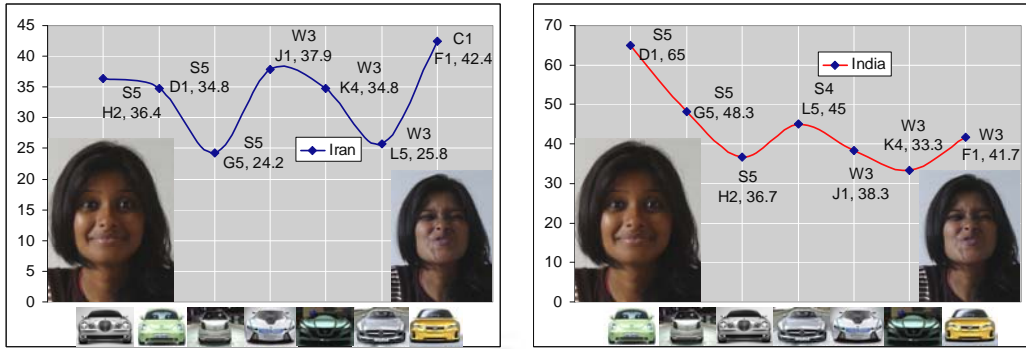


Figure 5.3a.20: After analysis Q3: Iranian people (Left) Indian people (Right)

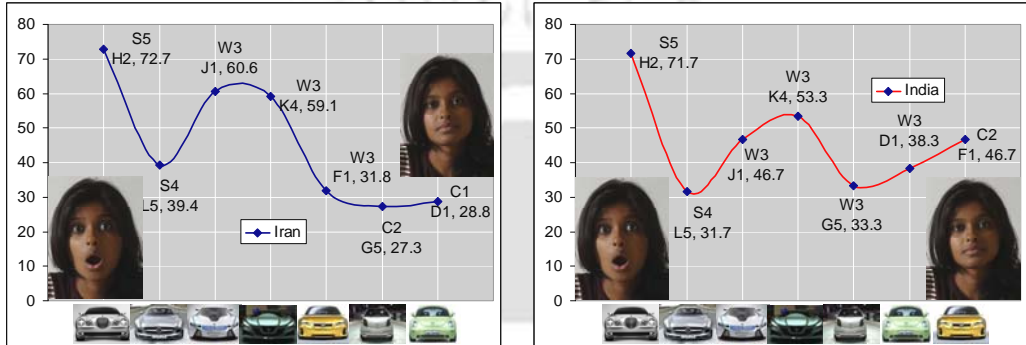


Figure 5.3a.21: After analysis Q4: Iranian people (Left) Indian people (Right)

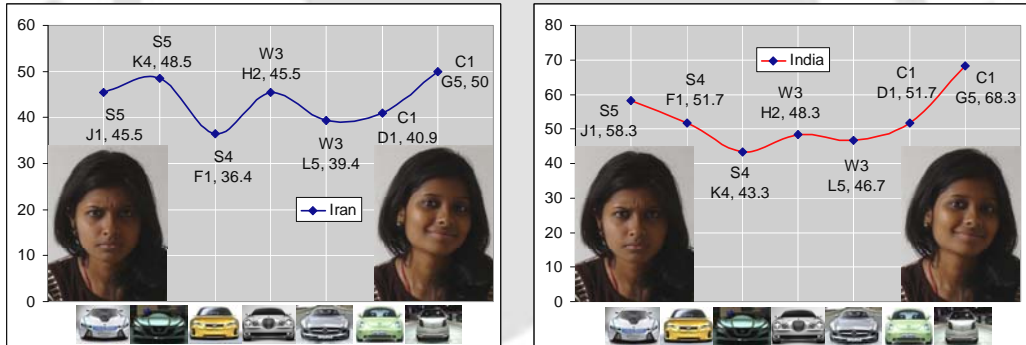


Figure 5.3a.22: After analysis Q5: Iranian people (Left) Indian people (Right)

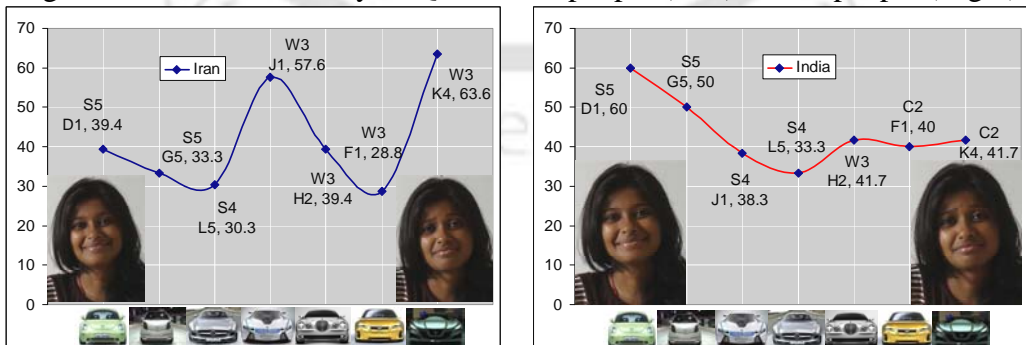


Figure 5.3a.23: After analysis Q6: Iranian people (Left) Indian people (Right)

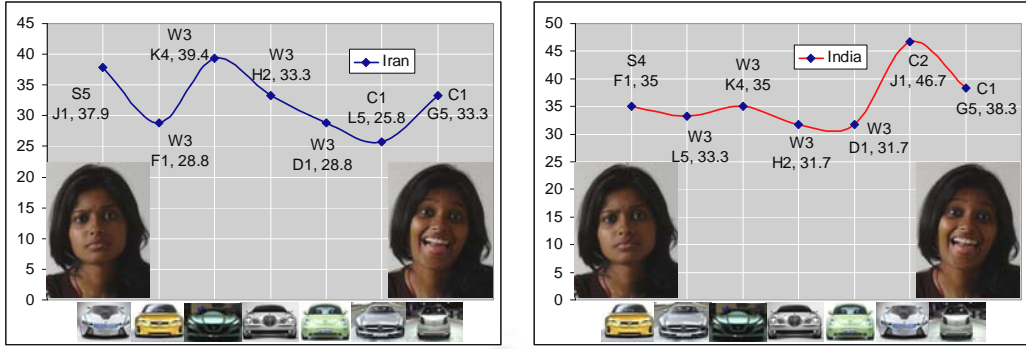


Figure 5.3a.24: After analysis Q7: Iranian people (Left) Indian people (Right)

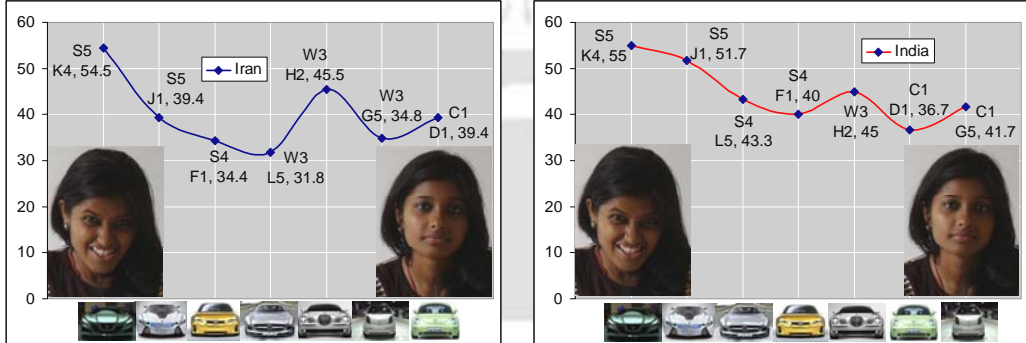


Figure 5.3a.25: After analysis Q8: Iranian people (Left) Indian people (Right)

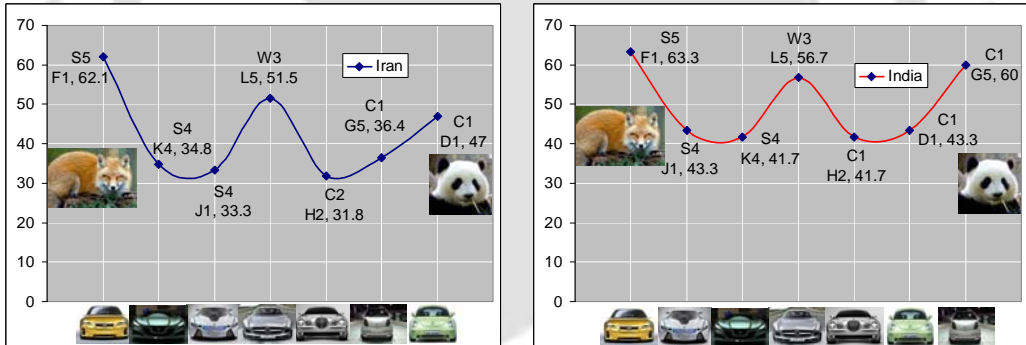


Figure 5.3a.26: After analysis Q9: Iranian people (Left) Indian people (Right)

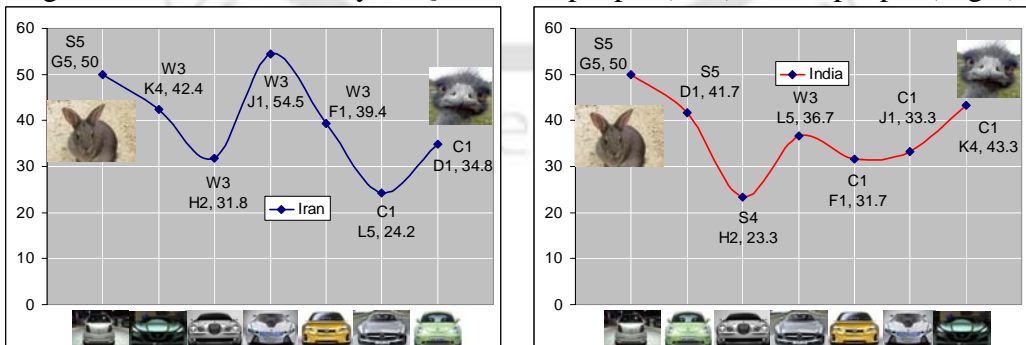


Figure 5.3a.27: After analysis Q10: Iranian people (Left) Indian people (Right)

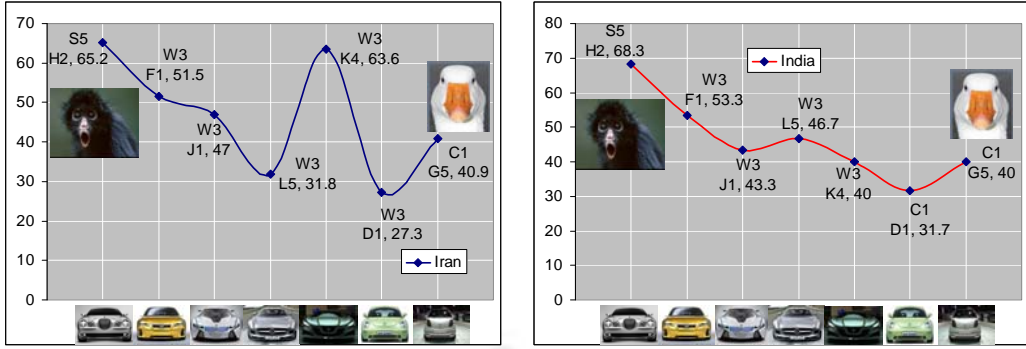


Figure 5.3a.28: After analysis Q11: Iranian people (Left) Indian people (Right)

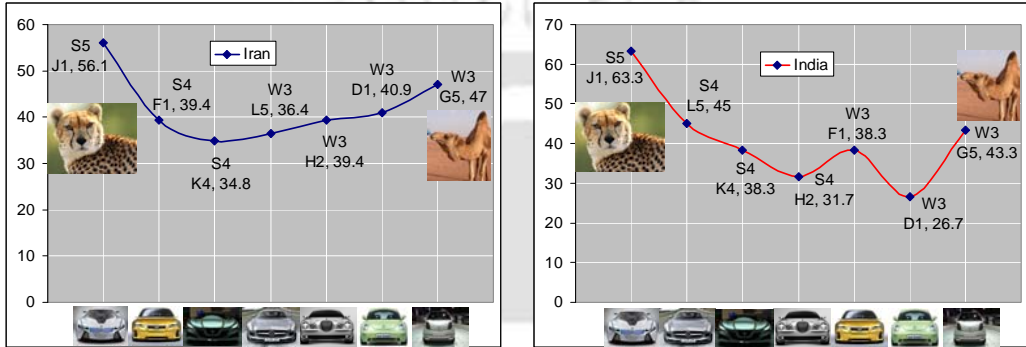


Figure 5.3a.29: After analysis Q12: Iranian people (Left) Indian people (Right)

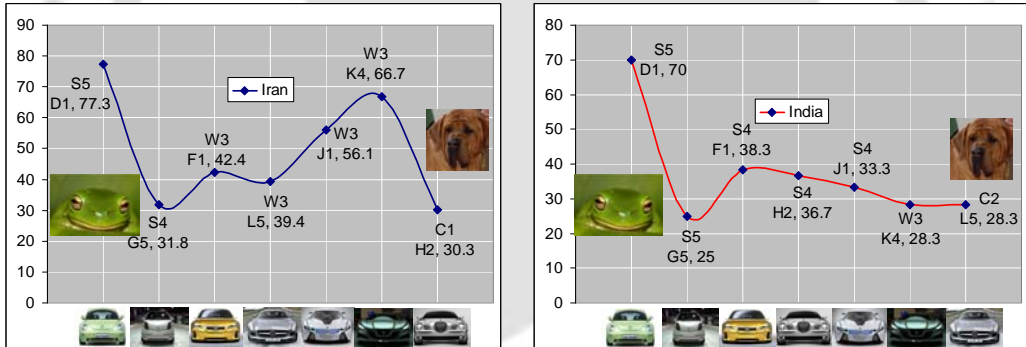


Figure 5.3a.30: After analysis Q13: Iranian people (Left) Indian people (Right)

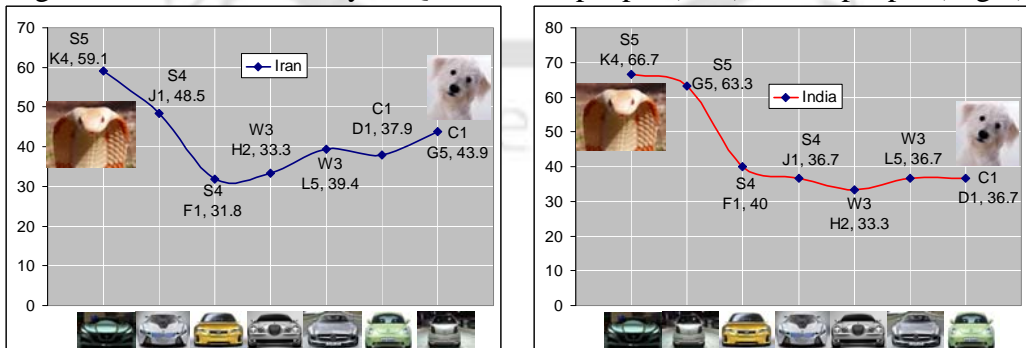


Figure 5.3a.31: After analysis Q14: Iranian people (Left) Indian people (Right)

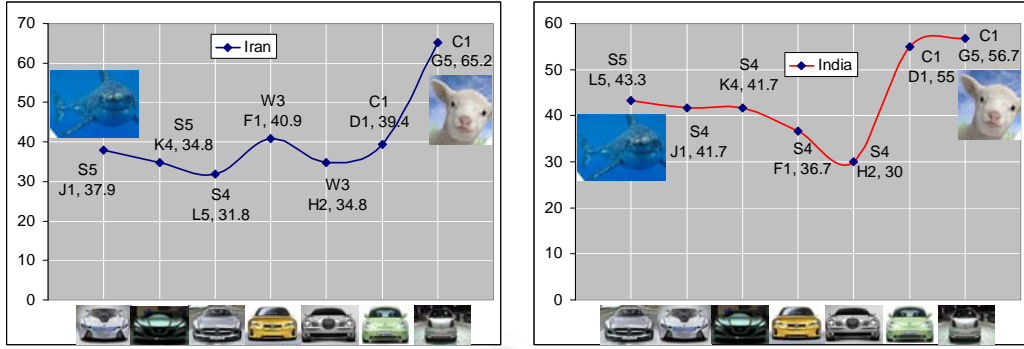


Figure 5.3a.32: After analysis Q15: Iranian people (Left) Indian people (Right)

E3a.5 Discussion

This part presents result of RGT technique on 7 car faces (chosen out of 35 car faces) accepted by both the cultures. This research compared the results of RGT technique, visual analysis (Experiment 2a) and co-relation techniques (Experiment 2b). Based on cross comparison of user response to the car expression the below mentioned 6 car faces were shortlisted for extracting and generating the visual key. (Table 5.3a.2)

Table 5.3a.2: Results of Experiment 3a

No	Car	Result of visual analysis Experiment 2a	Result of co-relation Experiment 2b	Result of RGT Experiment 3a	Useful for visual key
1	F1	Disgust, Anger	Disgust	Disgust	Confident
2	D1	Happy	Happy	Happy	Confident
3	G5	Happy, Curious	Curios	Happy, curios	Confident
4	H2	Surprise	Surprise	Surprise	Confident
5	L5	Danger	Safe	Happy, Surprise	
6	K4	Serious	-	Serious, Danger	Confident
7	J1	Anger	Anger	Anger, Danger	Confident

E3a.6 Conclusion

This part attempts to understand the processes of designing features from biological life forms in automobile forms based on how car users perceive them and categorize them based on their judgment. The question raised in the beginning: Are users aware and sensitive about the deliberate resemblance of car's face to human and animal's face? - The answer, as indicated by the experimental results, came as affirmative. The expressions that each car face most probably evokes were determined through hypothesis by the researchers (Table 5.3a.1) before the experiment. As per the hypothesis, the cars were assigned by the subjects almost the same emotional labels in list 1, 2, and 3 that indicated contrast, only 20 % of the results were not close to the assumption. Again on whether the car faces remind users of faces of human and animals - the answer was also in the affirmative.

Between the questions and the hypothesis the assumptions were close to 80% in case of both the Indian and Iranian cultures. But designers should think in terms of each culture separately. Also, both the cultures had similar views on the positive expressions of the car but not quite the same with the negative emotional expressions.

When human expressions and animal faces were selected by the researchers based on mutual process of bio-design method from a random collection, the research assigned expression labels that indicated the facial emote of the car and of the human and animal as already shown in Table 5.3a.1. In this part, the research presented a design method for bio-designing that helps researcher to sample collection. In the next part, the research will evaluate on its validity. This would create a very positive impact on the designers because bio-design essentially has a vast unexplored potential for ushering a new methodology in design.

Experiment 3b

A study of Iranian and Indian user response to car form using Semantic Differential Techniques: Can modern automotive faces represent positive emotional expression better?

E3b.1 Product transfer meaning

The effects of technological advance are widespread. Not only has technology compelled us to rethink our understanding of design as a significant element in our social and cultural lives but also the lightning-pace at which technology development of recent years has changed the very function of many well-known components and consumers, creating new design tasks that must adapt to new areas and patterns of use. More than ever before aesthetics has been influenced by technological development (Hauffe 1998).

Product as an instrument is a powerful vehicle for transferring meaning but some times they are unable to connect with the users and thereby impart the meaning to them. This is mostly due to the dichotomy of cultures (Zwaga et al. 1999). The presence of creations made by designers belonging to cultures around the globe, suggests that everyone is capable of designing for themselves (Cross 2006). But can a designer from a specific culture unanimously design for all cultures?

Cultural sign always had effect on marketing. One sign may not have similar meaning in two cultures. Owing to this if a designer designs for other cultures, they should search for a common sign in the cultures. For example Mowen and Minor (2008) state that automotive factories are preoccupied with the names from cat family, because in all cultures these names express agility, pugnacity and speediness (like Jaguar, Cougar, Lynx, Wild cat, Bobcat and Puma).

These considerations raise a few challenges to the designer. Can a designer transfer the form and expression of the human and animal faces on to a car's face? Are there differences in the users being able to draw upon these connections? How much difference can we see between Indian and Iranian understanding in such attempts? Do car faces show human reactions or animal reactions better? Does negative expression of a car's face come from an animal reaction? Does positive expression of a car's face come from human reaction? Several such questions arise.

The necessity to explain the questions pertaining to individual's interpretation of meaning arises while understanding the difference between the users' understanding of a car face and that of a designer. Krippendorff (2006) is of the opinion that for a designer of products, understanding semantic processes as they take place in the perception of users - forms the basis of embedding product features while conceptualizing.

Every day, each of us makes numerous decisions relating to every aspect of our daily lives. However, we generally make these decisions without stopping to think about how designers put meaning into these products and what is involved in a particular decision-making process itself. In the most general terms, a decision is the selection of an option from two or more alternative choices (Schiffman and Kanuk 2007). This decision takes place as the buyer can make sense of a product. Generally the product communicates a meaning to the buyer. In this part of research attempt is made to understand if this decision differs for two cultural context of use viz. Iranian and Indian, and if so then to what extent does the difference exist? Further attempt is made to understand if there exist any common preferences amongst users between the Indian and Iranian culture in terms of accepting car face's resemblance.

E3b.2 Plan of the Experiment

Outlined below in Table 5.3b.1 are listed the animal and human faces in the form of pictures which are to be mapped with car face with two opposite emotional expressions placed on either side.

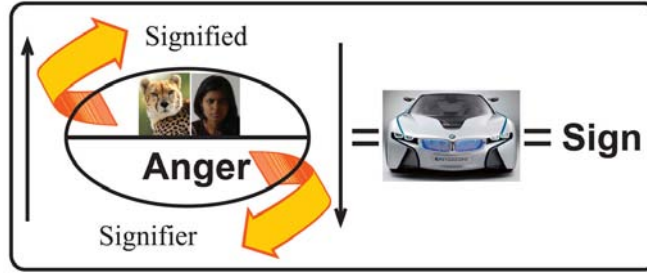


Figure 5.3b.1: Hypothesis of Experiment 3b

Table 5.3b.1: Hypothesis relationships

List 1		List 2	List 3	
Animals/Expression	Human / Expression	Cars	Animals /Expression	Human / Expression
Goose /Normal	Human / Normal	H2 series	Monkey / Surprise	Human / Surprise
Dog / Sad	Human / Sad	D1 series	Frog / Happy	Human / Happy
Camel /Relax	Human / Relax	J1 series	Cheetah / Anger	Human / Anger
Panda /Fondness	Human / Fondness	F1 series	Fox / Disgust	Human / Disgust
Lamb / Safe	Human / Safe	L5 series	Shark / Dangers	Human / Dangers
Dog / Comic	Human / Comic	K4 series	Cobra / Serious	Human / Serious
Ostrich / Stupid	Human / Stupid	G5 series	Rabbit / Curios	Human / Curios

To examine the above hypotheses, a semantic framework was considered for form analysis drawing co-relation between Signified (human and animals expressions) and its Sign (Car front face). This was evaluated for correspondence or contrast with the visual expression of the object. The purpose was to seek possible answers to the above questions. Users were asked to give marks to cars resembling human or animal faces through an online survey (data collection was done online). In this survey Semantic Differential Technique was used for mapping data from user's selection. Animal and human faces in the form of pictures were to be mapped with car face with two opposite emotional expressions placed on either side.

Sample Size

The total sample size of the survey was 126 respondents.

78 respondents (62%) were men (age 18-54) and 48 respondents (38%) were women (age 18-50).

All the subjects were Asians. Out of the total of 126 respondents there were 60 people (48%) from India and 66 people (52%) from Iran.

Objects

Seven car faces samples were taken (Figure 5.3b.2). To this were included a series of 14 animal face samples (Figure 5.3b.3) chosen from a total of 40 animal faces. These are

probable samples used for experiments. A series of 14 female faces samples (Figure 5.3b.4) were chosen through consensus and discussions by three professional car designers based on the experience and gender representation of emotional expression.



Figure 5.3b.2: Car face samples.

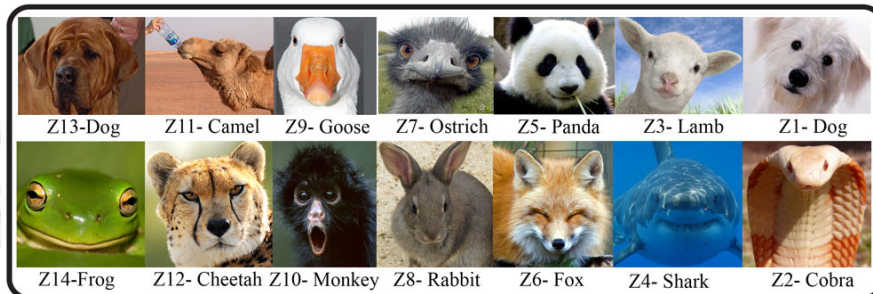


Figure 5.3b.3: Animal's faces: 'Similar' face reactions (Top row) 'Dissimilar' face reactions (Bottom row).

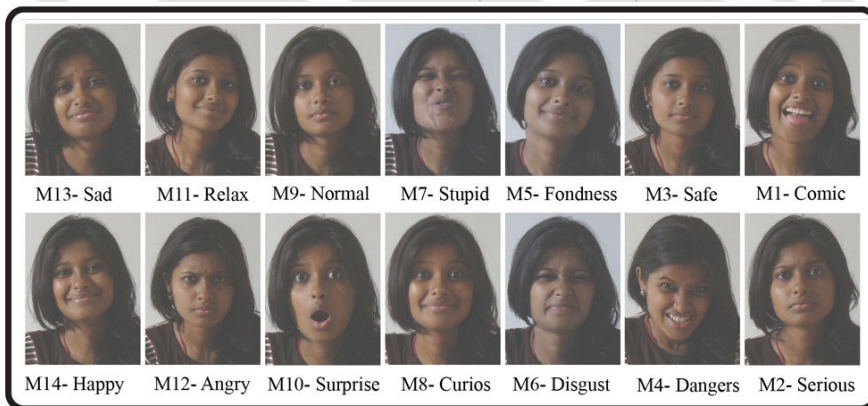


Figure 5.3b.4: Human faces: 'Similar' face reactions (Top row) 'Dissimilar' face reactions (Bottom row).

The human and animals were selected for similarity of emotional reactions (list 1). Car face samples (List 2); human and animal pictures were selected for contrasting emotional reactions (List 3) in Table 5.3b.1.

E3b.2.1 Experimentation Processes

The experimental set up and data collection were placed online (Figure 5.3b.5). The questionnaire explained the purpose of data collection and with the aid of an example, introduced the respondent to the method of filling up the questionnaire with their responses. The questionnaire had an explanation for each question set. There were 7 questions.

Using the grid that has five pictures of car faces one by one, human and animal pictures in sets of two were placed on the either end of the grid online. Subjects were asked to verbally rate 1 for the best dissimilarity 2 for dissimilarity, 3 for being impartial, 4 for similarity and 5 for the best similarity. Depending on the rating patterns groups were marked on the Internet. This was repeated for the entire seven human and animal pairs on base 7 car faces (L5, K4, J1, H2, G5, F1, and D1) one by one. The data collected for Semantic Differential Technique was analyzed for frequency of groupings for both Indian and Iranian cultures.



Figure 5.3b.5: Questionnaire on the internet.

In Figure 5.3b.6, Red line represents responses from Iranian respondents and the dark blue lines those of Indian subjects. In the graph there are two bipolar adjectives and in the row below it has 7 human emotional reactions and 7 animal faces with emotional expressions. The expressions are (left to right: Fondness, Stupid, Normal, Relax, Sad, Comic, Safe, Panda with Fondness expression, Ostrich with Stupid expression, Goose with Normal expression, Camel with Relax expression, Dog with Sad expression, Dog with Comic expression, Lamb with Safe expression). In the top row, again it has 7 human

emotional reactions and 7 animal faces with emotional expressions forming the top bipolar adjectives (left to right: Disgust, Curious, Surprise, Anger, Happy, Serious, Dangers, Fox with Disgust expression, Rabbit with Curious expression, Monkey with Surprised expression, Cheetah with Angry expression, Frog with Happy expression, Cobra with Serious expression, Shark with Dangerous expression).

Sample H2 is the main picture judged by the respondents. Research shows couple of bipolar adjectives placed one after the other which were required to be conferred with marks between 1 and 5. The presence of similarity between below adjective (for example Panda with Fondness expression) and the main picture (Here car H2) gets one mark and the level of similarity between top adjective (for example Fox with Disgust expression) and the main picture (Here car H2) gets five marks. Indian subjects for instance gave one mark to the car H2 for its similarity with the Panda with fondness expression while the Iranian subjects gave 2 marks to the car H2 for its similarity with the Panda with Fondness expression. But in terms of another two bipolar adjectives (Monkey with Surprise expression and Goose with Normal expression) both the cultures had the same opinion.

E3b.3 Data Analysis and discussions

The semantic differential is today one of the most widely used scales for measurement of attitudes. One of the reasons is the versatility of the items. The bipolar adjective pairs can be used for a wide variety of subjects, and as such the scale is nicknamed "the ever ready battery" of the attitude researcher (Himmelfarb 1993).

Five items, or 5 bipolar pairs of adjectives, have been proved to yield reliable findings, which highly correlate with alternative measures of the same attitude (Osgood et al.1957).

The biggest problem with this scale is that the properties of the level of measurement are unknown (Himmelfarb 1993). The most statistically sound approach is to treat it as an ordinal scale, but it can be argued that the neutral response (ie. the middle alternative on the scale) serves as an arbitrary zero point, and that the intervals between the scale values can be treated as equal, making it an interval scale (Osgood et al. 1975). Surveying

Cultures (Heise 2010) provides a contemporary update with special attention to measurement issues when using computerized graphic rating scales.

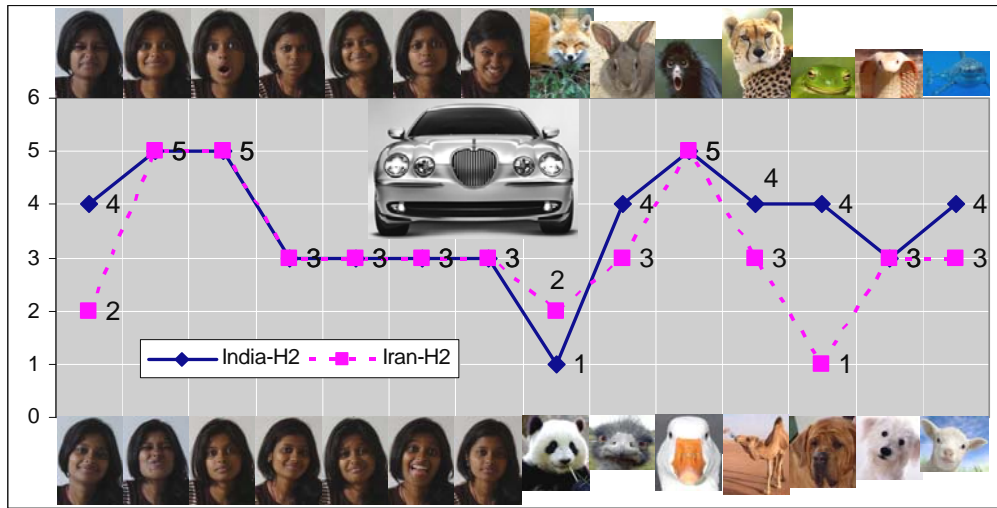


Figure 5.3b.6: Semantic deferential analysis on H2

Now this research uses the same method to show graphical results (Figure 5.3b.6), where both the cultures agree that the car H2 has a high degree of similarity with curious and surprised expression of human face and as well with a monkey face. Indian subjects believed that H2 has high degree of similarity with the Panda with Fondness emotional expression while it is seen that Iranian subjects gave only 2 marks as they believe that it has lesser similarity to the Panda.

In both of the cultures (Figure 5.3b.7) agree that car D1 has high degree of similarity between human with fondness, curiosity, relaxed, happy and safe emotional expression as well with Panda face with fondness expression, Frog face with happy expression, Dog face with comic expression and Lamb face with safe expression.

In both the cultures (Figure 5.3b.8) respondents agree that car J1 is similar to large extent to human with angry and dangerous emotional expression and Cheetah with angry emotional expression. In both the cultures respondents also agree that the car J1 has low level of similarity with Fox having a disgust emotional expression and Cobra having a serious emotional expression.

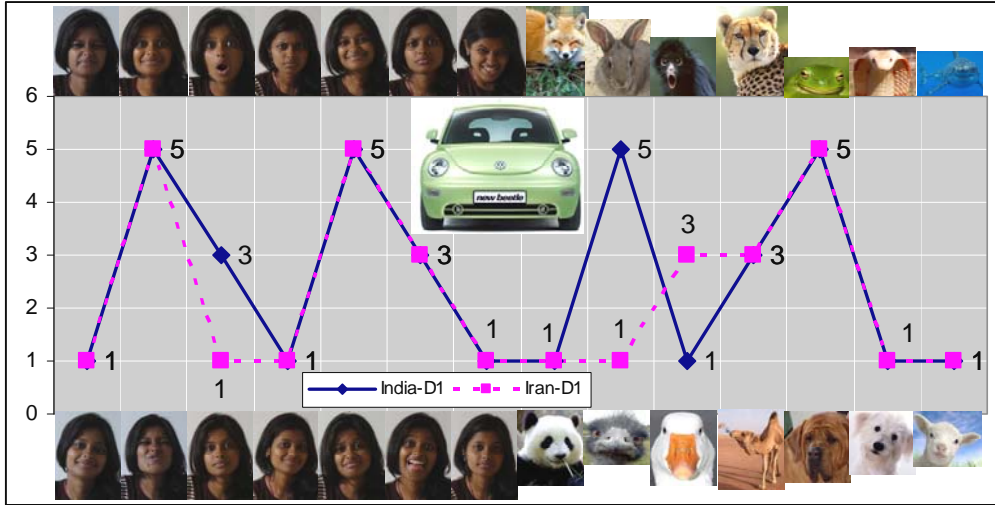


Figure 5.3b.7: Semantic differential analysis on D1

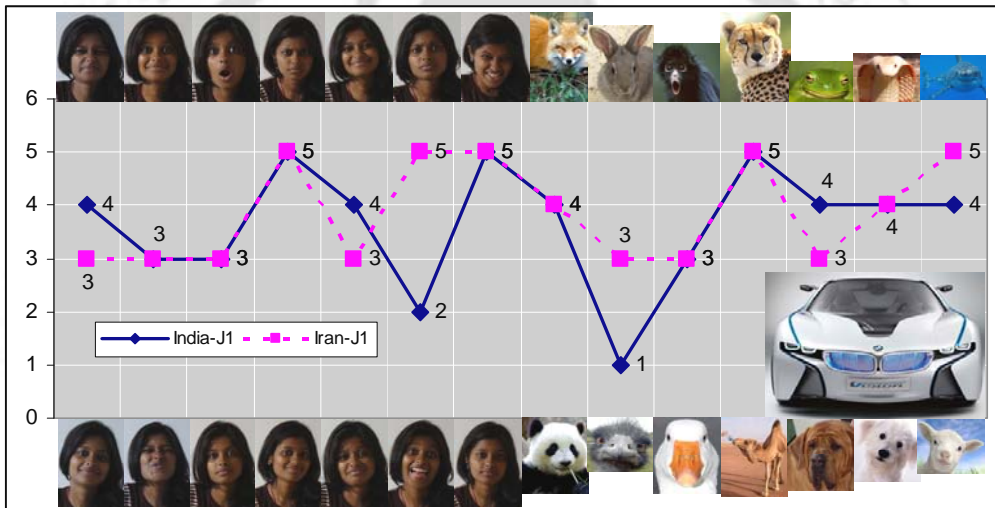


Figure 5.3b.8: Semantic differential analysis on J1

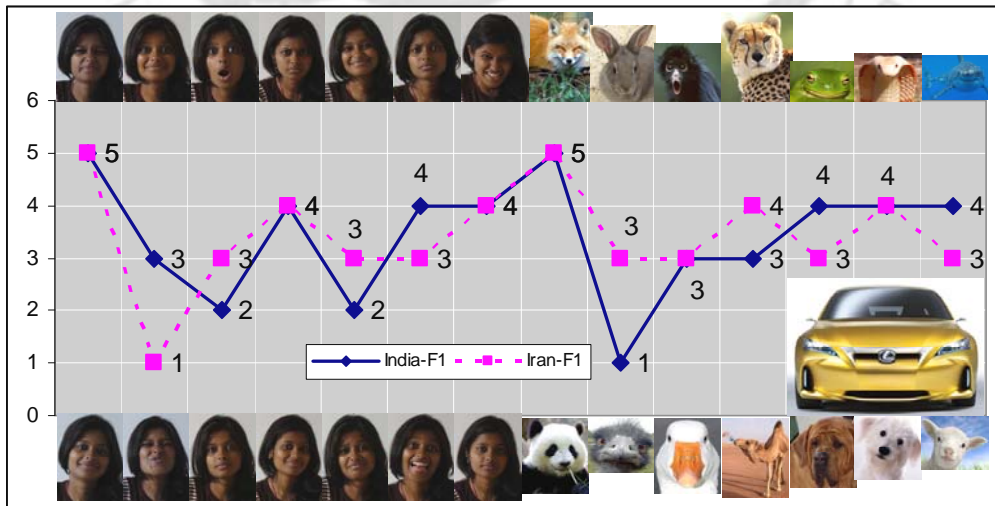


Figure 5.3b.9: Semantic differential analysis on F1

In both the cultures (Figure 5.3b.9) respondents agree that car F1 is similar to large extent to human with disgust expression and Fox with disgust emotional expression. Further they also agree that car F1 has lesser similarity to human face with angry and dangerous emotional expression and Cobra with serious emotional expression.

As seen in Figure 5.3b.10, in both the cultures respondents agree that car L5 has lesser similarity to humans with surprised and happy emotional expression.

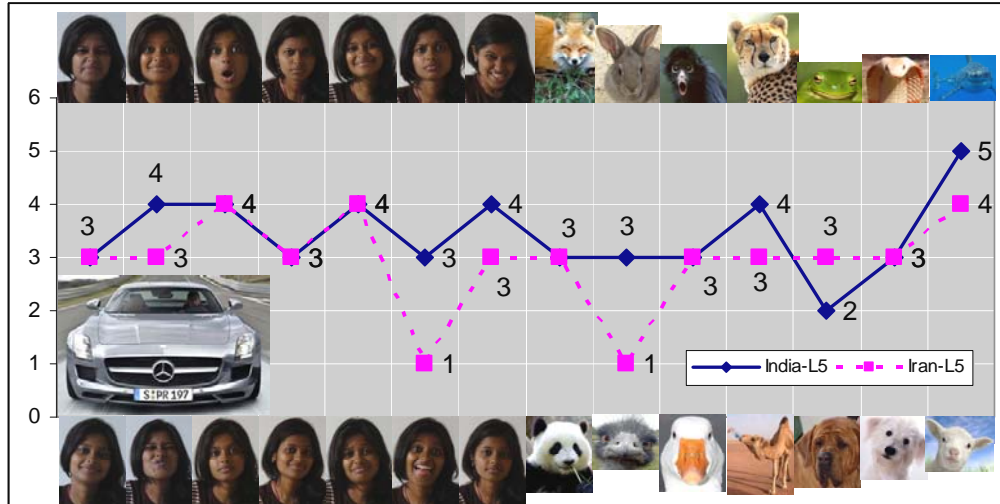


Figure 5.3b.10: Semantic deferential analysis on L5

In both the cultures (Figure 5.3b.11) respondents agree that car K4 is similar to large extent to human face with dangerous emotional expression and Cobra with serious emotional expression. Similarly respondents also agree that car K4 has lesser similarity to Fox with disgust emotional expression and Cheetah with angry emotional expression.

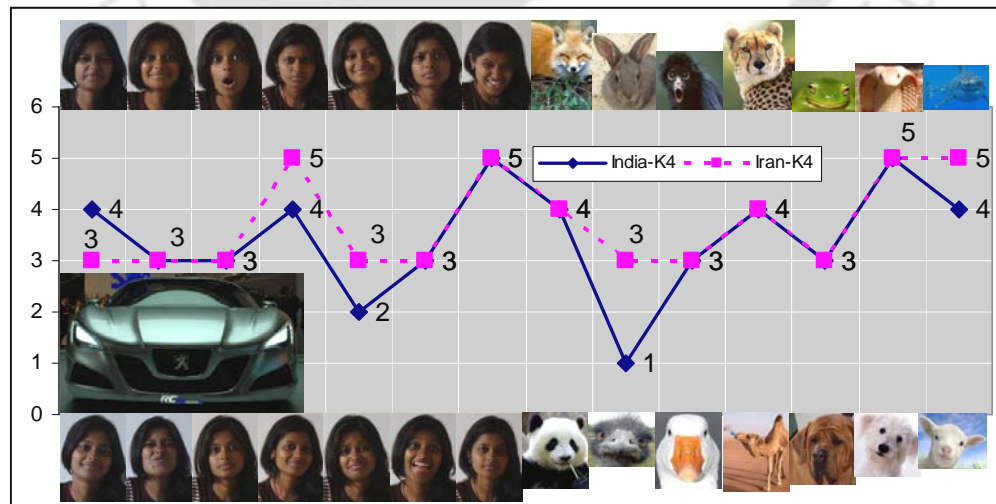


Figure 5.3b.11: semantic deferential analysis on K4

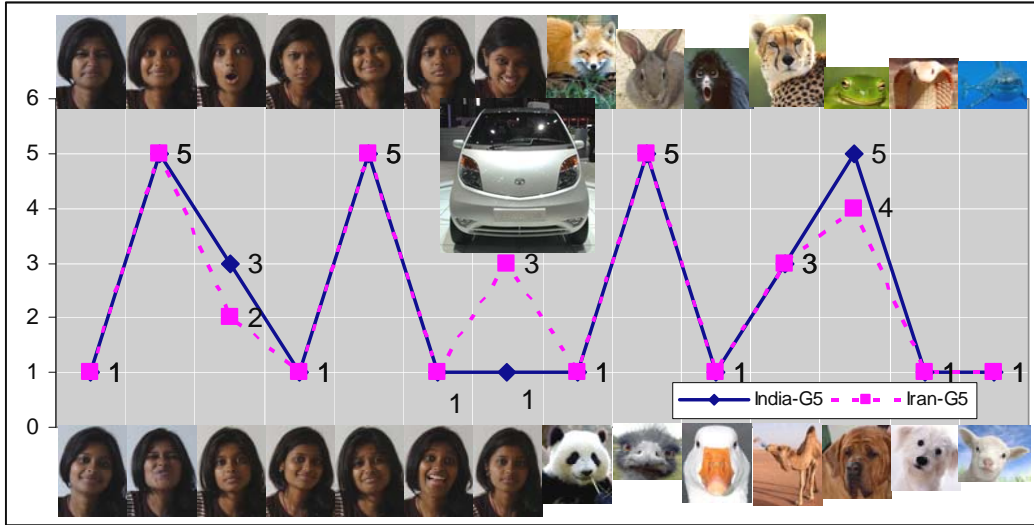


Figure 5.3b.12: Semantic deferential analysis on G5

In both the cultures (Figure 5.3b.12) respondents agree that car G5 is similar to large extent to human faces fondness, curios, relax, happy and comic emotional expression; Panda with fondness emotional expression, Rabbit with curios emotional expression, Goose with normal emotional expression, Dog with comic emotional expression and Lamb with safe emotional expression.

E3b.4 Discussion

This part presents results of the Semantic Differential technique conducted on the last 7 car faces (out of 35 car faces) accepted by both the cultures.

Table 5.3b.2: Results of experiment 2a, experiment 2b, experiment 3a and experiment 3b

No	Car	Result of visual analysis Experiment 2a	Result of co-relation Exp. 2b	Result of RGT Experiment 3a	Result of Semantic differential Experiment 3b	Useful for visual key
1	F1	Disgust, Anger	Disgust	Disgust	Disgust	Confident
2	D1	Happy	Happy	Happy	Happy	Confident
3	G5	Happy, Curious	Curios	Happy, curios	Happy, curios	Confident
4	H2	Surprise	Surprise	Surprise	Surprise	Confident
5	L5	Danger	Safe	Happy, Surprise	Happy, Surprise	
6	K4	Serious	-	Serious, Danger	Serious, Danger	Confident
7	J1	Anger	Anger	Anger, Danger	Anger, Danger	Confident

This research compares the results between Semantic Differential technique and the result of visual analysis, co-relation and RGT techniques. A set of 6 cars (viz. F1 / D1 /

G5 / H2 / L5 /K4 /J1) could be shortlisted as useful car faces in terms of extracting the visual key. (Table 5.3b.2). These are summarized in the chart below.

E3b.5 Conclusion

This part attempted to understand those common and acceptable meaning for forms that can be used in the processes of designing features for the vehicle to be used in more than one culture. From this study one can extract and identify those visual features that can be found acceptable in both Indian and Iranian context of use. The question that was put forward in the beginning, on whether designer can design for more than one culture finds its answer here. The experimental results clearly indicate that the response is affirmative. This was evident in shortlisted examples of car forms acceptable for both the cultures who had a similar judgment. On the contrary there also existed distinct differences in terms of Indian and Iranian understanding. In certain cases where car faces had less meaningful form for a specific expression the results were often confusing. For example car H2 had lesser similarity to Shark with dangerous emotional expression as per the Indian respondent owing to the vertical lines in grille. But Iranian respondents on the other hand appeared confused between the dangerous expression and that between fondness and sad expression. From this we can suggest that designers should be attentive these differences amongst both these cultures. In this part of research, Semantic Differential Technique also marked out the cars carrying meaningful connotation for both the Indian and Iranian cultures.

As for the last question whether 'Emotional expression can represent animal or human emotional reactions more in car faces,' it was seen reflected in the historical review that modern era designers transferred emotional expression of animal and human on to car faces. It was seen in the present study. It can be stated that the respondents also expected to see related emotional expressions of animal and human faces reflected in the expression and personality of the car face.

Experiment 4

Study of Design Semantic on car face design

Blaise Pascal (1623-1662) states “there are truths on this side of the Pyrenees which are falsehoods on the other” - (Hofstede 1984)

E4.1 Global design

Looking at the airline logos, one finds that different cultures use different sign and patterns on aircraft body – for example the Turkish airline uses evil eye and the Australian airlines uses Kangaroo (Lovegrove 2000). All these signs have emanated from their cultures. (Figure 5.4.1). When a designer designs for global market, like for instance the airline industry, design elements pertaining to human culture is maintained for the airlines. One can see that culture can change identity and design of air travel, in short, adapt it, develop it and sometimes even mutate it (Lovegrove 2000). If one



Figure 5.4.1: Air lines: Turkish airline ¹ (Top) Australian air line ² (Down)

Here an important question arise as to how art differs from design? A methodological consequences of these differences can be addressed when they occur as problems for particular approaches to the understanding of visual culture. Heinrich Wofflin in art history and Siegfried Giedion in design history, choose to concentrate on the stylistic characteristics and qualities of images and objects in the study of visual culture (Barnard 2001). If one looks at a dancer the beautiful gestures and moves of the body may or may

¹ <http://www.michaeltotten.com/archives/images/Turkish%20Evil%20Eye.jpg/> accessed in February 2011.

² <http://static2.stuff.co.nz/1289156750/033/4319033.jpg/> accessed in February 2011.

not be understood by the viewer. Sometimes they might not even have meaning but to appease the eyes, it gets the status of art (Figure 5.4.2). Now on the other hand from the point of view of design, if the same dancer uses some understandable symbolic motion related to cultures than it can deliver the meaning to the viewer. This aspect highlights the importance of the study of symbols and their meaning and their influence on perception. In this research an attempt has been made to skim out and evaluate the results of finding common sign between Iranian and Indian respondents pertaining to car form. Quite interestingly even here cultural parameters are found to be an important.

E4.2 The perception problem of the meanings

Study of semiotics in symbols is creating expressions in relation to cultures. As we know meaning and symbols come from culture. Because of which a symbol can have a different meaning in two cultures (Mowen and Minor 2008). While one symbol represents a word in our mind the same symbol may not have the same meaning in another culture and therefore a person belonging to another culture may not get the same meaning. For example, Ford model 'Pinto' in Portuguese language means small penis because of which this model of Ford reduces attractiveness for men (Tomkins 1999). Similarly, when Thai people are ashamed they have a small smile which otherwise could mean being embarrassed (Swenson 1993). This means a car face with 'shame' expression cannot have the same impact for Thai as for people in another culture. The eagle is a symbol of strength, courage and patriotism in United State of America. A designer can therefore use the eagle symbol for designing to create the same incentive. The Koala in Australia also has its significance in Australia (Wagner 1996). We assume that these symbols are universal, though in reality it is not so. For example, a picture of a snake represents sex, ominous, medicine and even energy in different beliefs. In United States of America, the cross is typically a religious symbol but in Taiwan, making right angles with fingers means the number 10 (Mowen and Minor 2008).

Study of semiotics in shape is an important empirical perspective on consumer behavior. Designers should have knowledge of the common meaning of signs if they want to understand why users from different culture have emotional reactions on symbols, shapes and figure.



Figure 5.4.2: The visual image'¹

It is seen in the illustration above that the cartoon used by Ernst Gombrich (1960) in his article 'The visual image' shows the ambiguity of symbols (Mijksenaar 1998) where sometimes one form can create different meanings and communicate different emotional expression to people. Products may be partly based on evaluation of their symbolic value when purchased. And the symbolic value of a product must have a common reality among consumers. Thus, many users must have a common understanding of symbolic meanings in the product. Richins (1994) suggests that if a vehicle is to have a prestige value, then people in the relevant social group should see the car in the same way as the buyer. However, products can possess symbolic value independent of its value as viewed by user. Designer should therefore make intelligent use of signs and symbols. We can say, semantic design approach is a powerful way to/for designing meaning in artifacts for specific cultures (Lynch and Srull 1982).








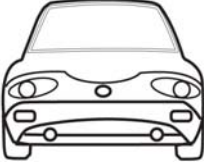






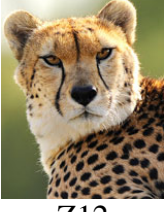

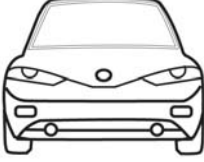
This section explores the question on whether 'expression word' represents same visual form in users mind in different cultures. This experiment was conducted involving respondents from Iran and India to seek possible answers to the questions on whether design can communicate the same word and meaning to the users and if they are different for different cultures.

















E4.3 Experiment

¹ Charles E. Martin, drawing, 1961, The New Yorker Magazine, Inc.

In the previous sections experiments were conducted to find out how sensitive and aware users were about the facial resemblance a car's face had with human and animal faces; and the special differences between results of Indian and Iranian subjects. In this part the research attempts to search for users' awareness and sensitivity about facial resemblance of a car's face to emotional expression word (the signifier). In this experiment the focus is on identifying those graphical car faces which generate similar emotional expression in the minds of respondents from India and Iran.


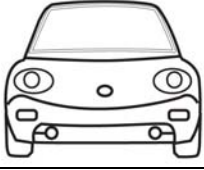
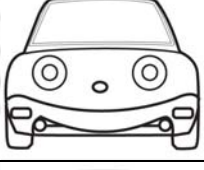
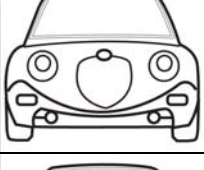
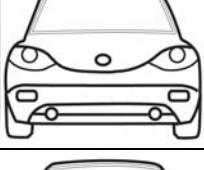
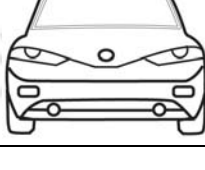
Table 5.4.1: Hypothesis relationship

No.	Human	Animals	Result of visual analysis, Signified	List 1 graphical car face, sign	List 2 Words Signifier
1	 M14	 Z14 Frog	 D1	 C9	Happy
2	 M13	 Z13 Dog	 D4	 C13	Sad
3	 M2	 Z2 Cobra	 K3  K4	 C19	Serious
4	 M12	 Z12 Cheetah	 J1	 C18	Anger

5	 M4	 Z4 Shark	 L2	 C16	Danger
6	 M10	 Z10 monkey	 H2	 C15	Surprise
7	 M6	 Z6 Fox	 F1	 C11	Disgust
8	 M8	 Z8 Rabbit	 G5	 C5	Curious

In Table 5.4.1 is the co-relation between the word 'Happy' and its equivalent visual correspondence of Human facial expression (M14); Animal Facial expression (Z14); The graphical Key (D1) derived from visual analysis and its corresponding car face expression (C9). The table 5.4.1 outlines a similar approach in deriving the graphical car faces for the expressions Sad, Serious, Anger, Danger, Surprise, Disgust and Curious. Table 5.4.2 extracts the Graphical car form that was consistently accepted by users with the word expression (eg. Disgust) through the experiments using visual analysis (Ex.2a), Co-relation (Ex. 2b), RGT (Ex. 3a) and SD methods (Ex.3b). This resulted in identifying six expressions that were accepted by the users viz. Disgust, Happy, Happy/ Curious, Surprise, Serious / Danger, Anger / Danger that were derived and their corresponding Car form.

Table 5.4.2: Hypothesis of last results

No	Car	Result of visual analysis Exp. 2a	Result of co-relation Experiment 2b	Result of RGT Experiment 3a	Result of Semantic differential Experiment 3b	Graphical car face as a hypothesis of Experiment 4
1	F1	Disgust, Anger	Disgust	Disgust	Disgust	
2	D1	Happy	Happy	Happy	Happy	
3	G5	Happy, Curious	Curious	Happy, curious	Happy, curious	
4	H2	Surprise	Surprise	Surprise	Surprise	
5	K4	Serious	-	Serious, Danger	Serious, Danger	
6	J1	Anger	Anger	Anger, Danger	Anger, Danger	

In this experiment these car forms derived from the summary of Table 5.4.1 and 5.4.2 form the basis for deriving a set of 20 car faces through a process of fuzzy logic resulting in generation of intermittent hybrid forms

E4.3.1 Methodology

A semantic framework (Figure 5.4.3) was considered for form analysis drawing co relation between emotional expression word (the Signifier) and its manifestation in

graphical key (the Signified). This was evaluated for correspondence in the visual form expression of the graphical Car front face (the sign).

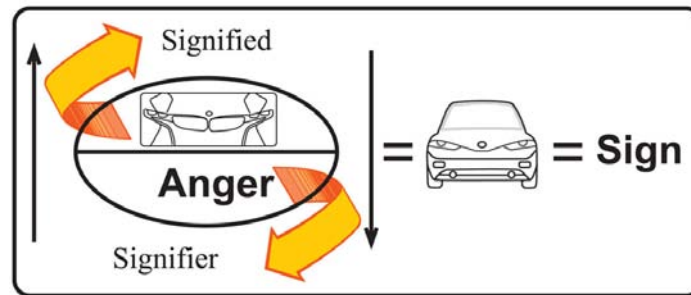


Figure 5.4.3: Current Hypothesis

The methodology followed involved the following steps:

1. Initially the set of 8 words for different emotions was selected (from table 5.4.1) as 'signifier'.
 - a. Short listing of the emotional expression words (the signifiers) were reflected in a set of Graphical front face of cars (the signs). This formed the hypothesis (Table 5.4.1 and Table 5.4.2).
 - b. Cross verification and evaluation of the visual form of graphical car face for their representation of an emotion was done with an expert group of trained car stylist.
2. Drawing from the result of visual analysis in experiment 2a that depict the 8 emotions a set of 20 hybrid graphical car forms were using the technique of morphing. (Figure 5.4.4)
3. For example car face C5 and C15 were derived from D1 and H2 and after that the intermittent car face C10 was derived through the process of morphing from C5 and C15 (they are the signs).
4. Identification of co-relationship correspondence between car face and emotional correspondence (Table 5.4.1)
5. The Visual sets of 20 graphical car face (C1, C2 ... C20) were arranged in a set in such a way that they corresponded with 8 emotional expression word one after the other.

6. User response was sought through an online survey (Figure 5.4.5). Respondents were asked to select a graphical car face (out of 20 graphical car faces) for each word expression. In this discovery relational technique was used for user's selection.

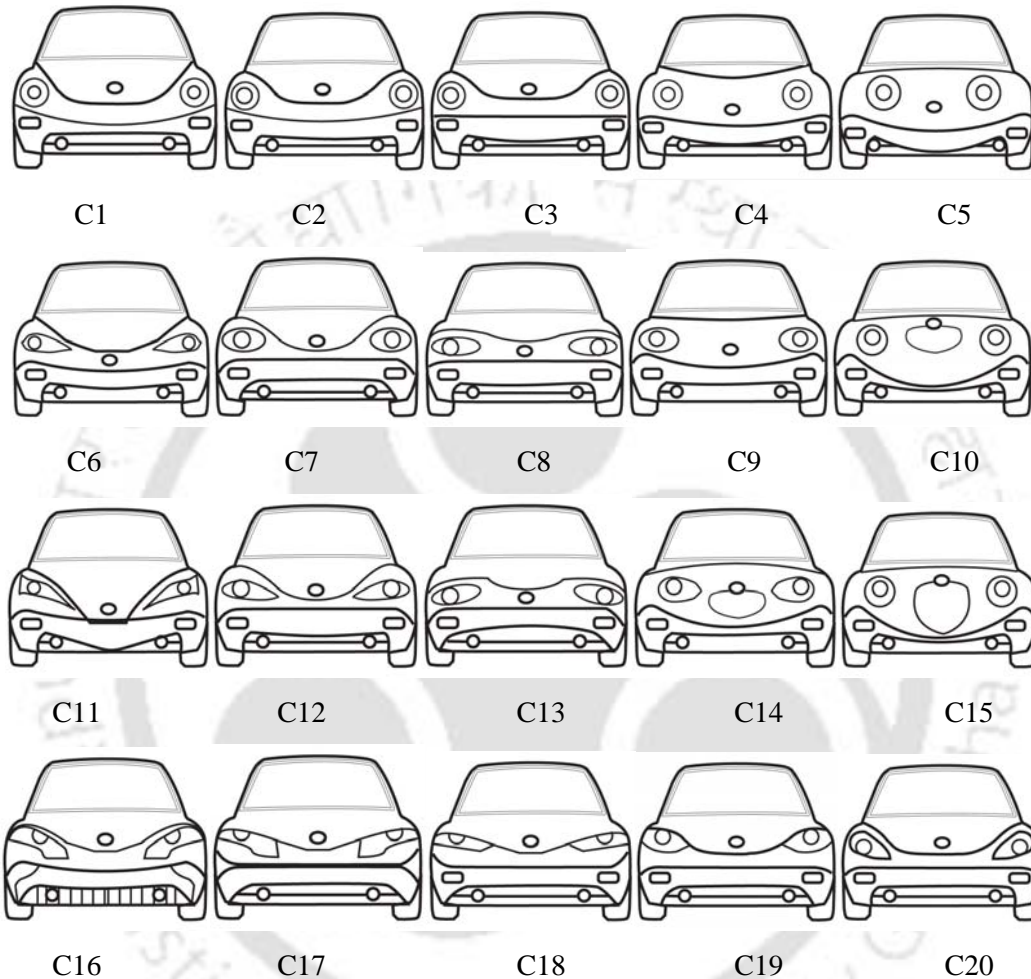


Figure 5.4.4: Graphical car facia: C1, C2,..., C20 from top, right to left

This section of the questionnaire had 9 questions in which the same set of 20 graphical car faces were presented to the respondents and they were to select the one against the selected most appropriate for the word expression.

Responses were recorded on line.

Online response was sought to the following questions.

Q23- which one (graphical car face) do you like?

Q24- which one has a dangerous expression?

Q25- which one has a sad expression?

- Q26- which one has an angry expression?
 Q27- which one has a serious expression?
 Q28- which one has a surprised expression?
 Q29- which one has a curios expression?
 Q30- which one has a disgusted expression?
 Q31- which one has a happy expression?

Sample Size

The total sample size of the survey was 126 respondents.

78 respondents (62%) were men (age 18-54) and 48 respondents (38%) were women (age 18-50).

All the respondents were Asians. Out of the total of 126 respondents 60 people (48%) were from India and 66 people (52%) from Iran.

Objects

In beginning of this section, the details of this series of 20 graphical car faces samples are given (Figure 5.4.4).

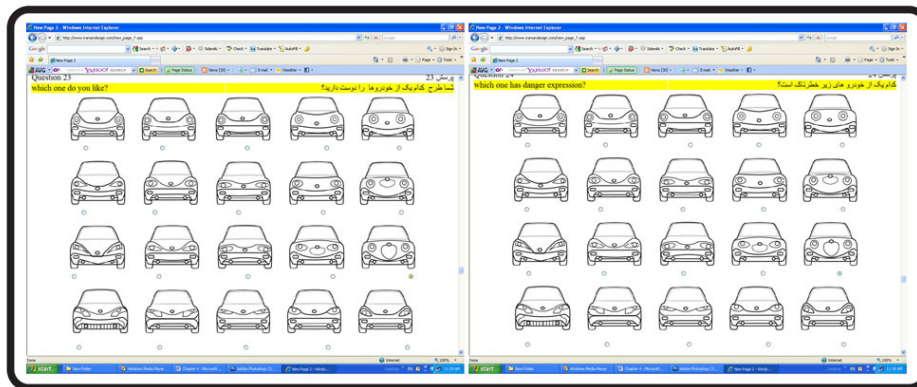
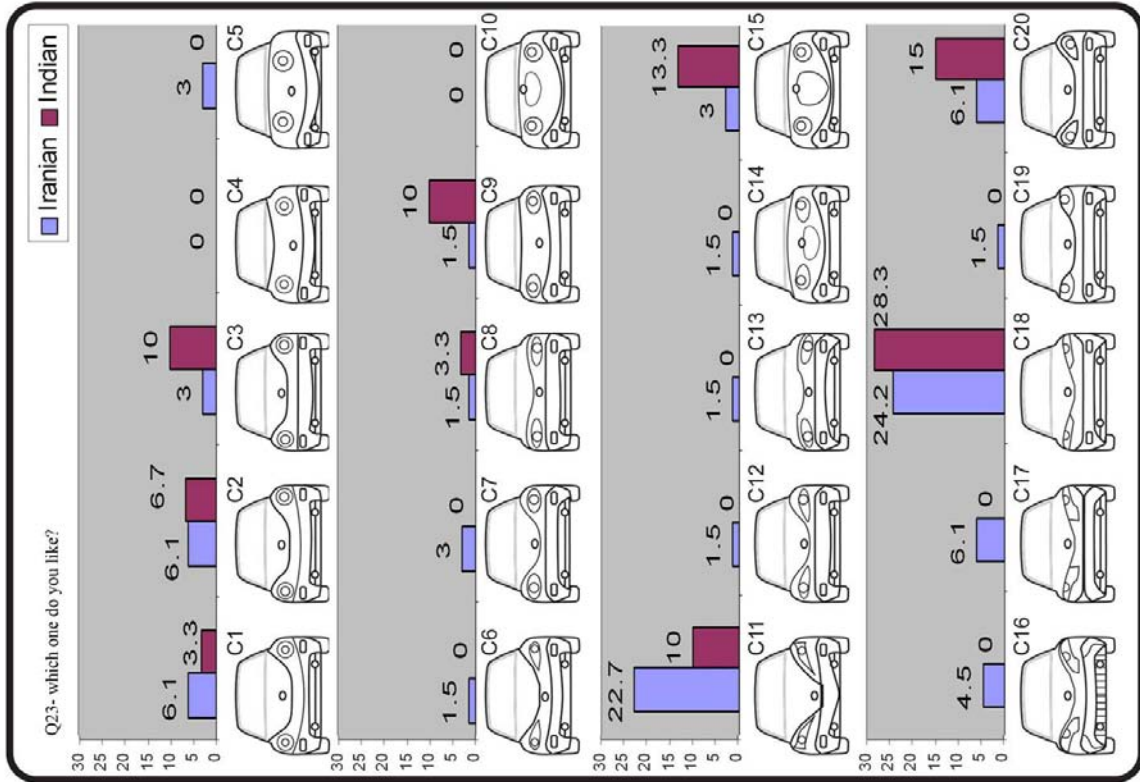


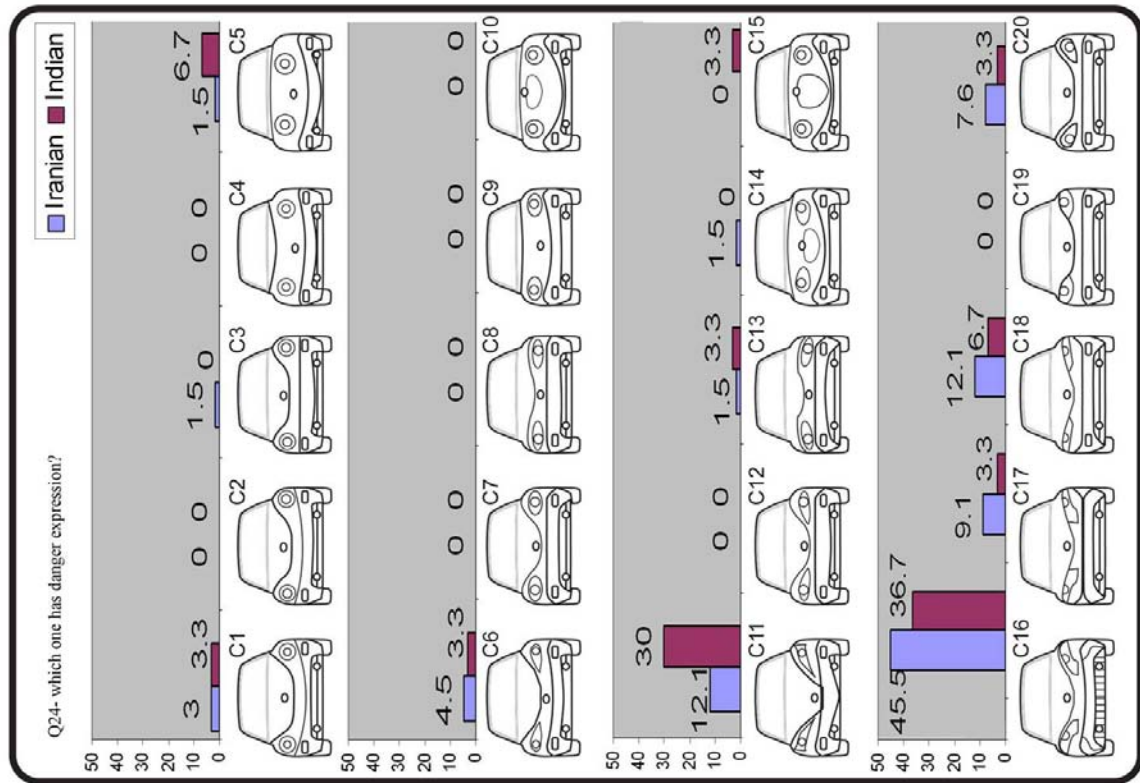
Figure 5.4.5: Questionnaire on the internet.

E4.4 Data Analysis

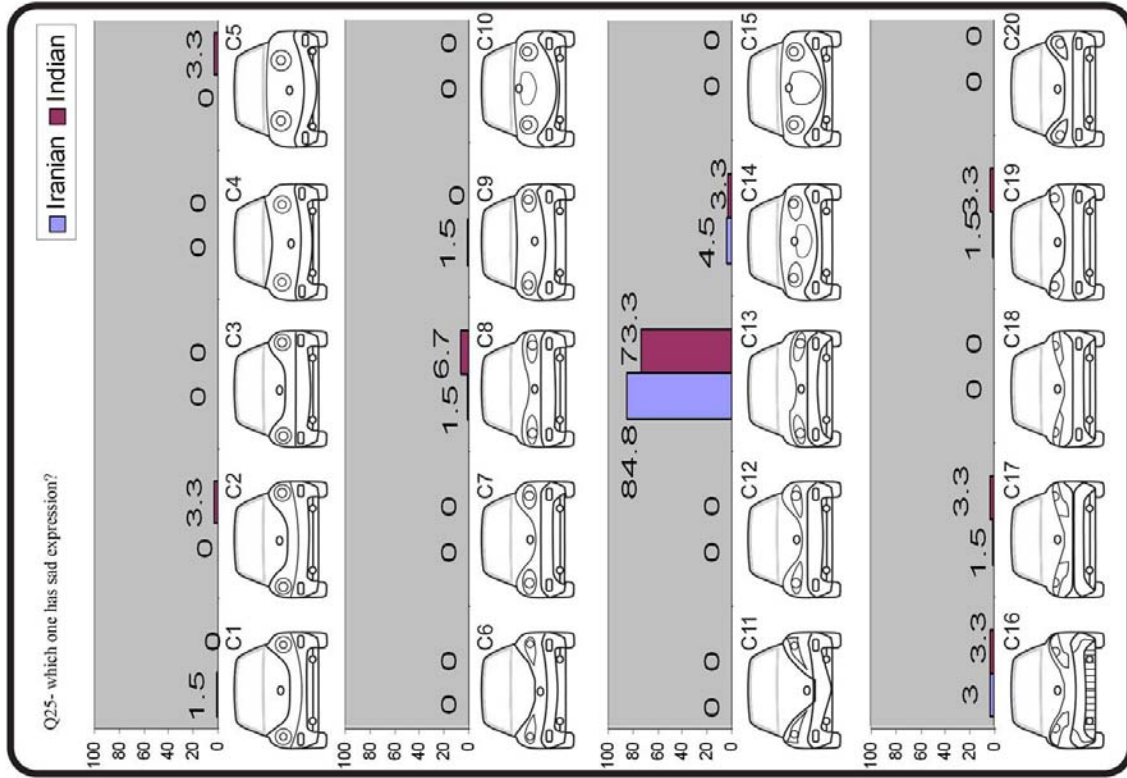
Statistical analysis of the data was done by using Column graph technique based on frequency. Percentages emerged for each graphical car face samples pertaining to each question. Selected results for questions have been statistically compiled from the data collected and are presented below keeping the length of this part in view.



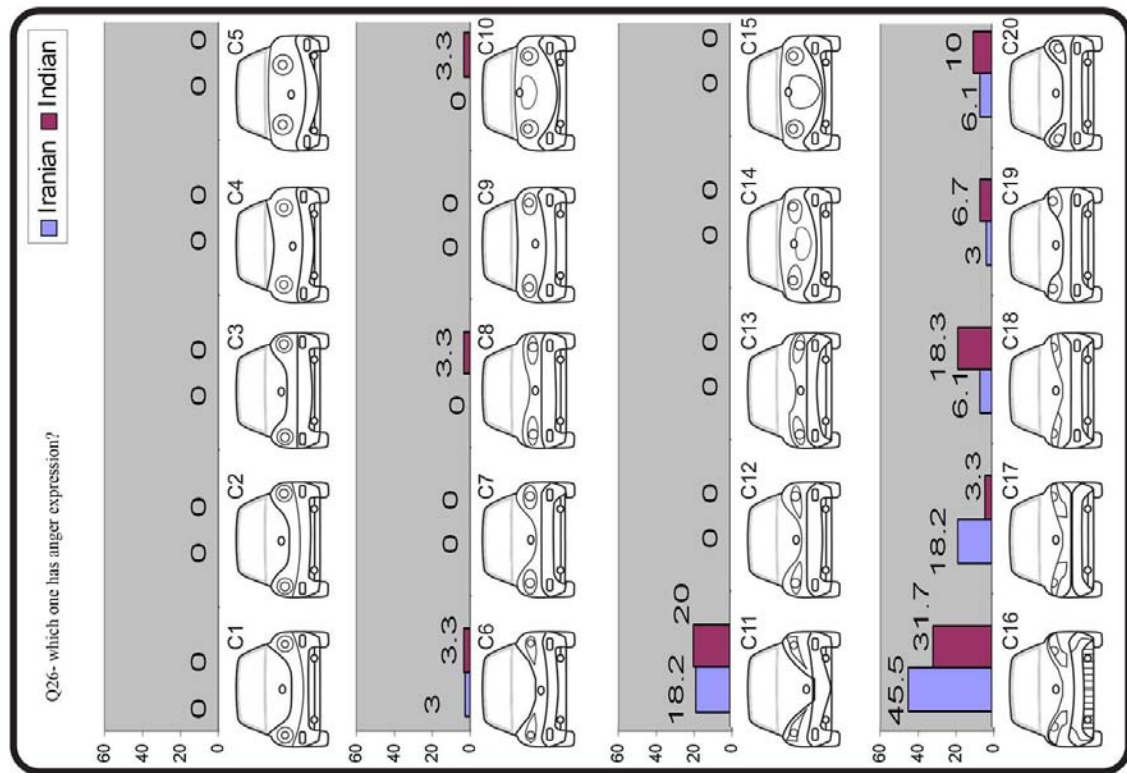
← Figure 5.4.6: Q23- which one (graphical car face) do you like?



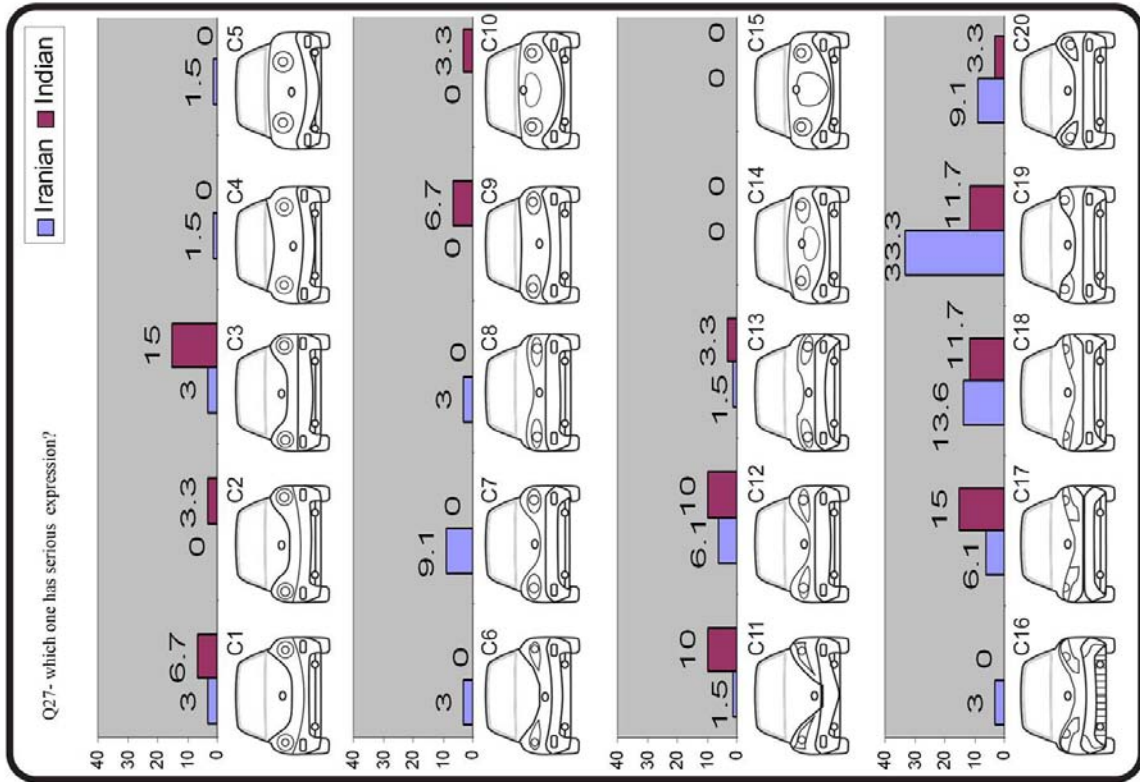
← Figure 5.4.7: Q24- which one (graphical car face) has a dangerous expression?



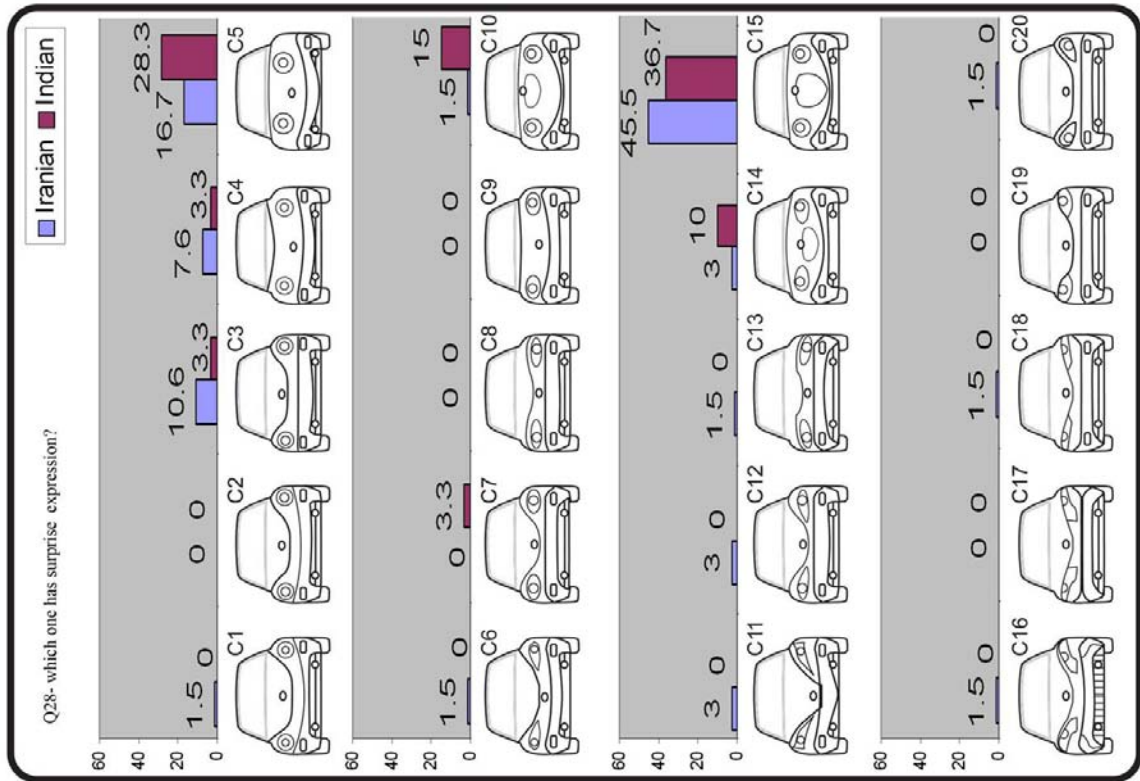
← Figure 5.4.8: Q25- which one (graphical car face) has sad expression?



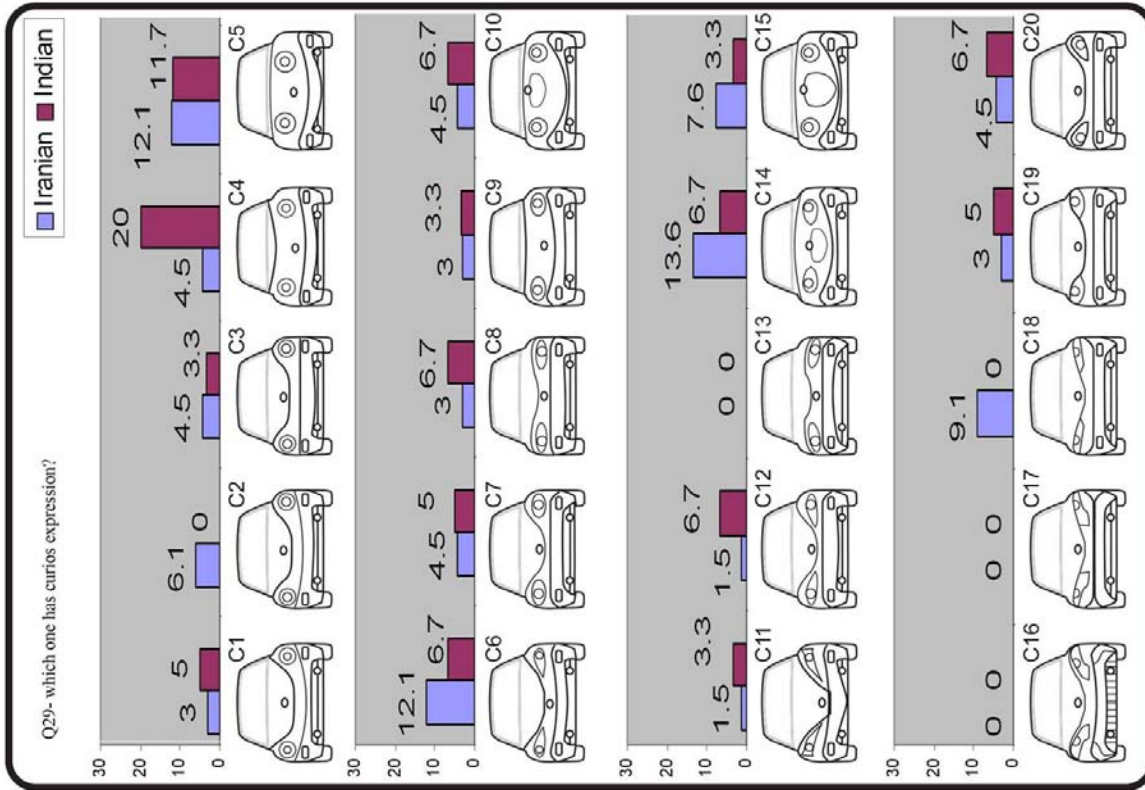
← Figure 5.4.9: Q26- which one (graphical car face) has an angry expression?



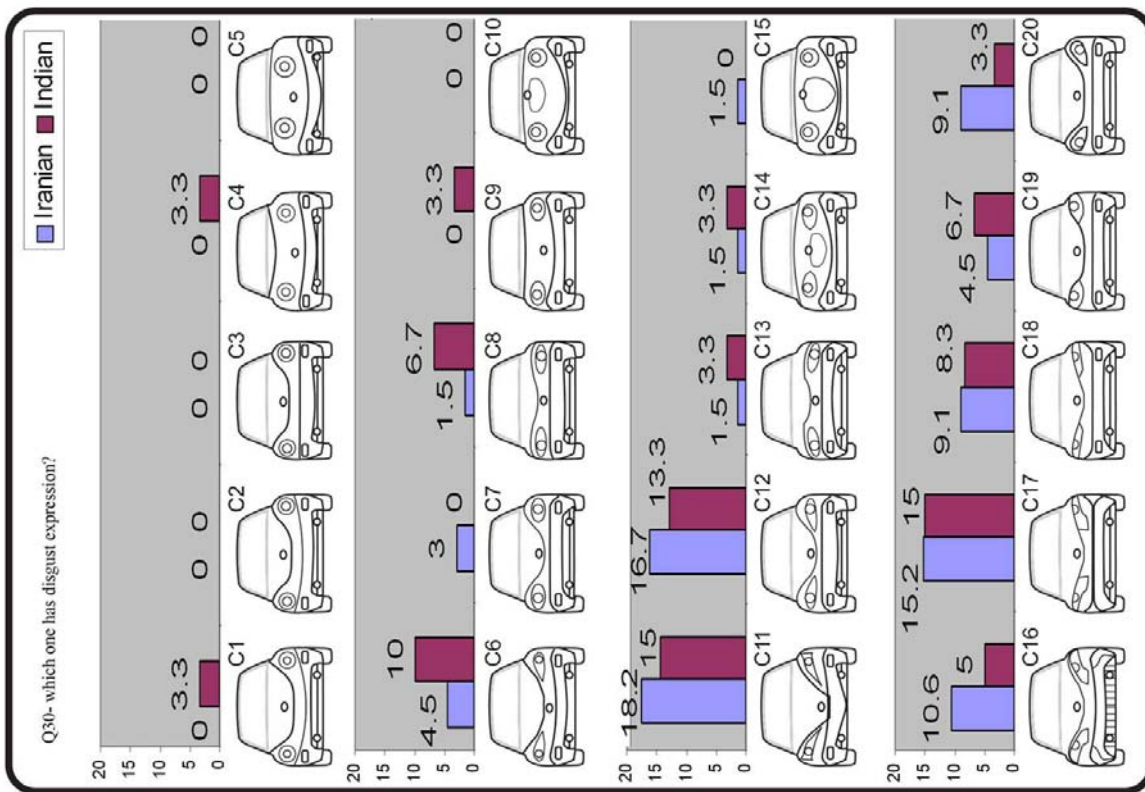
← Figure 5.4.10: Q27- which one (graphical car face) has a serious expression?



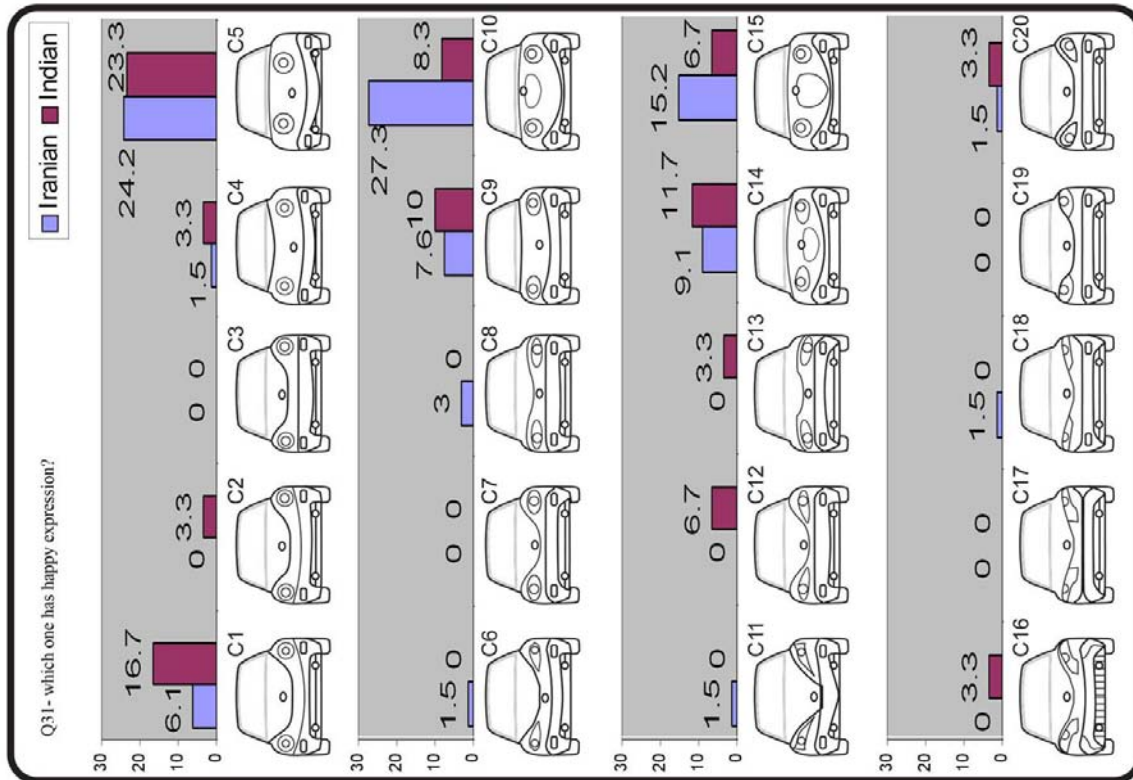
← Figure 5.4.11: Q28- which one (graphical car face) has a surprised expression?



← Figure 5.4.12: Q29- which one (graphical car face) has a curios expression?



← Figure 5.4.13: Q30- which one (graphical car face) has a disgust expression?









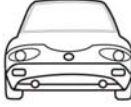


← Figure 5.4.14: Q31- which one (graphical car face) has a happy expression?

E4.5 Discussion

Table 5.4.3 presents graphically the preference pattern for the car face indicated by respondents from Iran and India against 8 expression words viz. Happy / Sad / Serious / Angry / Danger / Surprise / Disgust / Curious.

Table 5.4.3: Effect of Fuzzy logic on result of experiment

N	Human	Animals	Result of visual analysis	words	Preference Pattern of car form amongst respondents from Iran and India
1	 M14	 Z14 Frog	 D1	Happy	 C9 C5 C1  C10 C15 C14
2	 M13	 Z13 Dog	 D4	Sad	 C13




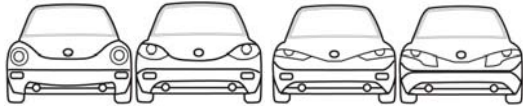



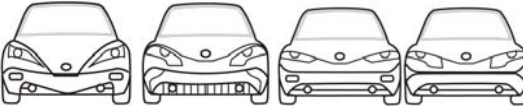







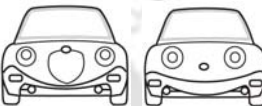








3	 M2	 Z2 Cobra	 K3	Serious	 C3 C19 C18 C17
4	 M12	 Z12 Cheetah	 J1	Anger	 C11 C16 C18 C17
5	 M4	 Z4 Shark	 L2	Danger	 C11 C16
6	 M10	 Z10 Monkey	 H2	Surprise	 C15 C5
7	 M6	 Z6 Fox	 F1	Disgust	 C11 C12 C17
8	 M8	 Z8 Rabbit	 G5	Curios	 C5 C4 C6 C14

Table 5.4.4: Results of section 2




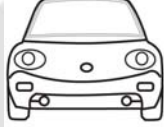



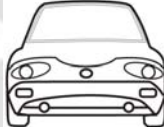




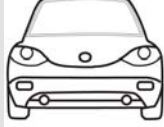



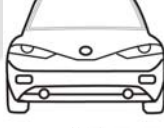








No	Car	Result of visual analysis Experiment 2a	Result of co-relation Exp. 2b	Result of RGT Experiment 3a	Result of Semantic differential Experiment 3b	Graphical car face as a hypothesis of Experiment 4
1	F1	Disgust, Anger	Disgust	Disgust	Disgust	Disgust
2	D1	Happy	Happy	Happy	Happy	Happy
3	G5	Happy, Curious	Curious	Happy, curious	Happy, curious	Happy, curious
4	H2	Surprise	Surprise	Surprise	Surprise	Surprise
5	K4	Serious	-	Serious, Danger	Serious, Danger	Serious, Danger
6	J1	Anger	Anger	Anger, Danger	Anger, Danger	Anger, Danger
7	L2	Danger	Danger			Danger
8	K3	Serious	Serious			Serious
9	D4	Sad	Sad			Sad




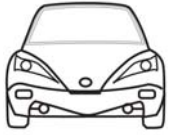


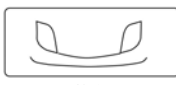

Table 5.4.4 presents graphically the summary of findings from the different experiments (2b / 3a / 3b / 4) co-relating word, emotional expression, car face expression and cross

cultural preference pattern for the car face indicated by respondents from Iran and India for the 8 expression words viz. Happy / Sad / Serious / Angry / Danger / Surprise / Disgust / Curious.

Table 5.4.5 on the other hand presents graphically the summary of graphical car face association amongst respondents from Iran and India against 8 expression words viz. Happy / Sad / Serious / Angry / Danger / Surprise / Disgust / Curious.

Table 5.4.5: Results of hypothesis (based on common selection of nations)

N	Human	Animals	Result of visual analysis	Sign graphical car face	signifier words	Hypothesis based on both cultures
1	 M14	 Z14 Frog	 D1	 C9	Happy	It is very weak. It is true for only 30 %
2	 M13	 Z13 Dog	 D4	 C13	Sad	It is true 100%
3	 M2	 Z2 Cobra	 K3  K4	 C19	Serious	It is very weak. It is true only for 20 %
4	 M12	 Z12 Cheetah	 J1	 C18	Anger	It is very weak. It is true for only 30 %
5	 M4	 Z4 Shark	 L2	 C16	danger	It is true 100%
6	 M10	 Z10 monkey	 H2	 C15	Surprise	It is true 100%

7	 M6	 Z6 Fox	 F1	 C11	Disgust	It is true 100%
8	 M8	 Z8 Rabbit	 G5	 C5	Curios	It is true for only 50%

E4.6 Conclusion

In this part all relevant analysis were directed at finding car faces in which both cultures had concurrence of opinion to the question whether ‘a design can communicate same word and meaning to the users’ amongst respondents belonging to two different cultures. We can see from Table 5.4.5 that in certain instances the word expression can imply different responses amongst two different cultures. In conclusion, of the 20 car faces that were presented 16 car faces appear as good sources for extraction of the visual heuristic as they represent same meaning and word for users from Iran and India. We can claim that for car faces C11, C13, C15 and C16 there is maximum concurrence between respondents from India and Iran.

Chapter 5

Section 3

Validation of Heuristic Set and Bio-Design Method

V5.1 Heuristic Set and its validity

Many companies, such as BMW and Chevrolet, have their own identity that runs through all of their products. The 'anger' expression on lights and the form of grille appear consistently throughout BMW's identity. Many companies pay large amounts of money for the research, design and execution involved in creating an identity that is extremely distinguishable and appealing to the company's target audience.¹ How is Corporate Identity created?

In marketing parlance corporate identity is the "persona" of a business. Branding and the use of trademarks help identity of companies (Knapp et al. 2001). When there is a common ownership of an organizational philosophy, Companies require corporate identity, which is manifested in a separate corporate culture - the corporate personality. At its most depth, the public think that they are owner of the philosophy (Balmer et al. 2003), which is referred to as organizational identity. Chouliaraki and Morsing (2010) suggest's that some questions such as "who are we?" and "where are we going?" are important for developing the organizational identity of companies.

Towards generating a corporate identity through the visual form of the car can a heuristic set be derived based on the outcome of the previous set of experiments? How can the outcome be validated. In the section to follow such an attempt is be made in generation of new concept for a car and seeking validation of results.

V5.2 Developing the Heuristic set (Expression keys)
























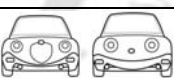






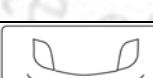

In section 2, an attempt has been made to develop a heuristic set (expression keys) for form generation. This heuristic set can be useful for car designers designing for both

¹ http://en.wikipedia.org/wiki/Corporate_identity// accessed in May 2011.

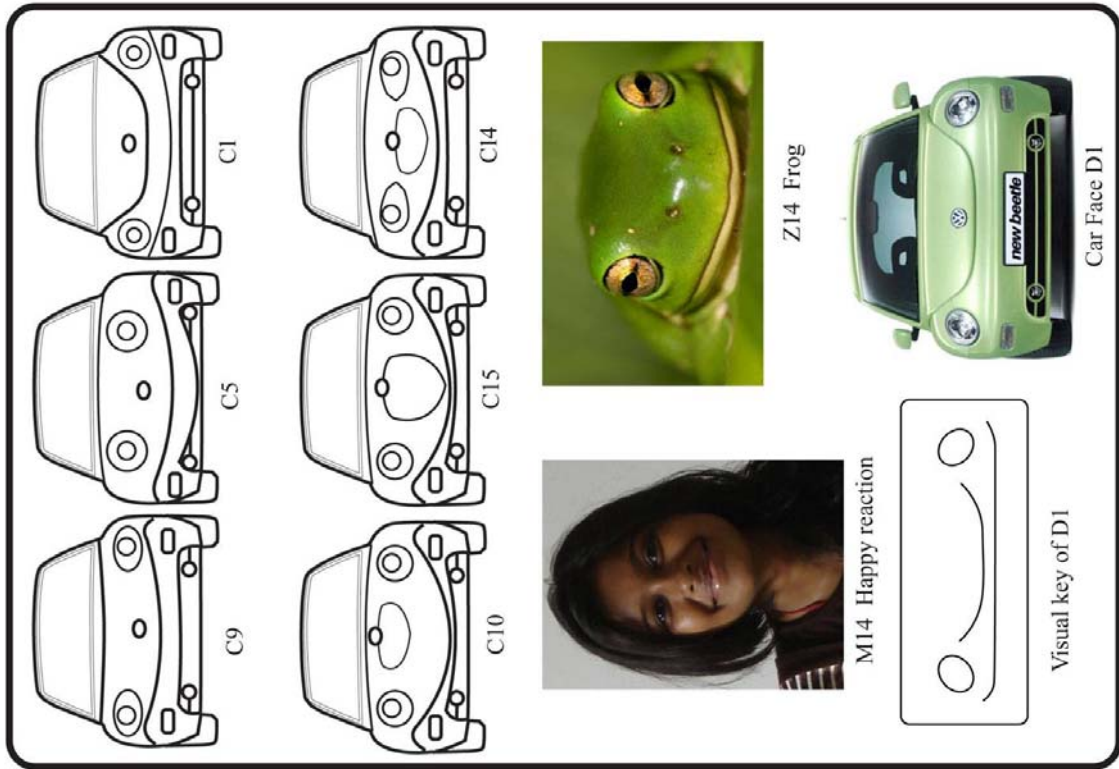
Indian as well as Iranian culture. This part of research extracts all common signs that were drawn from the outcome of the previous set of experiments, retain the ones accepted by both Iranian context and Indian context and over looks those that are not common to the two cultures.

As seen in Figure V5.1 to Figure V5.16 can form the common signs that can help designers to create ‘visual keys’ to derive different expressions of car faces. This offers the possibility to further explores if *designers can use Bio-design method or heuristic sets of design in the generation of concepts for two brands with two different identity.*¹

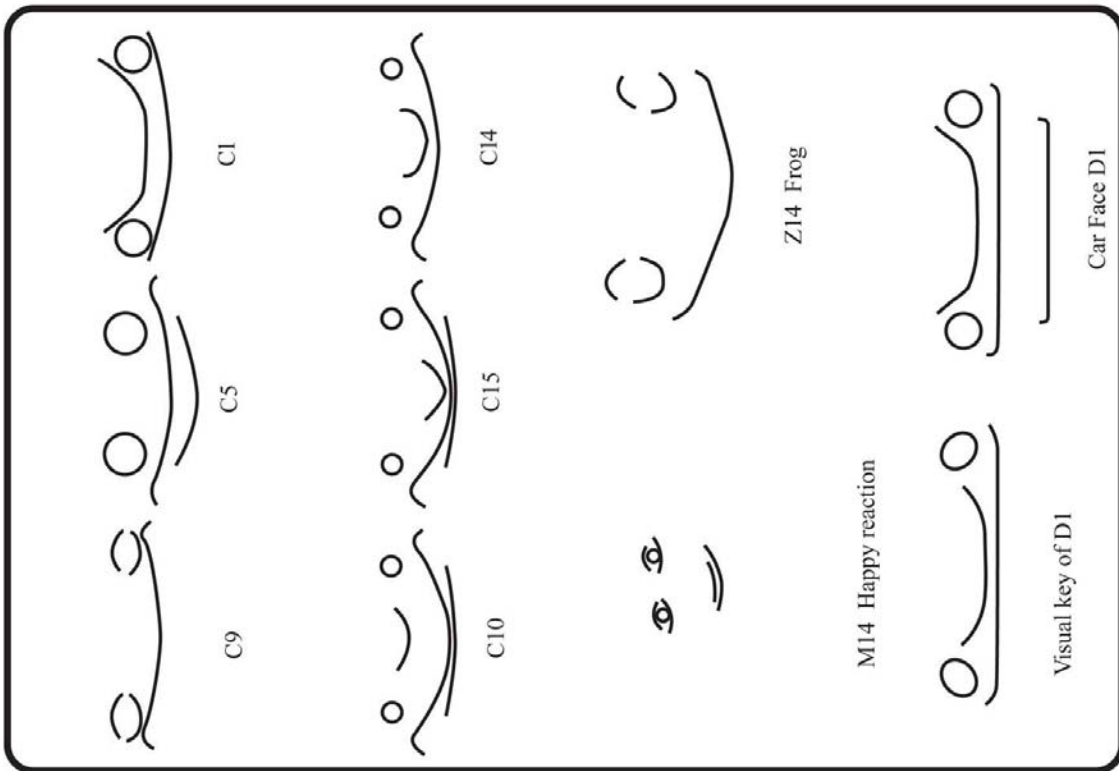
Table V5.1: Final result of section 2

N	Human	Animals	Result of visual analysis	words	Answer of both cultures
1	 M14	 Z14 Frog	 D1	Happy	 C9 C5 C1 C10 C15 C14
2	 M13	 Z13 Dog	 D4	Sad	 C13
3	 M2	 Z2 Cobra	 K3	Serious	 C3 C19 C18 C17
4	 M12	 Z12 Cheetah	 J1	Anger	 C11 C16 C18 C17
5	 M4	 Z4 Shark	 L2	Danger	 C11 C16
6	 M10	 Z10 monkey	 H2	Surprise	 C15 C5
7	 M6	 Z6 Fox	 F1	Disgust	 C11 C12 C17
8	 M8	 Z8 Rabbit	 G5	Curious	 C5 C4 C6 C14

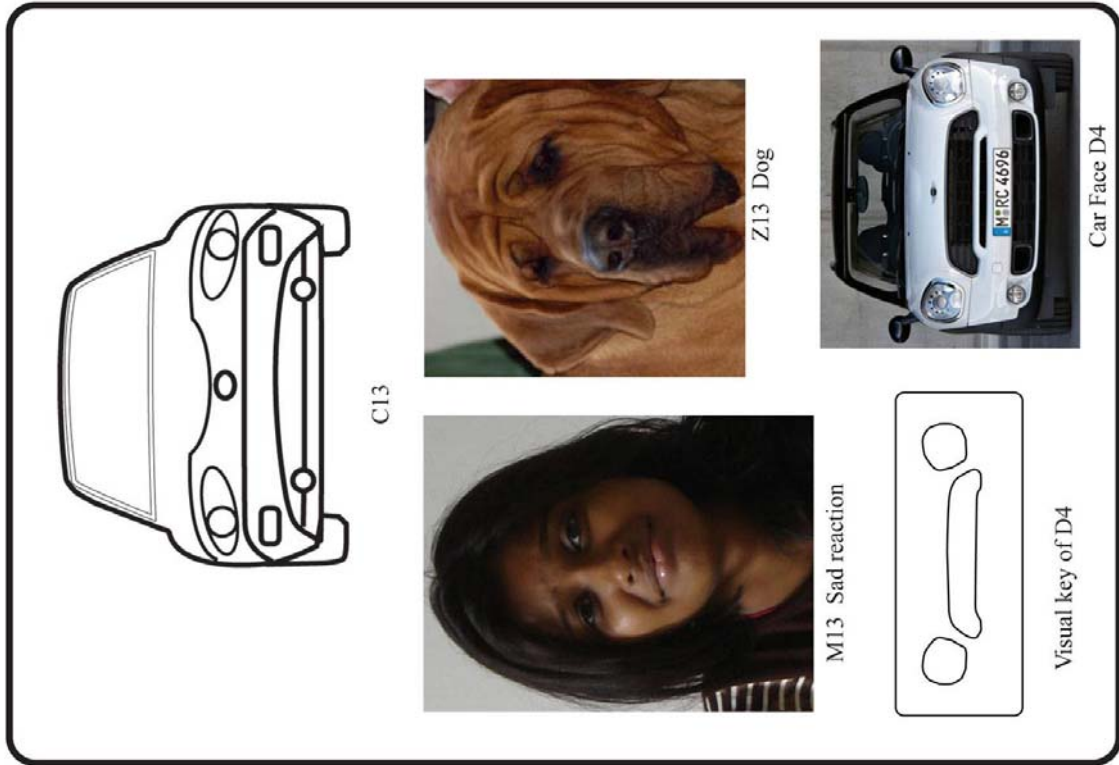
¹ This question rose in the State of the Art Seminar by Professor Amarendra Kumar Das and Professor Debkumar Chakrabarti.



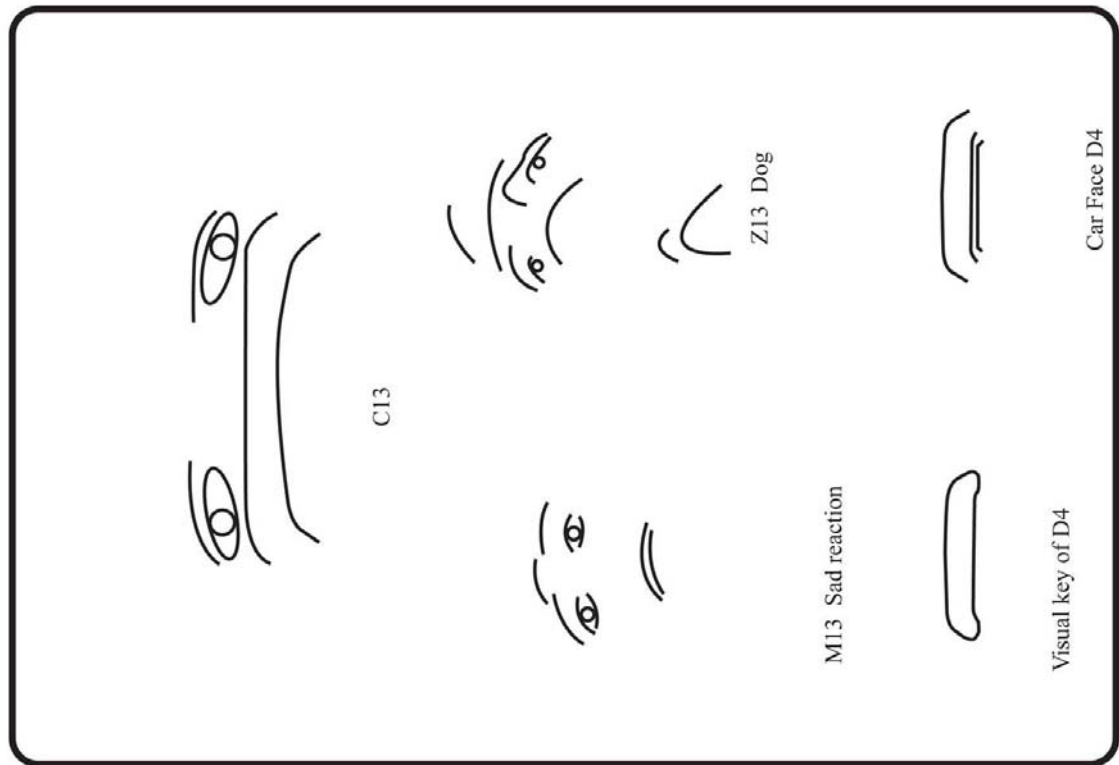
← Figure V5.1: Base of happy expression



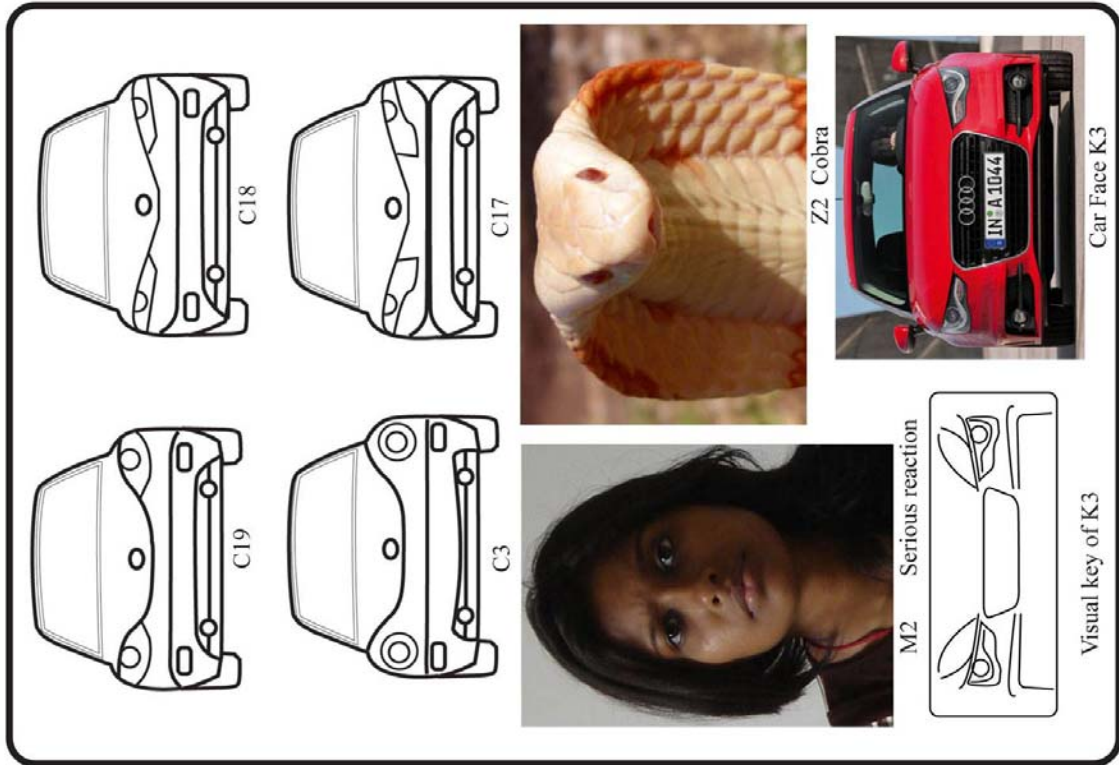
← Figure V5.2: Visual Key of happy expression



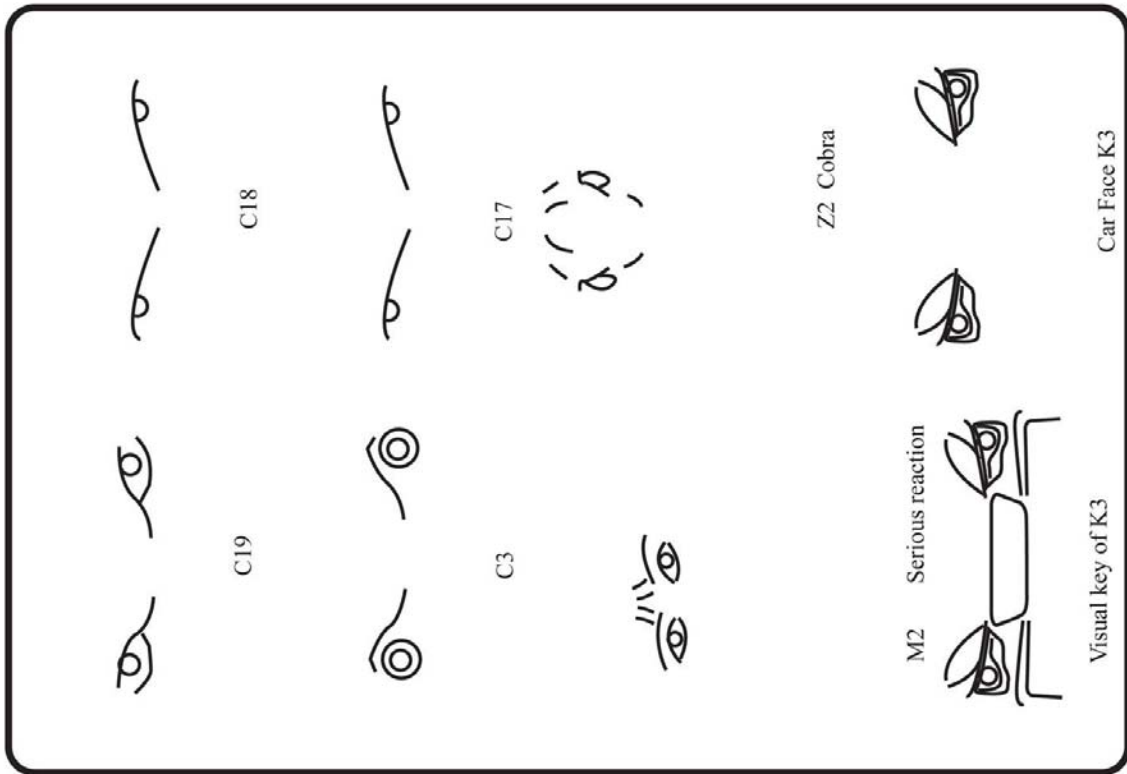
← Figure V5.3: Base of sad expression



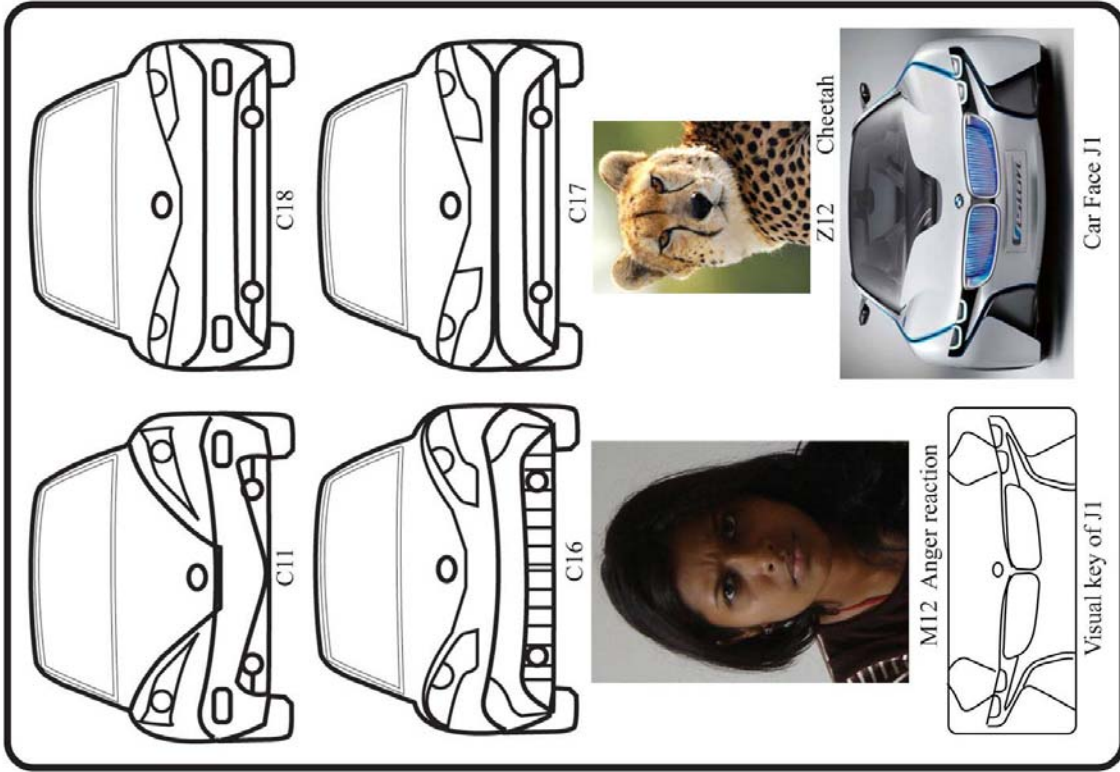
← Figure V5.4: Visual Key of sad expression



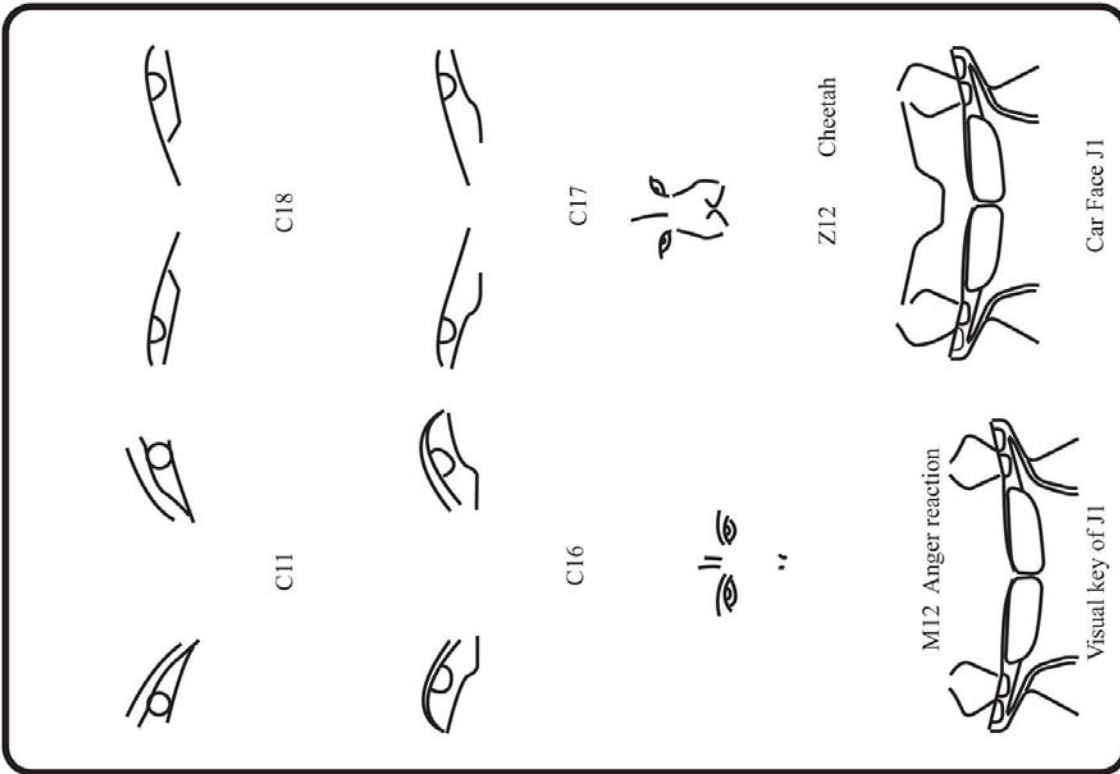
← Figure V5.5: Base of serious expression



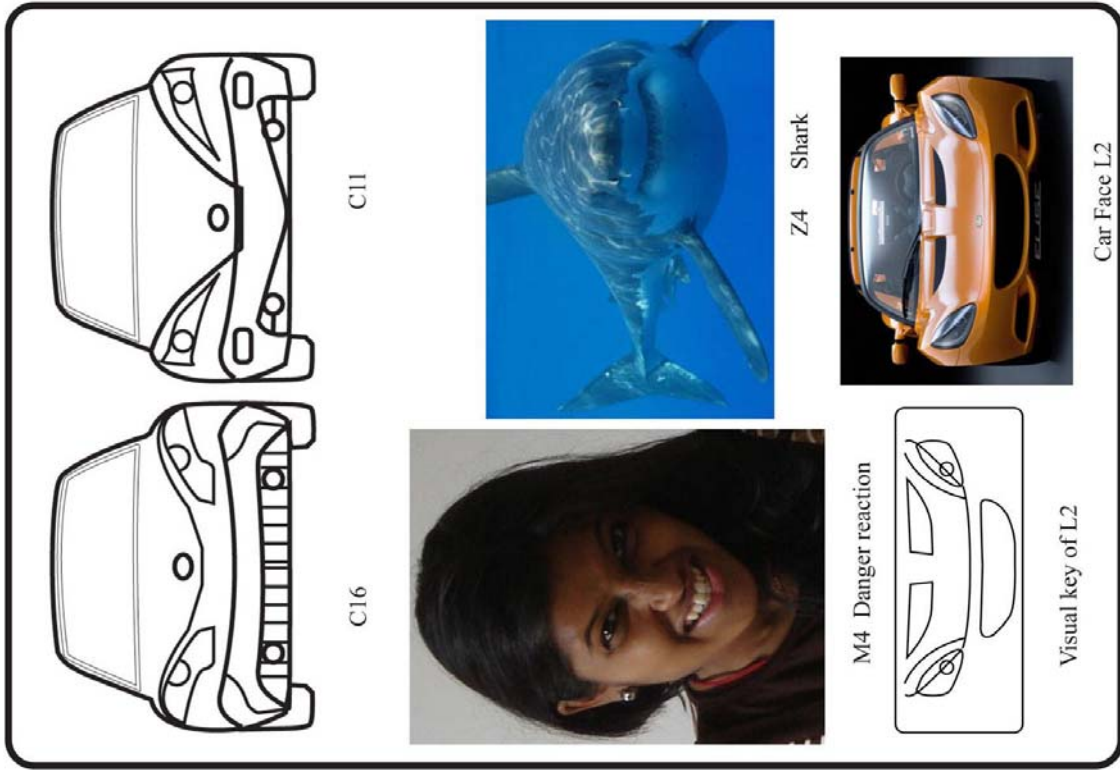
← Figure V5.6: Visual Key of serious expression



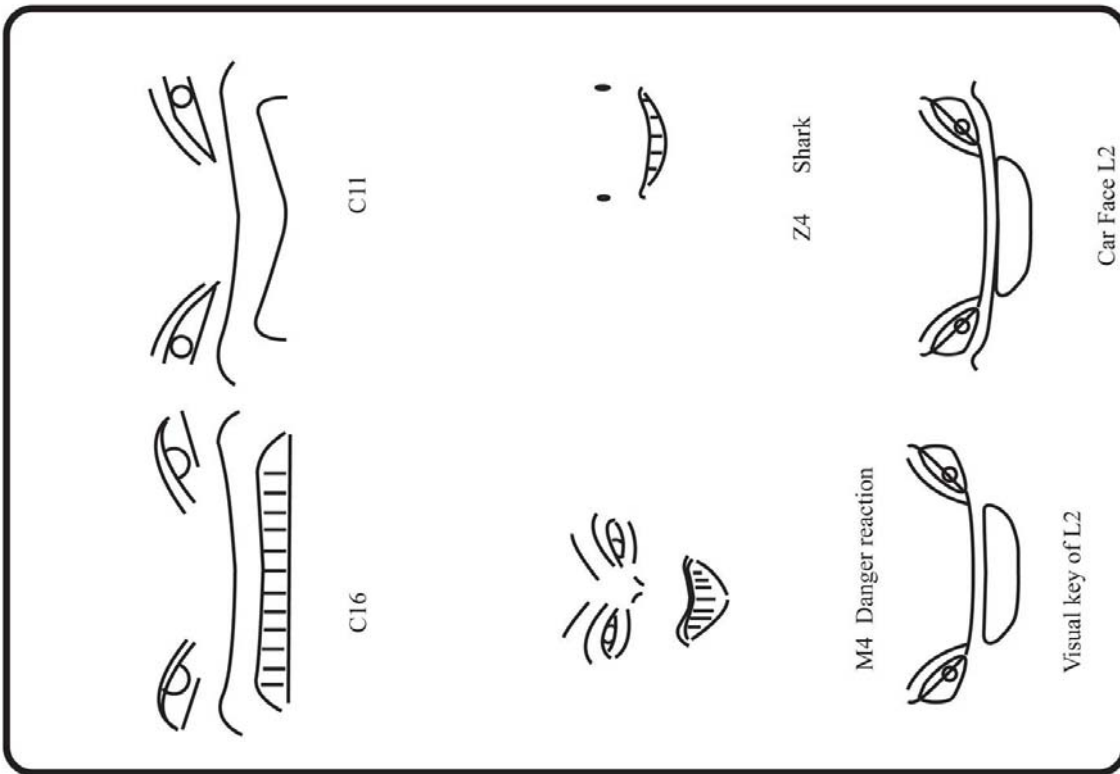
← Figure V5.7: Base of anger expression



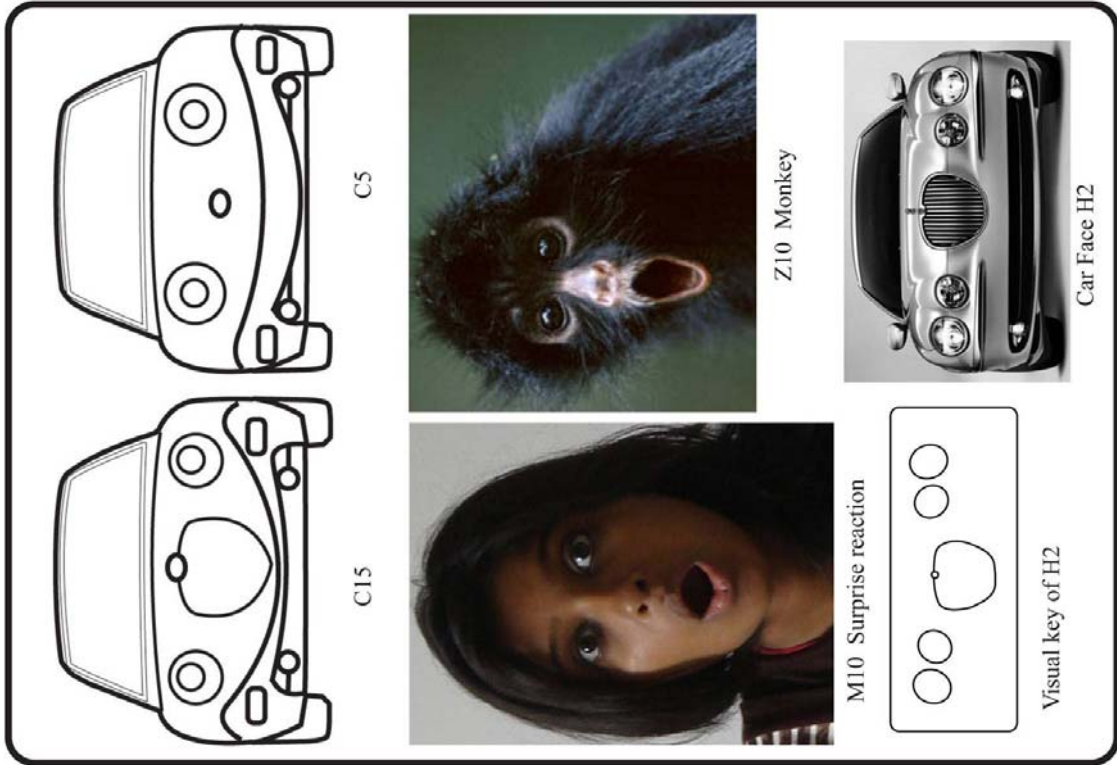
← Figure V5.8: Visual Key of anger expression



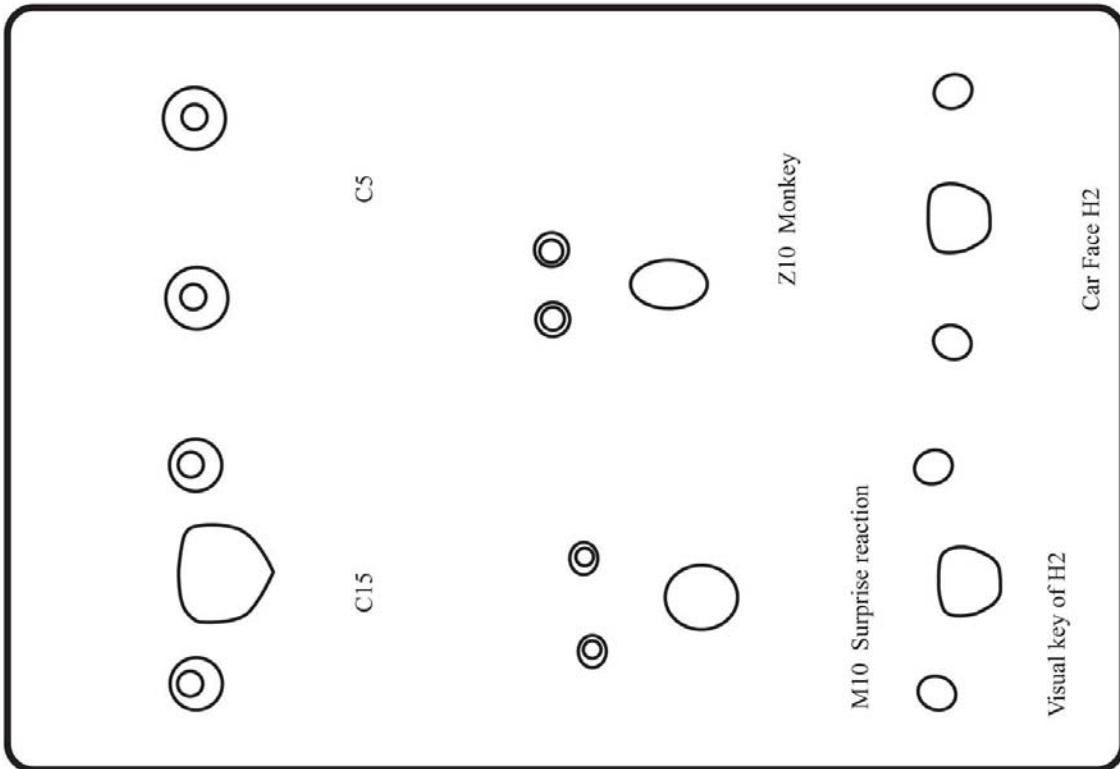
← Figure V5.9: Base of danger expression



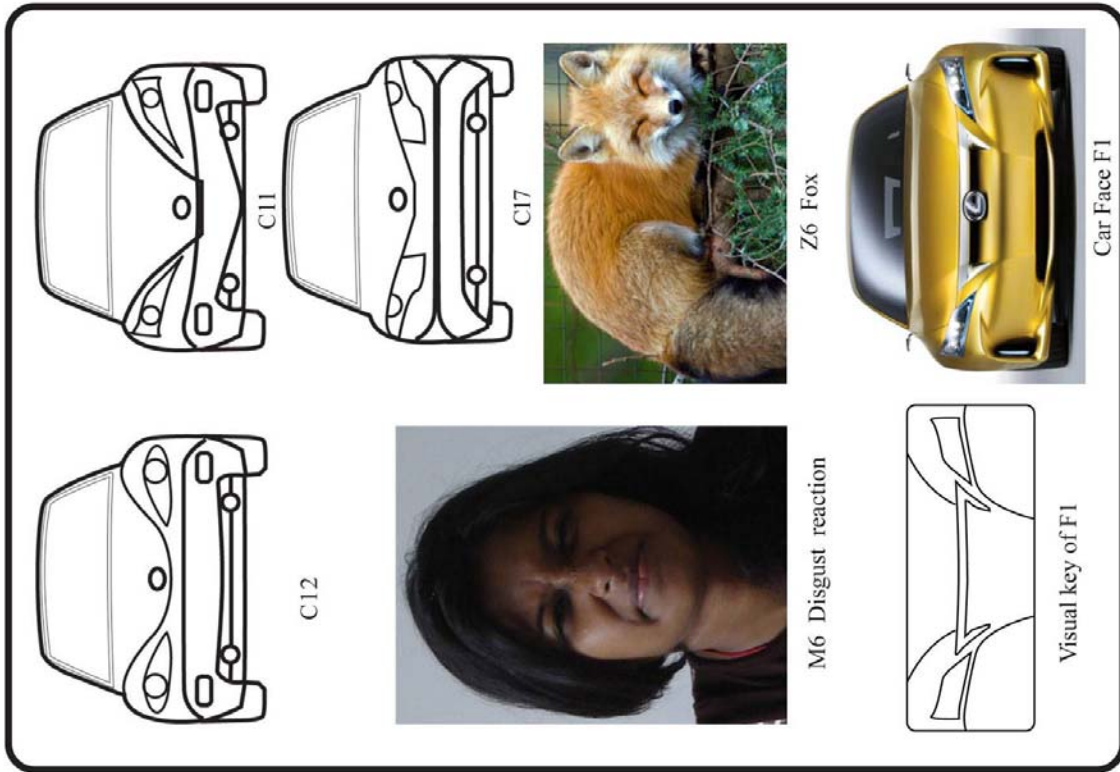
← Figure V5.10: Visual Key of danger expression



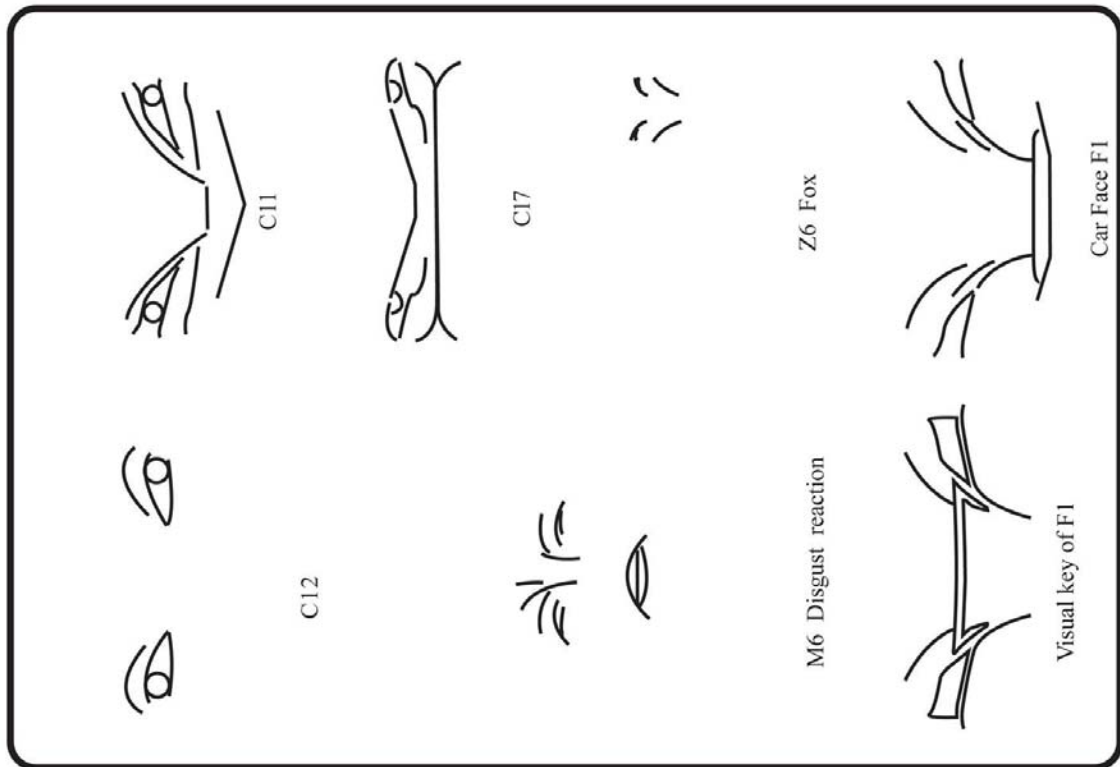
← Figure V5.11: Base of surprise expression



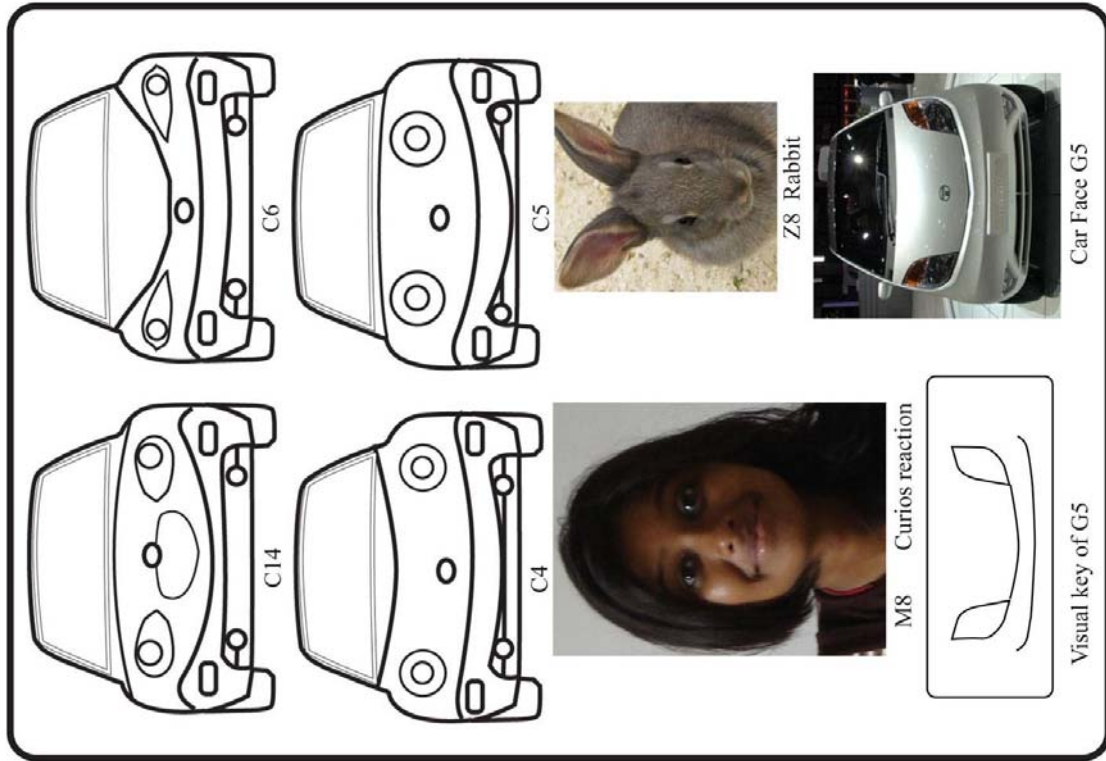
← Figure V5.12: Visual Key of surprise expression



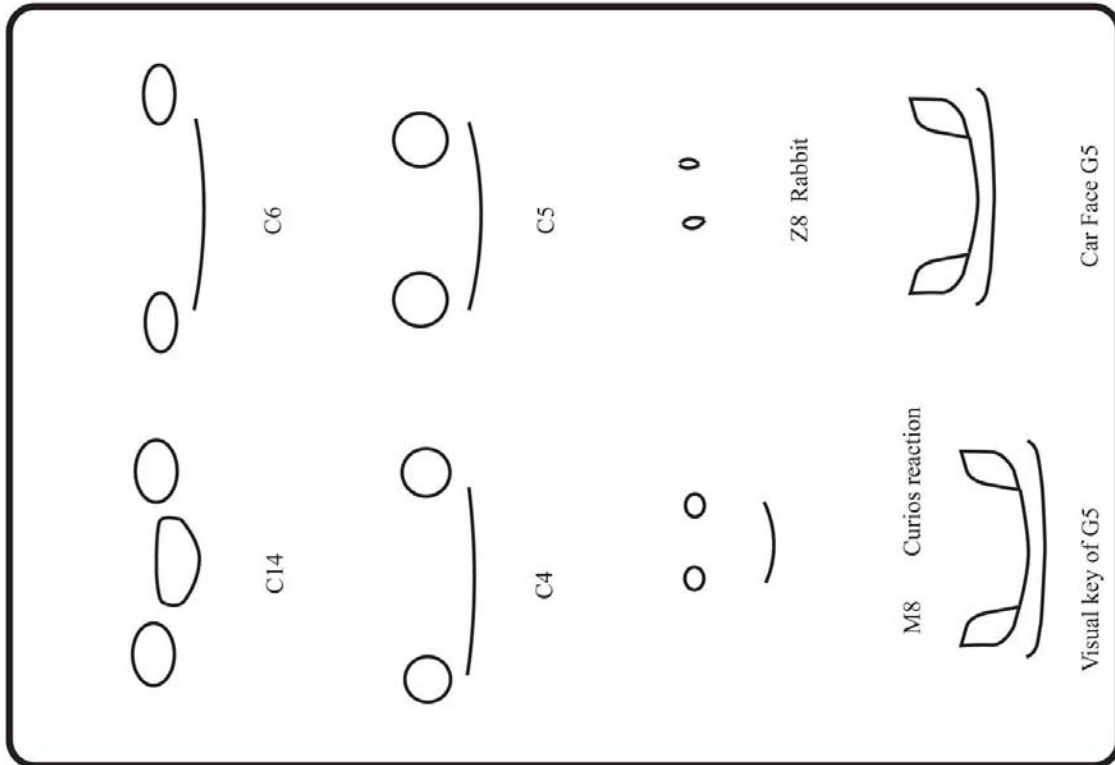
← Figure V5.13: Base of disgust expression



← Figure V5.14: Visual Key of disgust expression



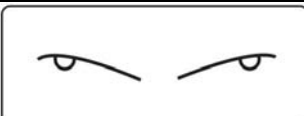
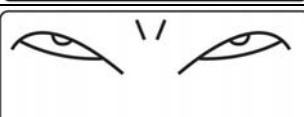
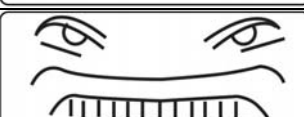


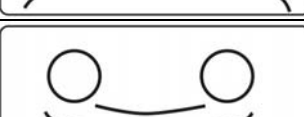


← Figure V5.15: Base of curios expression



← Figure V5.16: Visual Key of curios expression

Table V5.2: Set of sign

No	Expression word	Expression key
1	Happy	
2	Sad	
3	Serious	
4	Anger	
5	Danger	
6	Surprise	
7	Disgust	
8	Curios	

To explore validation, an attempt has been made in section 2, to use a set of heuristic and bio-design approaches to design car forms for BMW and Chevrolet brands which have two different identities. The emphasis to identity is given because the notion of identity plays an important role in the context of design semantic of product (Burdek 2005).

V5.3 Designing car forms for two competing brands possessing distinct brand identities

This is an attempt on the part of this researcher to design the car forms for two competing brands viz. BMW and Chevrolet which possess distinct identities of their own based on heuristic set derived for achieving the expression of anger.

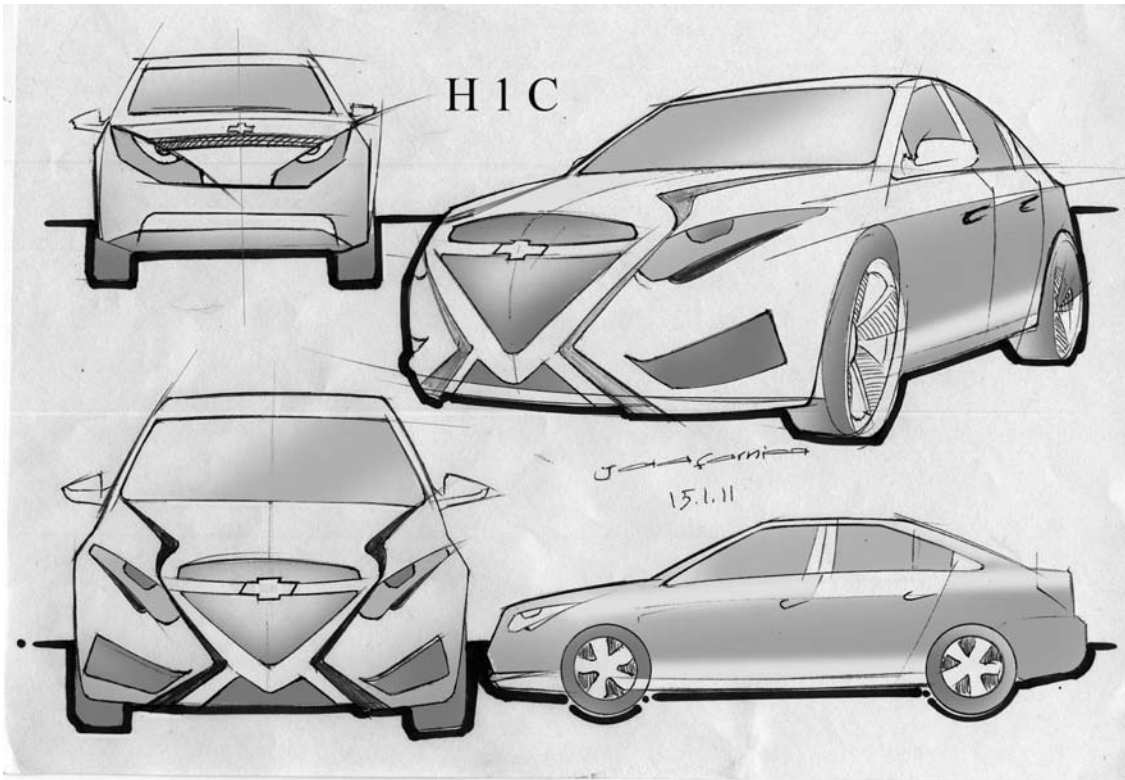


Figure V5.17: Design number H1C (use heuristic set with the identity of Chevrolet)

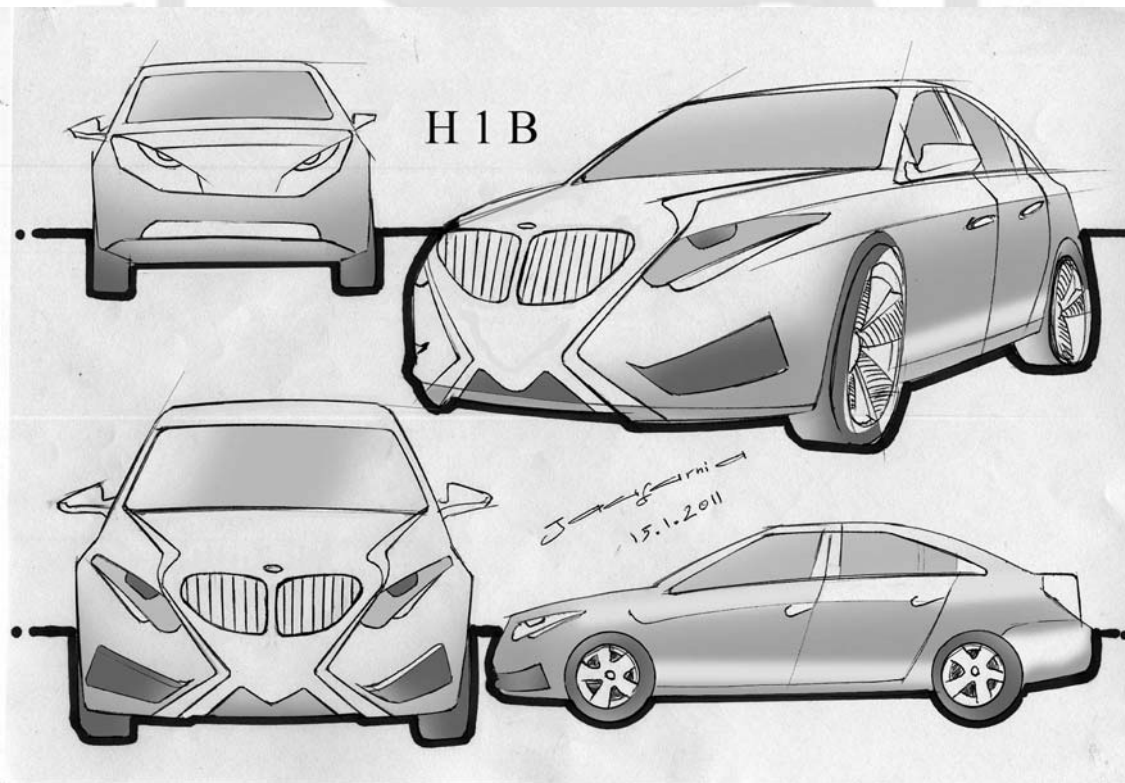


Figure V5.18: Design number H1B (use heuristic set with identity of BMW)

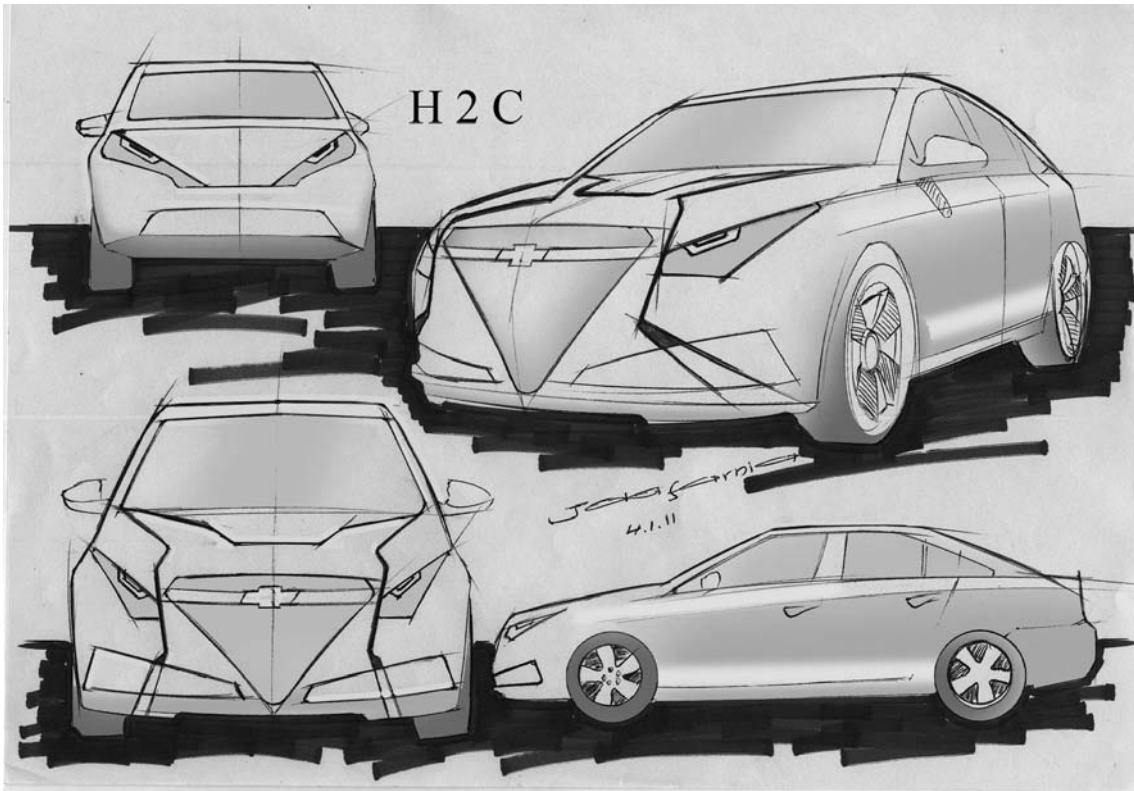


Figure V5.19: Design number H2C (use heuristic set with identity of Chevrolet)

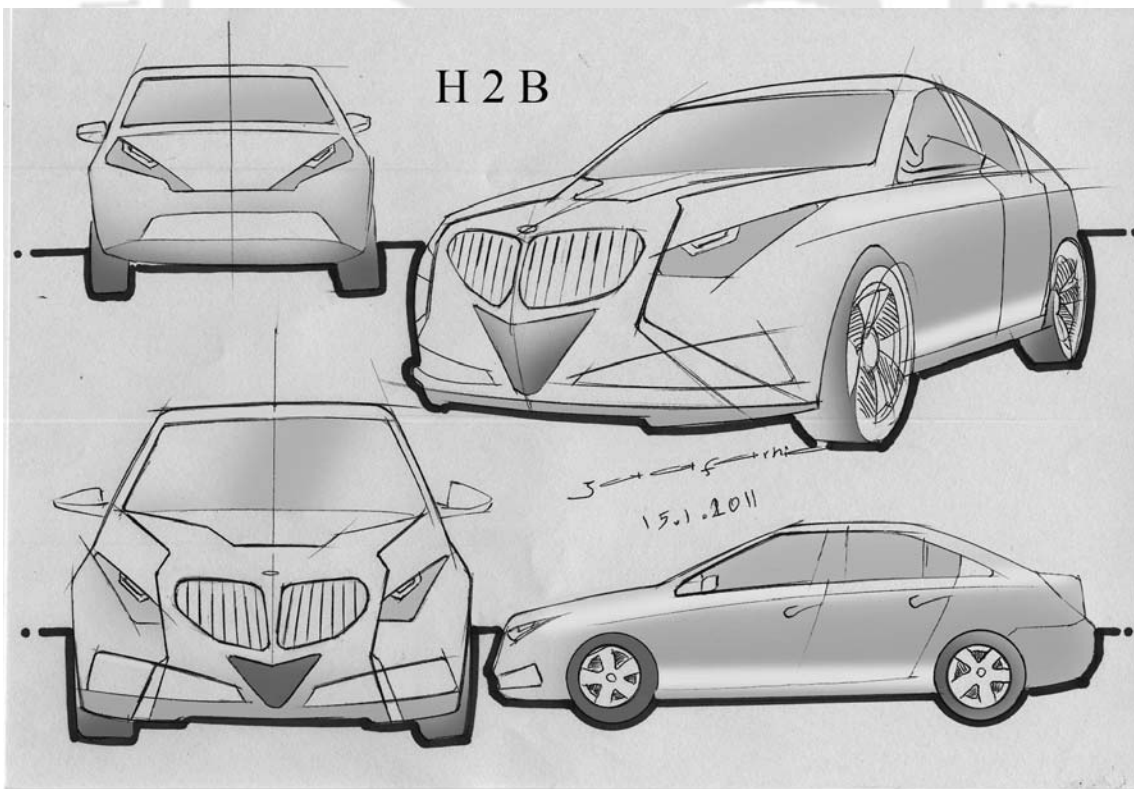


Figure V5.20: Design number H2B (use heuristic set with identity of BMW)

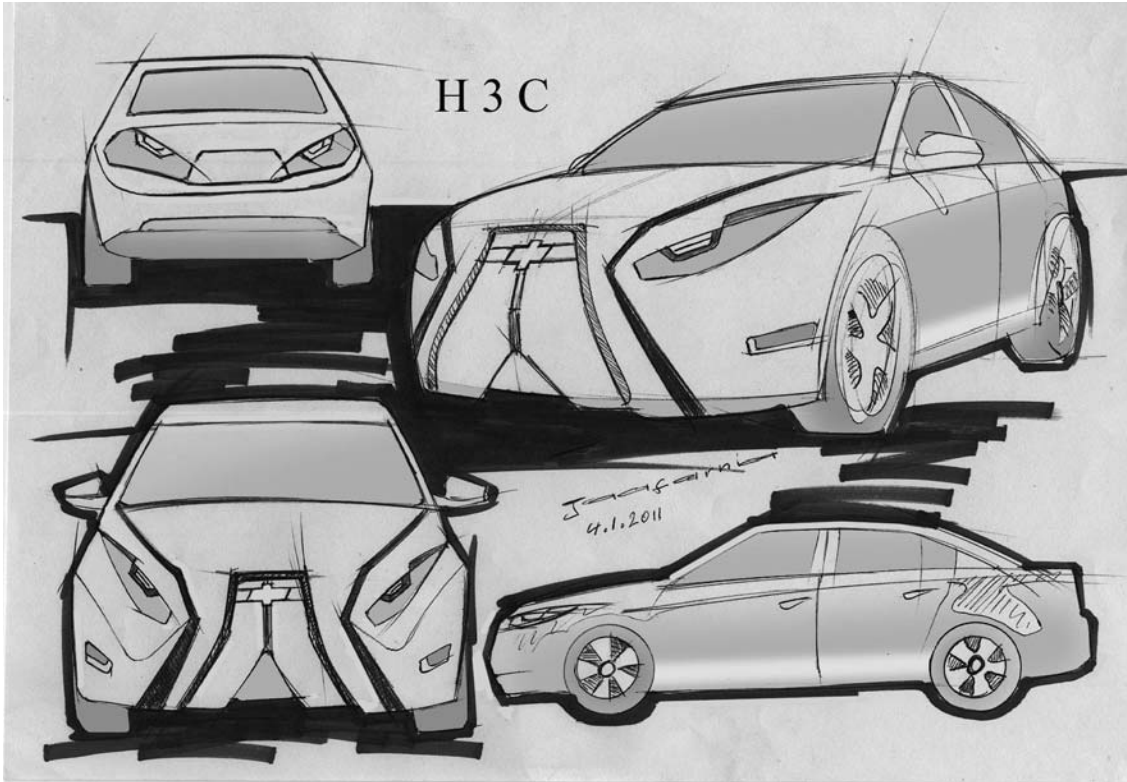


Figure V5.21: Design number H3C (use heuristic set with the identity of Chevrolet)

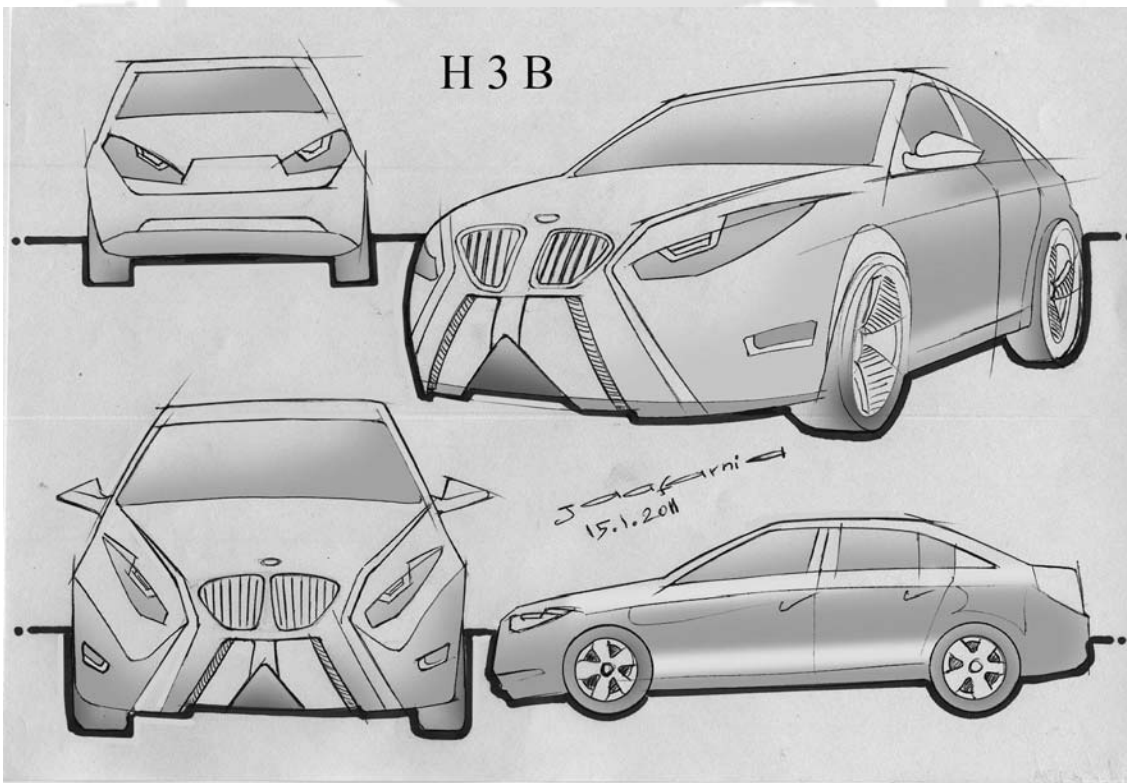


Figure V5.22: Design number H3B (use heuristic set with the identity of BMW)

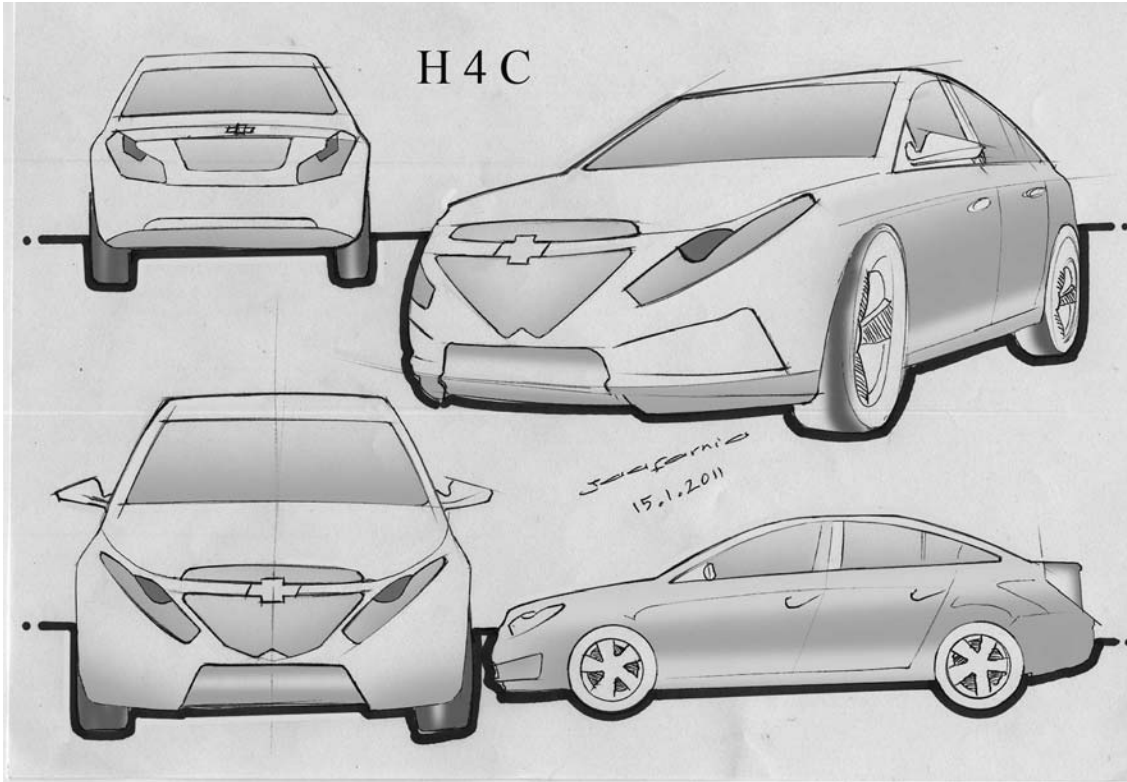


Figure V5.23: Design number H4C (use heuristic set with the identity of Chevrolet)

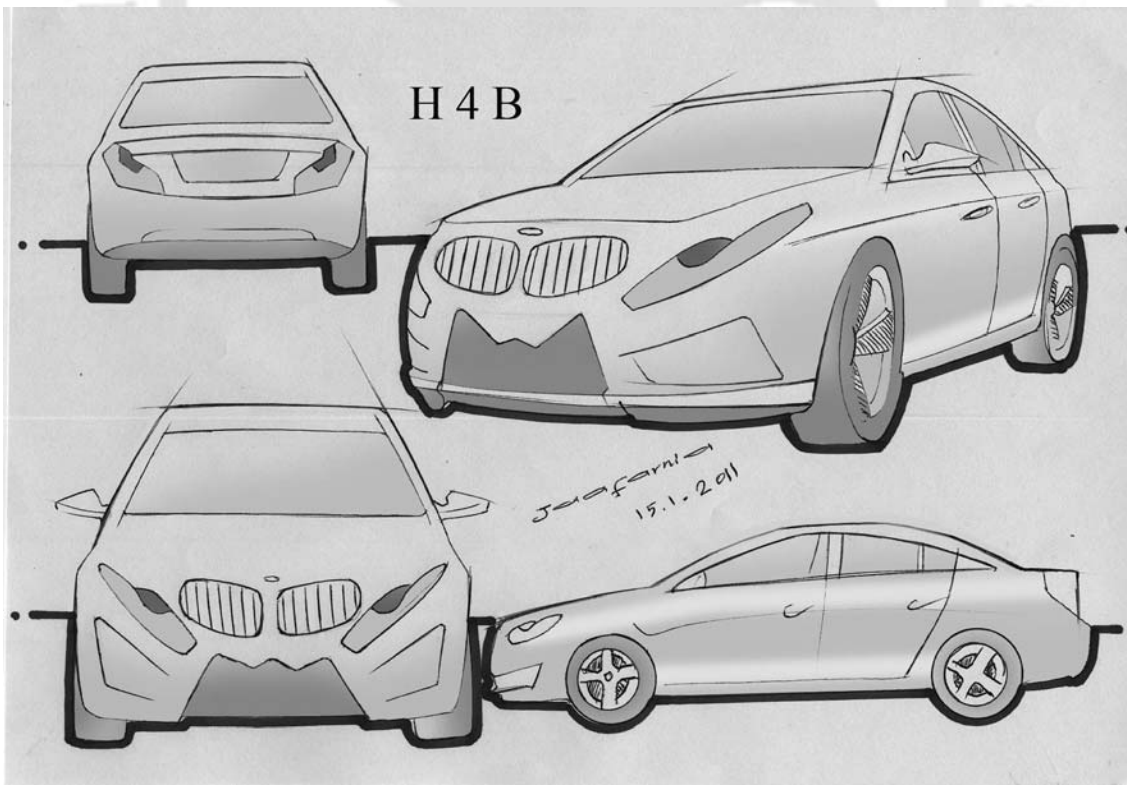


Figure V5.24: Design number H4B (use heuristic set with the identity of BMW)

V5.4 Designing car forms for two competing brands possessing distinct brand identities based on bio-design method

This is an attempt on the part of this researcher to design the car forms for two competing brands viz. BMW and Chevrolet which possess distinct identities of their own based on bio-design method derived for achieving the expression of anger

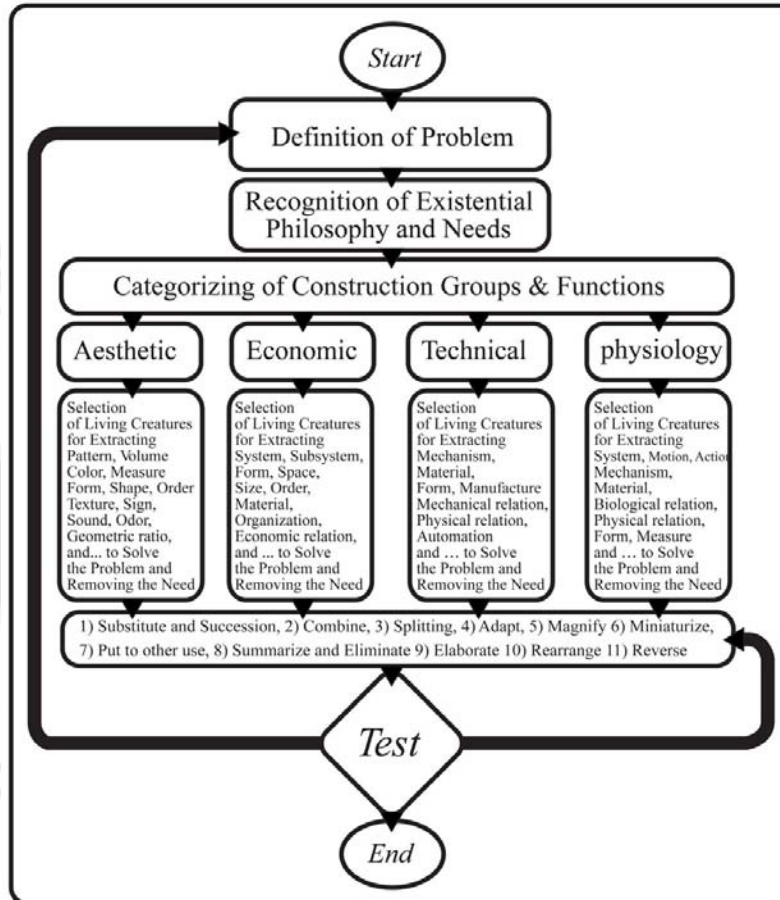


Figure V5.25: Bio-design method

This method can cover all needs (Aesthetic need, Economic need, technical need and Physiological need) but the main aim of the research is to find out about emotional needs and meanings of forms for culture. Because this research only covers the branch of aesthetic (Figure V5.26) if this branch is found valid then we can deduce that all four branch are also valid. In the last part of the research, it was evident that both cultures like the “anger” expression hence the researcher selected the “anger” expression as a need.

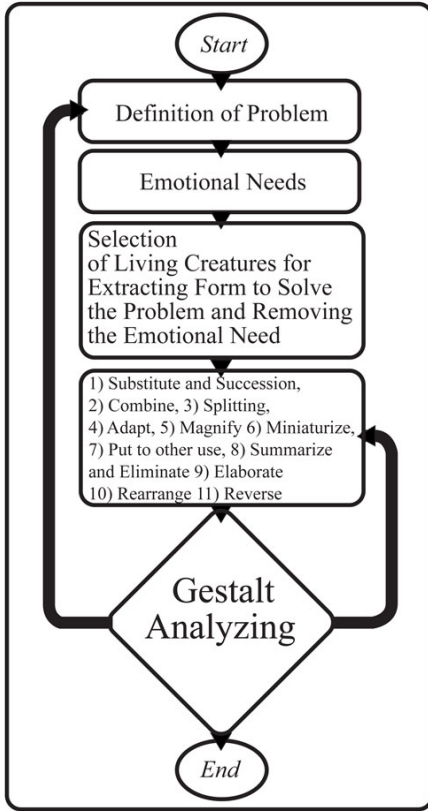


Figure V5.26: Aesthetic part of Bio-design method



Figure V5.27: Common animals and insect with anger expression in India and Iran. ¹

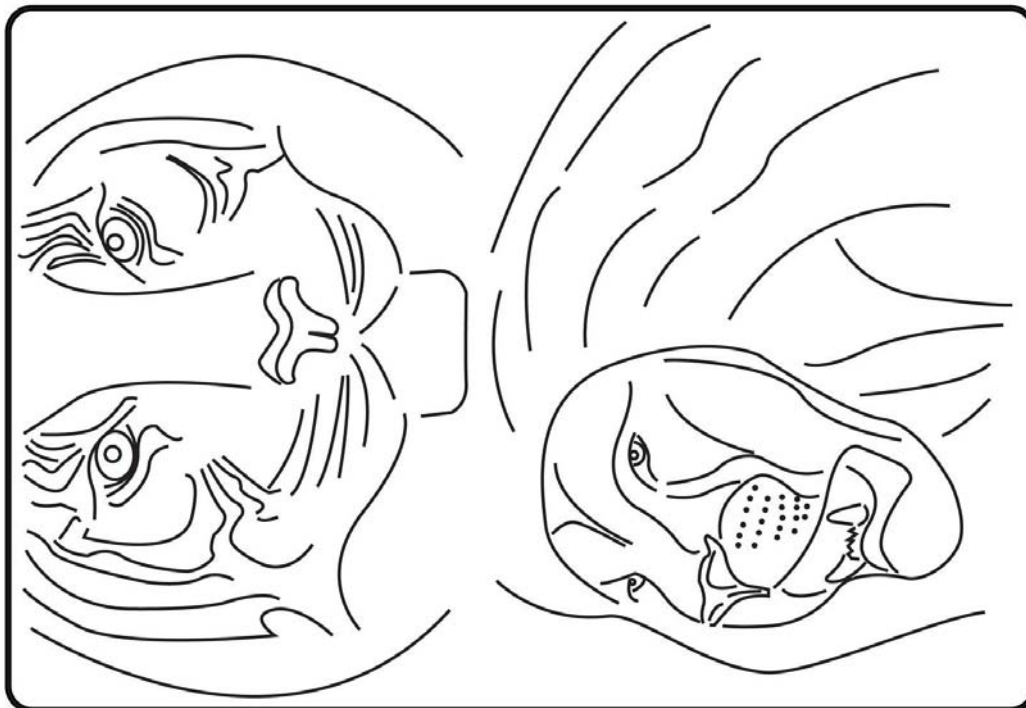
- a) *Definition of Problem*: car designing for both Indian and Iranian cultures, or determining a global market for them
- b) *Emotional Needs*: anger expression

Living Creatures Selection: Now in this step, designers select an animal or insect to analyze and extract its form to solve the problem and cover the need for anger expression. This design should cover both the cultures and then the designer must select animals or insects prevalent in the Indian and Iranian surroundings. After searching for all common animals and insects in Indian and Iranian natures, lion and tiger were selected as the basis for extraction of the expression ‘anger’.

¹ http://bio.kuleuven.be/ento/photo_gallery.htm
<http://www.flickr.com/photos/nikon66/2106992946/in/gallery-snocturnus-72157622490038466/>
<http://www.flickr.com/photos/digitalart/478734577/>
<http://www.flickr.com/photos/valdecasas/2832871916/>
<http://www.acuityortho.com/FunStuffMisc/LionsDen/tabid/186/Default.aspx>
http://www.wallpaperweb.org/wallpaper/animals/indian-tiger_1024x768_36060.htm/ accessed in February 2011.



← Figure V5.28: Lion and tiger with anger expression in India and Iran.



← Figure V5.29: Keys of anger expression for Lion and tiger.

- c) *Substitute and Succeed, Merge and Combine, Split, Adapt, Magnify Miniaturize, Put to other use, Summarize and Eliminate, Elaborate, Rearrange, Reverse*: In this step designers derive a pure idea from an animal or plant or insect but it is not useful for imbibing into the product directly. Then the designer must 1) Substitute and Succeed, 2) Merge and Combine, 3) Split, 4) Adapt, 5) Magnify 6) Miniaturize, 7) Put to other use, 8) Summarize and Eliminate 9) Elaborate 10) Rearrange 11) Reverse, (Jaafarnia, 2005).
- d) *Gestalt Analysis*: In this step designers try to perform gestalt analysis on the product (design) to check it can be solved or not. If the designers could not solve the problem and remove the need. Then it should be understood that the problem needs to have more designing to be done and so they should again go to the previous step. If the problem needs to have more ideation, then the designer should again go to the “Definition of Problem”. Else the designing is over.

V5.5 Concept sketches

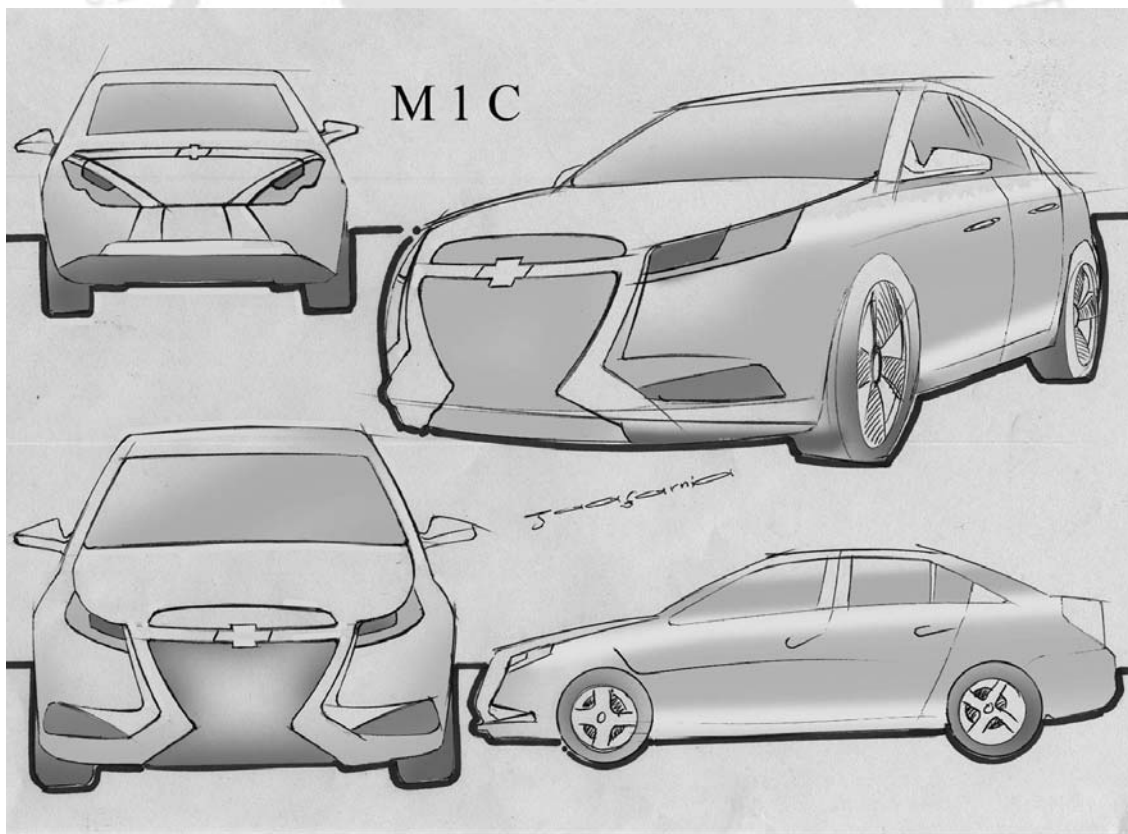


Figure V5.30: Design number M1C (use Bio-method with the identity of Chevrolet)

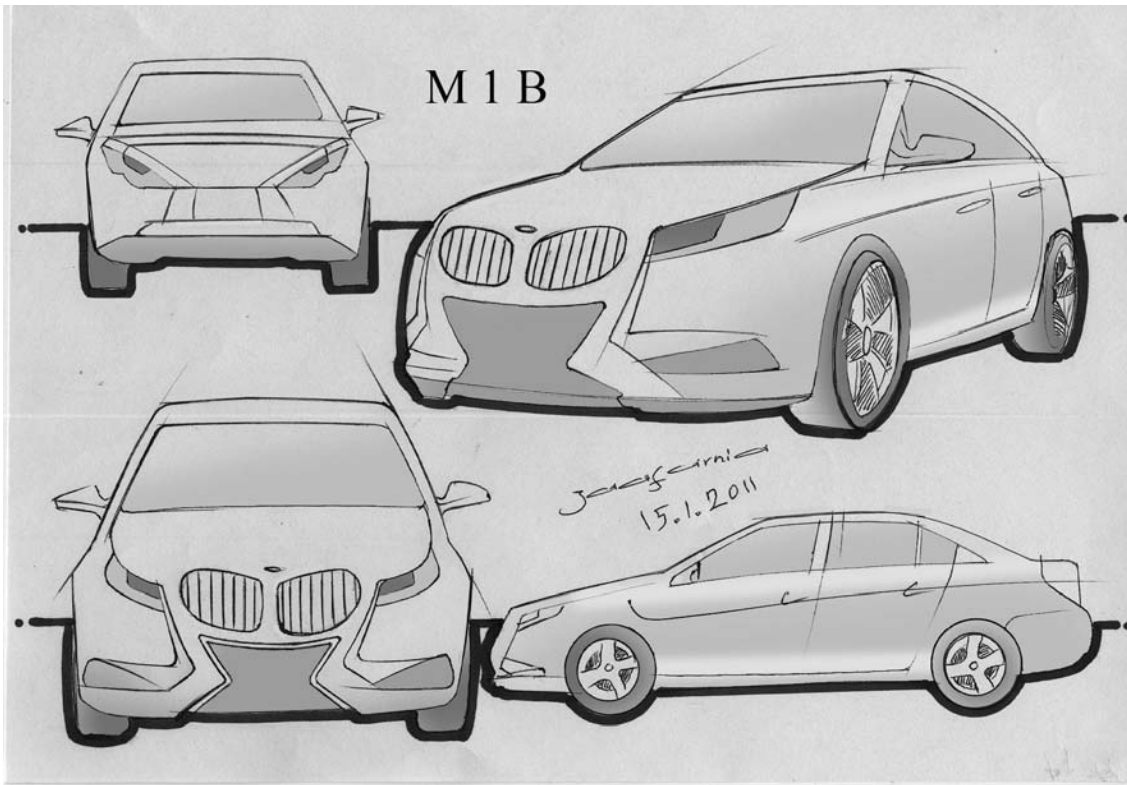


Figure V5.31: Design number M1B (use Bio-method with the identity of BMW)

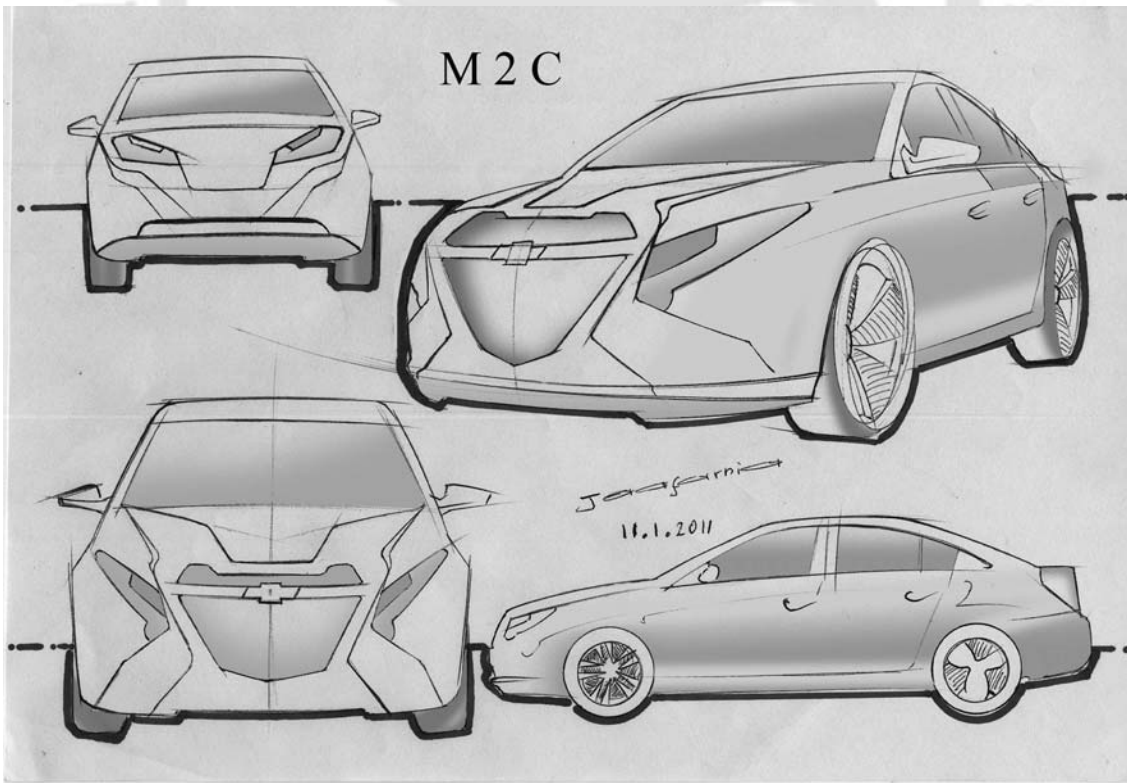


Figure V5.32: Design number M2C (use Bio-method with the identity of Chevrolet)

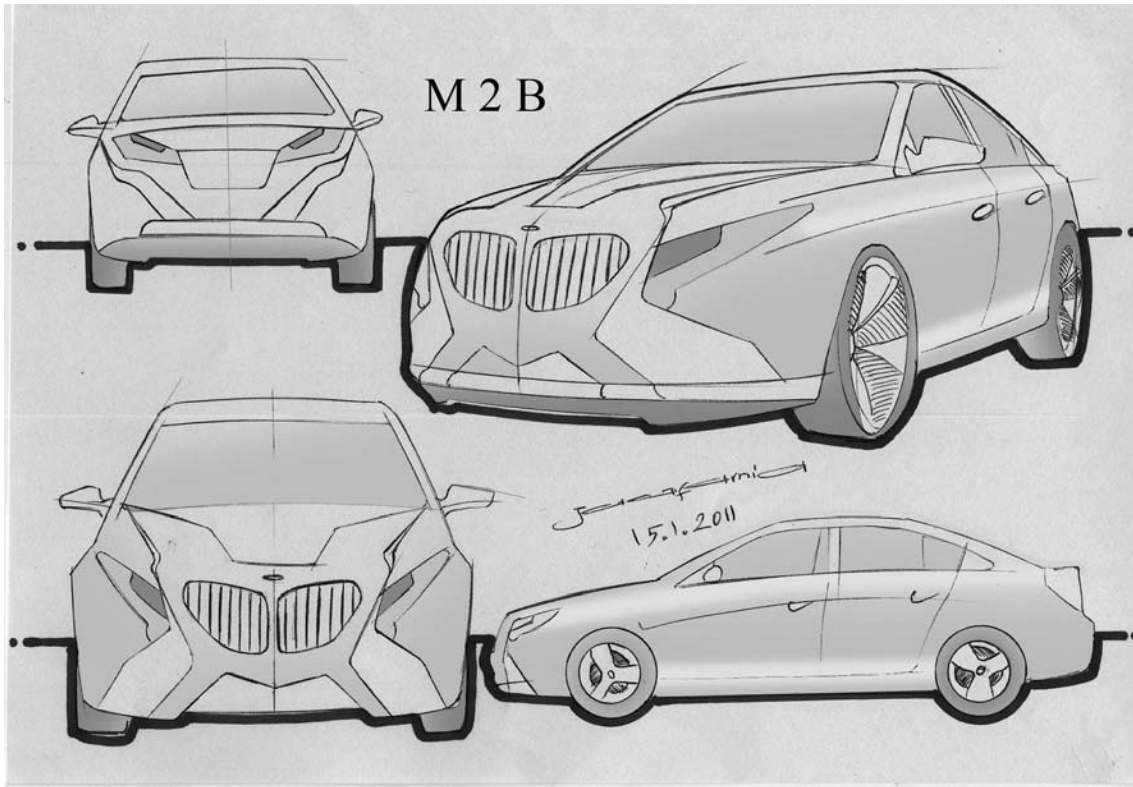


Figure V5.33: Design number M2B (use Bio-method with the identity of BMW)

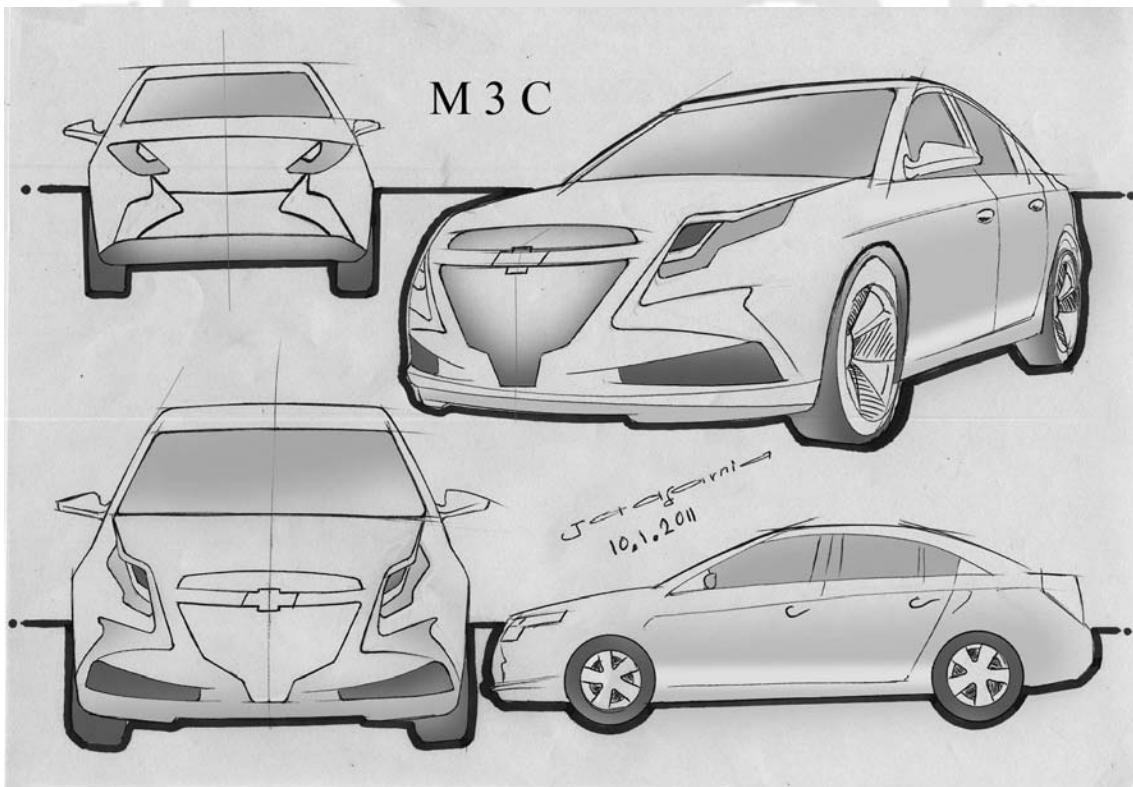


Figure V5.34: Design number M3C (use Bio-method with the identity of Chevrolet)

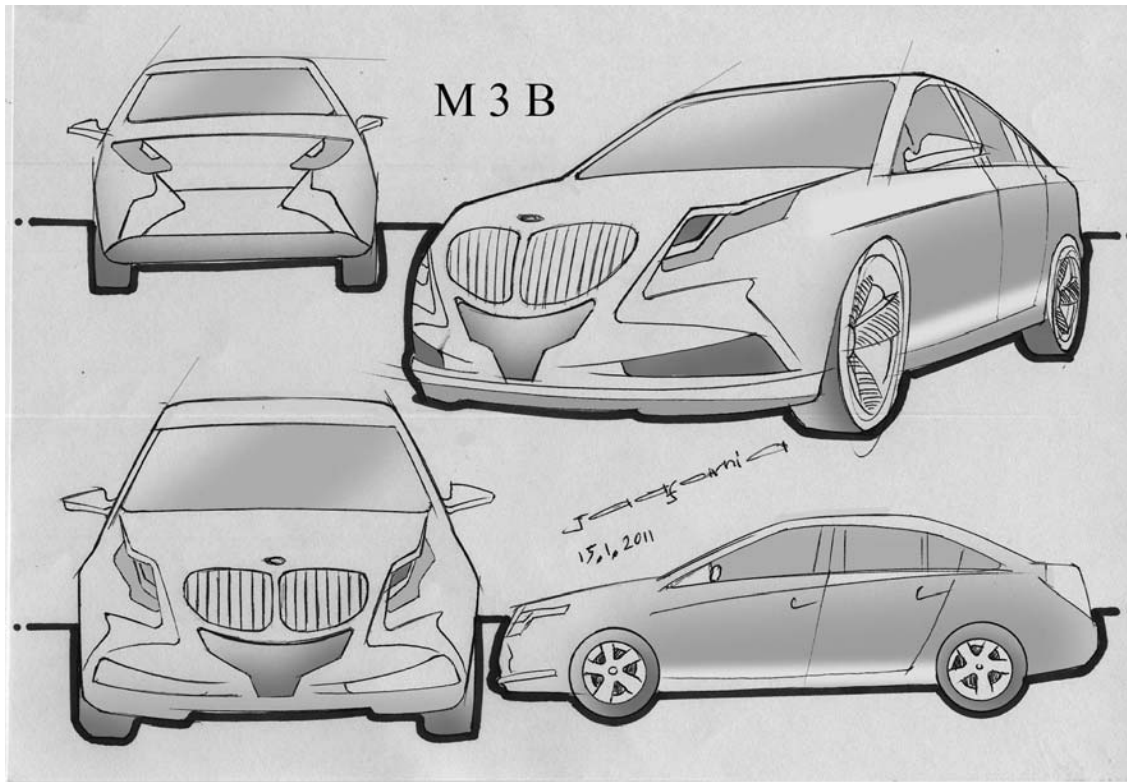


Figure V5.35: Design number M3B (use Bio-method with the identity of BMW)

V5.6 Final design

We combined the back face of M2B with the front face of M3C. To this we add the grille of M1C and light design of M1C and finally create MFC. So this design is derived from lion and tiger forms for which it is specially named as 'Tigon' made of 'Lion' + 'Tiger'.

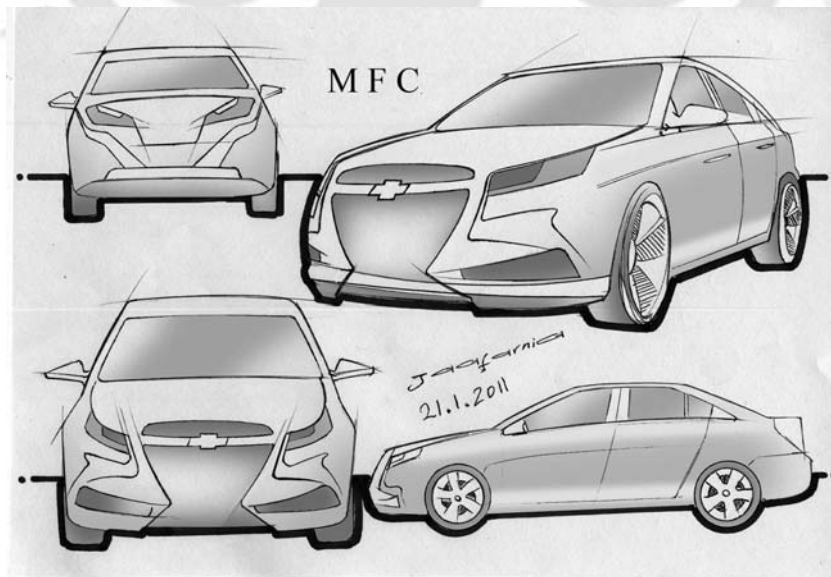


Figure V5.36: Final Design MFC (use Bio-method with identity the of Chevrolet)

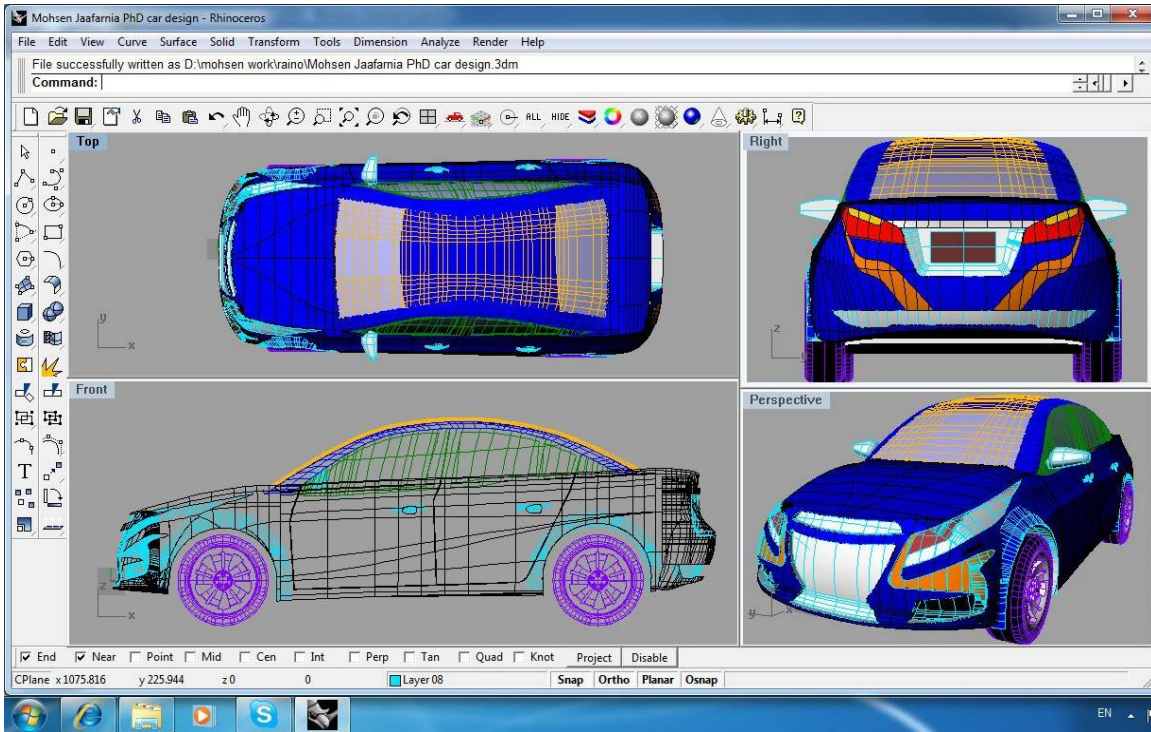


Figure V5.37: Tigon - Final Design MFC (four view in Rhino software)

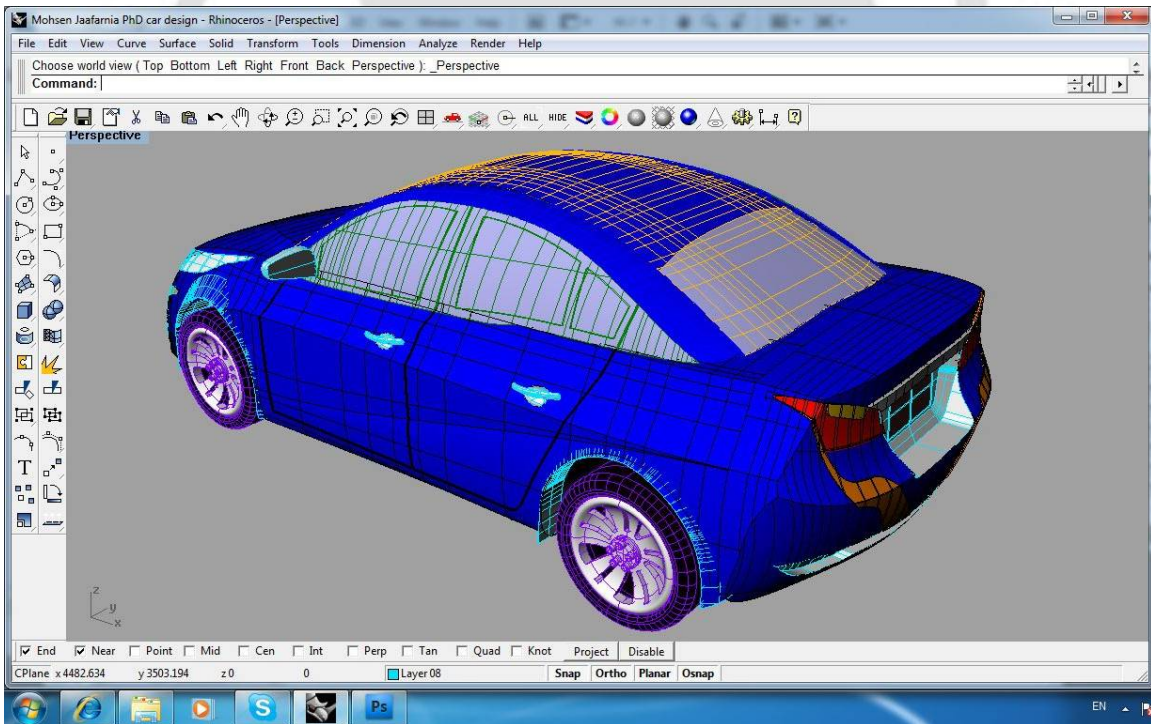


Figure V5.38: Tigon - Final Design of MFC (Perspective in Rhino software)

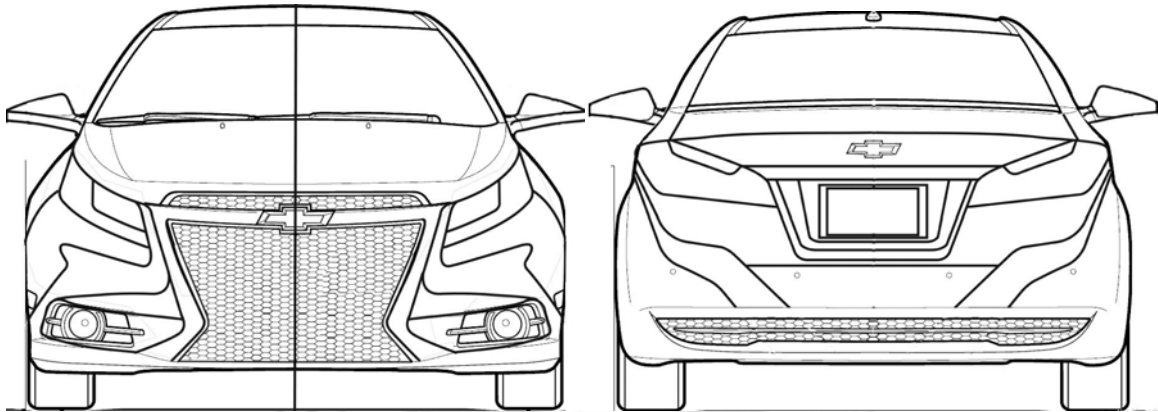


Figure V5.39: Tigon - Final Design of MFC (Blue print)



Figure V5.40: Front face of Tigon - Final Design of MFC



Figure V5.41: Back face of Tigon - Final Design of MFC



Figure V5.42: Tigon - Final Design of MFC, Perspective from front face



Figure V5.43: Tigon - Final Design of MFC, Perspective from back face

V5.7 Drawing Confirmation on Concept Car Forms based on User feedback

The aim of this experiment is to seek the confirmation of result of the concept car based on User feedback. It can show how much the heuristic set and the bio-design method could be helpful for expressing a special expression and also finds out as to how much of the results (which was found based on front face study) is best suited for placing any meaning on the overall face of car. The design of the experiment first involved generating a set of images of car faces, comprising the two front faces which are outcome of bio-design method and two front and back face which are outcome of heuristic set. Using this as the reference for enquiry, responses are sought from users to seek their response to the car faces.

Experiment

The experiment was planned in the following manner:

Selection of cars sample

Shown below are 7 views of car faces shortlisted and used in this confirmation test. The 7 views samples were chosen from the car faces which we designed, based on the result of the heuristic set and the bio-design method. There were H1C, H3C, front face of MFC and back face of MFC.

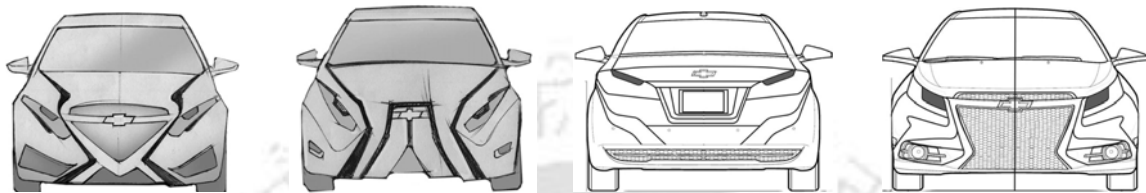


Figure V5.44: Left to right car faces, H1C, H3C, front face of MFC and back face of MFC.

In this experiment we select three more car faces for attaining better test results. In this section of designing we use just the expression of anger, therefore for attaining better objective tests, we select three more car faces with different expressions (curios, stupid and sad expressions).

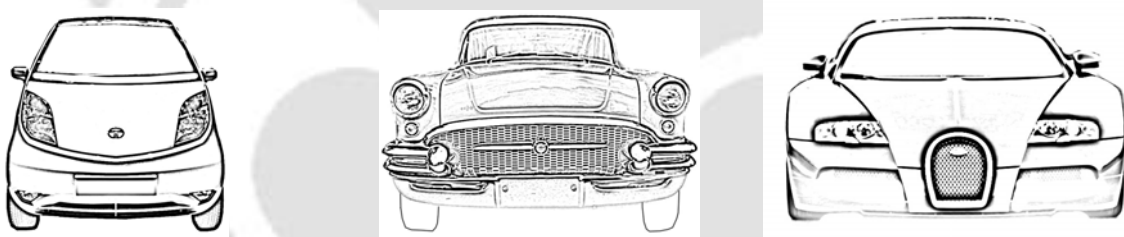


Figure V5.45: Left to right car faces, curios, stupid and sad expressions.

Planning Questionnaire

This confirmation experiment set out to seek user response to 'Expressive words' association vis a vis a set of car faces. The experiment sought to evaluate an overall understanding of user response to visual expression of the car faces.

Structure of Questionnaire

A prepared questionnaire format along with a set of interviews was used that was displayed on the LCD of laptop computers and the experimental data was collected through it. To fulfill this task the following questions were asked to 70 respondents of which 35 were males and 35 females. All were inhabitants of the Indian Institute of Technology Guwahati.

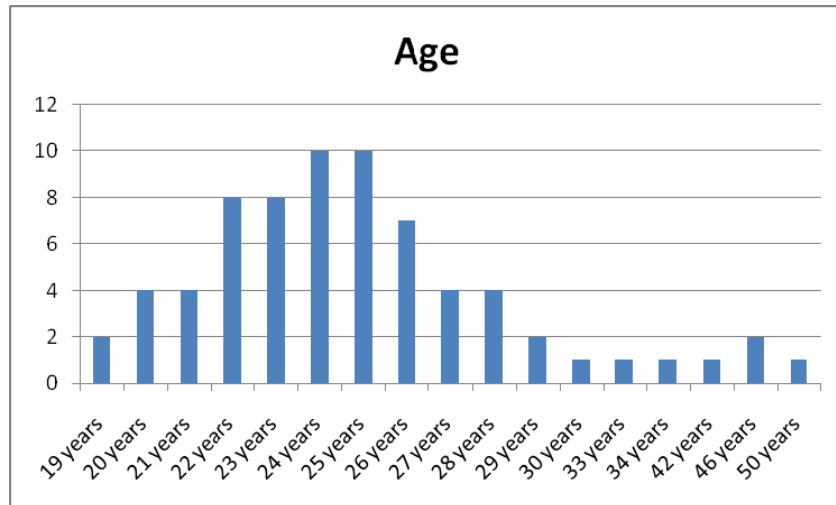


Figure V5.46: Statistic of ages

The experiment was conducted in the campus of the Indian Institute of Technology Guwahati.

Questionnaire and interview techniques were used into the following manner.

Introduction: The questionnaire explained the purpose of data collection.

General information on profile of the user: The questionnaire had 3 questions pertaining to Age, Gender and Education.

Emotional categorizing: This part of the questionnaire was designed to consist one question pertaining to emotional expression and selecting an expression word for each car face between four expressions which were curiosity, stupidity, anger and sadness expressions.

A set of 7 car faces were shortlisted for this study which were presented one by one. The respondent was asked to select the one of expression that fits to the given car face.

The questions were posed as per the 7 image:

-Which one of following expression matches with this car face?

Data Analysis

The statistical analysis of the data was done by using Pie technique. Selected results for 7 car faces have been statistically compiled from the data collected and have been presented below.

Discussion

In car face H1C, 44 percent of respondents selected car face H1C as the ‘Angry’ car. It implied that the using heuristic set of anger expression could be very useful for designing the H1C.

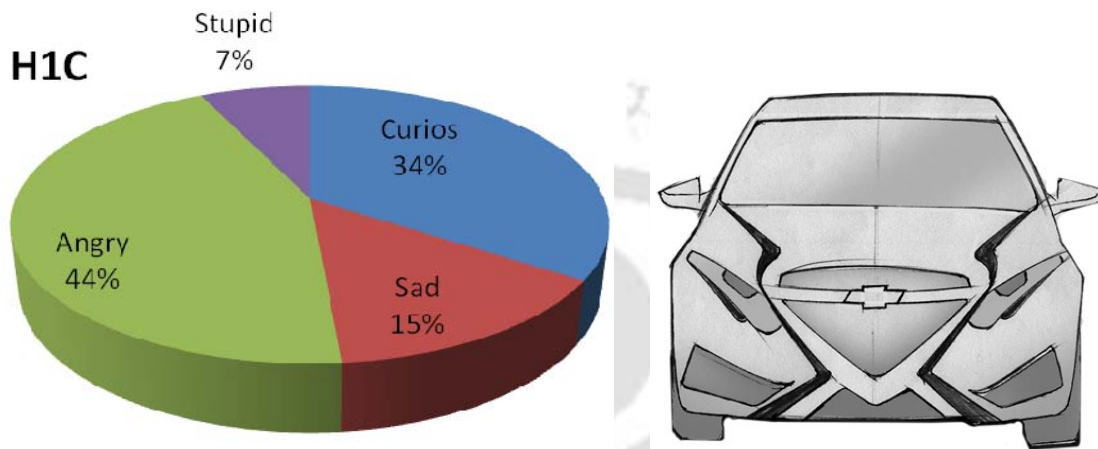


Figure V5.47: Stastics of car face H1C (n=70)

In car face H3C, 79 percent of respondents selected car face H3C as the ‘Angry’ car. It implied that the using heuristic set of anger expression could be very useful for designing the H3C.

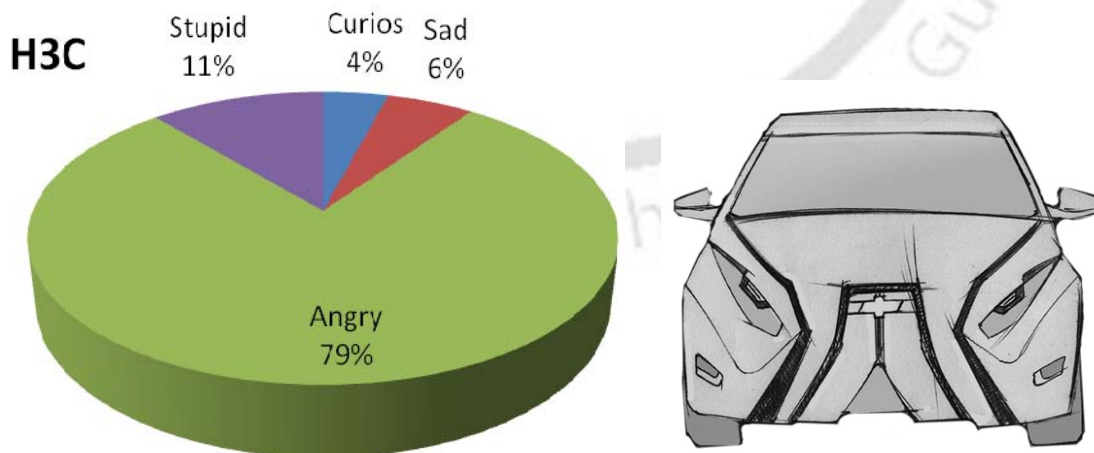


Figure V5.48: Stastics of car face H3C (n=70)

In front face of MFC, 46 percent of respondents selected the front face of MFC as the 'Angry' car. It implied that the using bio-design method could be very useful for designing the front face of MFC.

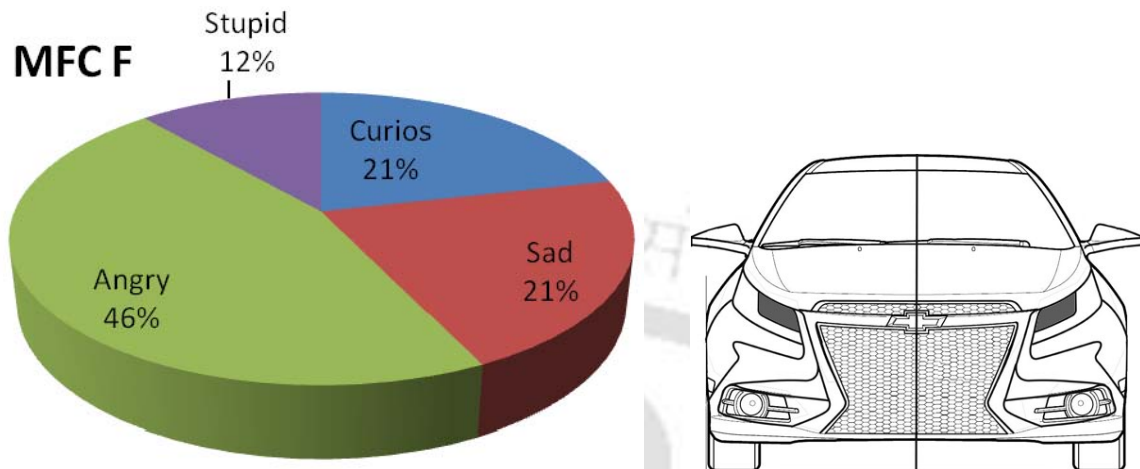


Figure V5.49: Statics of car face MFC (n=70)

In back face of MFC, 36 percent of respondents selected the back face of MFC as the 'Curious' car and then the second most popular selection that is 28 percent of them called it the 'Angry' car . It implied that the use of bio-design method could be very useful for designing the back face of MFC.

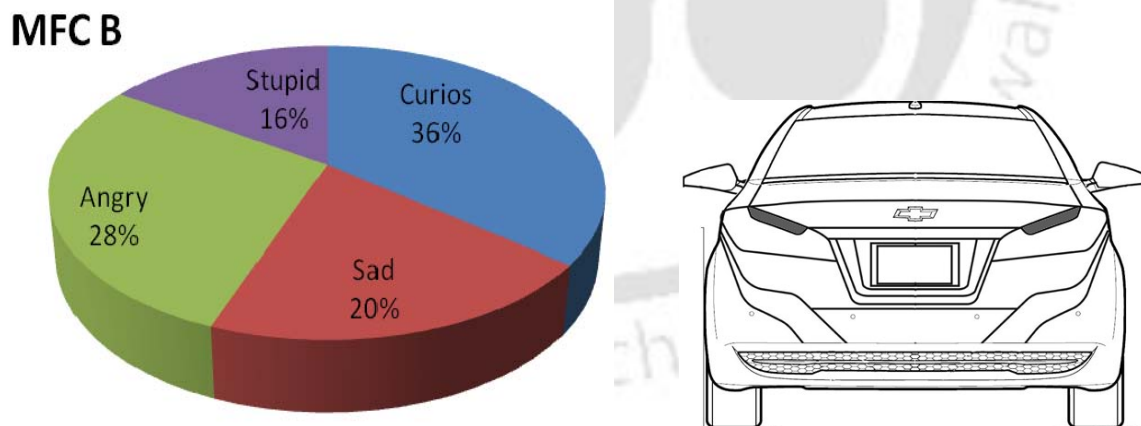


Figure V5.50: Statics of back face MFC (n=70)

V5.8 Conclusion

After these two attempts at design based on heuristic set and Bio-design method one can state that both the approaches were valid as an answer to the following enquiries -.

'Can designers use these Bio-design methods or heuristic set to design for two brands with different identities?'

In this test the researcher used heuristic set method and Bio-design method respectively and found them helpful for generating car concepts for the two brands Chevrolet and BMW without any difficulty. However, as a researcher one may also note that sometimes designer cannot fix the identity of companies with heuristic set and Bio-design method as some of these companies also have their signature expression fixed on their identity. Here if an emotional expression (identified with a company) is contrary to the user's emotional need then there may arise contradictions.

Now *'Can a design method or a set of heuristics be developed using which Designers from a particular culture can incorporate the most relevant feelings and aspirations into the design of the car?'* The answer derived post experimentation led to affirmative results and confirmed that Bio-design method is valid for all cultures while heuristic sets were valid only for the Indian and Iranian cultures.

Again on whether *'such design method or heuristic set can also be used by designers belonging to different cultures for designing for users of another culture/ nationality/ foreign market?'* The answer derived was again affirmative as it was confirmed that designers from a specific culture can use Bio-design method and heuristic sets for both Indian and Iranian cultures.

'In the context of a semantic framework the meaning is derived from signified to sign. Alternatively, can designers approach form, using a bio-design method then draw meaningful form from nature (as a signified) and use it in designing a product (as a sign)?' Here two possibilities may emerge. As in case of the question whether designers can use Bio-design method to extract ideas from nature and put it in the product, the answer is 'yes' in case the source of ideas is clear to the users. And the answer is 'No', if the source of ideas is not clear for user and the users have no clue about the source. Hence it may be summed up that the source of idea should be clear to the users for better understanding.

Chapter 6

Summary and Conclusion

This research set out to examine the creative process involved in the generation of visual form that aims to express, communicate and invoke in the user a certain desired emotional response. It has traversed and covered ground through a set of eight experiments that examine the different approaches, more often interlinked, that would enrich the designers understanding of the meaning and communication of visual form in the context of automobile design. Most part of this research has been done based on qualitative techniques using an online survey. Here five techniques were used in this research that were based on a semantic framework of analysis interlinking word, expression and emotional response that it invokes through the visual form of the automobile.

1. A study based on a historical review, tracking the developments in the automobile form amongst leading auto manufacturers in the world since 1885, gave an insight of the evolutionary trends in the transformation of the visual form of the automobile. The study also pointed towards the shift from functional considerations during the early 1900 towards the visual characteristics of the form of the automobile in the mid nineties. The emotional response of users to the automobile form seems to be drawn from the front face of the car and has been the focus of attention of designers for communication of expression over the last decade. This was examined through detailed study outlined in section 1a and 1b. In experiment 1a it was evident that the car face is a good location as compared to the other positions. This place has been identified as the best location for placing all the meanings and expressions in comparison to the other sides. The results of experiment 1b and 1c indicated that the face is more important than the sides. Also in chapter 2, *Figure 2.19* it is evident that users often look at the front face first before they look at the rear face of the automobile. Similarities are drawn to

ones experience of seeing the car face to that of human face. The two do not differ much in this regard. This observation led to the car face being selected as the primal position for the subsequent phase of the research, thereby narrowing down the focus and attention of the visual study for this thesis.

2. A number of studies have been examined of the evaluative processes involved in study of automobile forms. But they stop short of not being able to suggest the manner in which the designer could use such findings in the creative processes of evolving novel and visually expressive forms during the conceptual phase of product development. A comprehensive framework for analysis suggested by Nathan, Crilly, Maurice and Clarkson helps in outlining the different considerations in a comprehensive manner. This has formed the basis for the experiments conducted in this research. This research through the different experiments has attempted to bridge this shortcoming through evolving user response to the visual form of the automobile drawing from inter-relations of visual form, word and expression. Deducing at each stage correlations in the interpretation of meaning generation in response to visual form. This process of filtering out and deducing meaning and form has led to identifying elements of the visual language that form a heuristic key in generating concept drawings of automobile forms.
3. Approaches to study of the visual form of automobile as planned for this research are an outcome of examining approaches as referred in the literature review and include the following three broad approaches:
 - A) The constructivist approach which looks at the visual elements in the automobile form in terms of their syntactic elements viz. lines, planes, volumes, color and the inter-relationship between the play of these elements when they come together. Deductions from outcome of Experiment 1c reinforces that the automobile form, comprising of all the visual elements and their attributes, form the most important parameter and the foundation for product communication. Through this experiment it was confirmed that

beauty was more due to the harmonious relationships existing among the elements in an automobile form than the elements themselves (Federick 2007).

- B) Product Semantic as an approach formed a second school of thought that looked at product form as a medium of communication. Deriving theoretical framework from the domain of linguistics and semiotics, this research has adapted this framework to outline a set of experiments to study the automobile form. Visual analysis and product semantic approach form two distinct approaches in product analytics.
- C) A third school of thought shifted emphasis by examining the process of meaning creations not with a focus on the product, as much on the evaluation of emotional response of users to products in the creation of meaning, opening a set of research experiments in the domain of Design and Emotions.

The planning of studies anchored around users response was an outcome of the preliminary studies including:

1. A study of visual elements on automobiles through self evaluation of the automobile form from a historical perspective of evolution of the form.
2. A self evaluation study of a select set of 35 automobile forms based on visual analysis to identify the key visual elements that contribute to product expression;
3. Finally selecting the final set of 35 automobile car forms and seeking user response co-relating word, expression and form of automobile car forms vis-a-vs human facial expression and animal face expression.

Drawing from the above three domains: visual analysis; design semantics and emotional design, this research has focused on a combination of approaches including self-evaluation, user evaluation and expert opinion in generating the

heuristic set comprising the visual key for form generation. The techniques applied were qualitative in nature engaging end users response to the visual form of automobiles. The techniques for evaluation included Co-relation, RGT, Semantic Differential, relation techniques on car faces and animal faces through the different experiments conducted in an integrated manner. The survey was conducted online. The respondent opinion was filtered to include only those from two specific geographical locations – Iran and India. The objective was to get a sense of the cultural preference patterns of users based in these two countries and to compare similarities and differences in likes and dislikes.

4. In chapter 2, experiment 1a and experiment 1b, it is seen that the design of the ‘hatchback’¹ automobile evolved to reflect the culture and lifestyle of those times (*Figure 5.1a.11*). Here cultural factors have strongly influenced car designing. In experiment 1b it is seen that culture has a strong influence on emotional design and design semantic. It is seen that designers often search for cultural signification and influences that result in symbolic communication of product form. We can conclude that cultural factors can strongly influence car designing. It is also seen from the results of experiment 1c that respondents recognize form very well.

Based on a semantic framework as the point of reference, User response were sought to draw inter-relation between word and expression, and automobile form. The outcome of these experiments formed the basis for the next set of experiments also conducted through an on line survey to examine co-relations between human facial expression, word and automobile face expression on the one hand and on the other between animal face expression, word and automobile face expression.

¹ Experiment 1a presented ‘The design of hatchback has been done to facilitate the culture of traveling. Quantity of luggage always differed with reference to cultures. Cultural traveling is very important part in personal car design’

In experiment 3a and experiment 3b subjects found resemblance between car face and that with animal faces very easily. This ability of the users resulted in the identification of Bio-design method as a means for identification and resolving aesthetic need in automobile design for different cultures.

The outcome of Experiment 2a, experiment 2b, experiment 3a, experiment 3b and experiment 4 has resulted in deriving the visual key for the following expressions: happy (*Figure V5.2*), sad (*Figure V5.4*), serious (*Figure V5.6*), anger (*Figure V5.8*), danger (*Figure V5.10*), surprise (*Figure V5.12*), disgust (*Figure V5.14*) and curios (*Figure V5.16*). Through such an experiment an attempt has been made to comprehensively extract and identify those visual keys, through the manipulation of which the designer is able to achieve a desired expression for the visual form of the automobile. Through experiment 4 it was also evident that graphical representation of car faces could arouse in the respondents the same emotional 'word' response in spite of the respondents being located in two different cultures. This has resulted in suggesting an approach for deriving a set of heuristics that constitute the 'visual key' using which Designers from a particular culture can incorporate a visual personality that can capture the most relevant feelings and aspirations into the automobile form.

5. In experiment 2b and experiment 4 it is seen that one wrong word used as a signifier (Ford model 'Pinto'¹) or one form used as a signified (experiment 1a , *Figure 5.1a.11*, Ford model Streetka 2003 ²) can result in a negative impact on the marketing of the car. This suggests that users have special emotional needs and desires in the different cultures. This cultural influence affects the user's market.

6. As can be seen from the results of co-relational analysis (experiment 2b and experiment 4) exciting insights can be drawn to know the similarities and

¹ In different cultures word can represent different form and this difference can be effective. For example, Ford model "Pinto" in Portuguese language has meaning of small penis and because of that this model of Ford reduces attractiveness for men (Tomkins, 1999).

² When Streetka was launched, Ford claimed that 80% of the buying public would be female. In 2003, 1% of men bought this car. It showed the form of this car was feminine and men did not like this form.

differences in perceptions that are influenced by culture specific tastes, likes and understanding. Such clarity in understanding cultural parameters may help designers to make intelligent choices in designing global products that meet specific needs of the local contexts. It reaffirms that although 'Global markets' may reflect a business perspective of opportunities to do business across different geographical location, the act of designing must take into consideration a holistic perspective of all design parameters including cultural and emotional which are specific to the 'region'. Designers in the conceptualization and generation of product forms must examine and understand those visual parameters that are influenced by the regional/cultural/emotional considerations of the user segment. Product form must factor in parameters influenced by the culture in which it must exist if it to be accepted leading to a business success. The relevance of this can be an important shift in approaches to automobile form generations for designers working in multinational automobile manufacturing firms.

7. In Section 3, Attempt was made to use the visual keys derived from the experiments and these were applied in the conceptualization of the automobile for two car manufacturers Chevrolet and BMW. The results of this attempt at validation were found helpful for car designers. It was also seen that a designer, not of Indian nationality, could also design for Indian users. It can be concluded that designers in one culture can use heuristics guidelines to design in another cultural context quite successfully with such an understanding and insight.
8. Further it was confirmed that Bio-design method offers an exciting direction for car designing. In the context of a semantic framework it can be summarized that when the source of the idea from nature is known to the users, designers can approach product form generation using bio-design method viz. drawing meaningful forms from nature ('signified') and using it while designing the automobile form ('sign'). Should the source be unknown, this method may fail. This is also reflected in the outcome of form generation attempted in section 3. Hence it may be summed up that designers should draw inspiration from sources

that are familiar to the context of the user. This will result in better acceptance of the automobile form.

9. It is also seen that sometimes designers can fail in their attempt to establish the identities of companies using visual keys comprising the heuristic set and the Bio-design method. This may be primarily because some companies have a distinct emotional expression that has been consistent and one that has evolved over time. This identity cannot be compromised. In this case problems would arise if the emotional expression (identity of the company) contrasted with the of user's emotional need. It may therefore be pertinent for the designer to maintain continuity of form language consistent with that followed by the company and not deviate by making any drastic deviations in the language of visual form.

6.1 Contribution of the thesis

Reflecting on the contributions of this research in approaches to form generation of automobile design, it is significant to note that it outlines an approach that draws upon understanding users' deep inherent perceptions and emotional desires of the aesthetic elements of the external form of the automobile. It bridges the gap in enriching the designer understanding of users aspiration and enabling making intelligent decisions in translating these aspirations into tangible form of the automobile through identification and generation of visual keys comprising of visual elements. The thesis has been able to demonstrate an approach (that focuses on the creative half of form generation) of how to derive and identify those syntactic visual elements that constitute a 'visual key' that can be used in the generation of distinct emotional expression of the face of the automobile. With these heuristic sets of 'visual keys' designers can conceptualize automobile form to achieve distinct expressive forms that can meet users aspirations.

It further identifies specific cultural context of use that influence the choice and preference for the visual form of the automobile by making a comparative analysis of user response belonging to two different cultural environment of product use - Iranian

and Indian. In the process it derives 'visual' directions for the automobile design style that may be acceptable to that specific cultural environment of use. This thesis identifies cultural parameter to be an important consideration in design methods.

As is commonly accepted this thesis reaffirms that 'holistic' form consideration in an automobile is important. Designers must look at the interrelationship between the various visual elements in a harmonious manner to achieve an aesthetic, pleasing and expressive form of the automobile. Further it derives from user response that in terms of hierarchy of position, the car face is the most important position for placing meaning and expression of the car.

This thesis identifies Bio-design method for helping designers derive inspiration from nature, as it is a common belief that all the emotional expressions that a designer uses in design semantics is derived from nature. The heuristic set derived from qualitative users' data obtained from Indian and Iranian respondents indicate that people belonging to both the cultures find resemblance between the emotional expressions of car samples with animal expression.

6.2 Limitation of this research study

This design research has focused on evolving an approach to generate the visual attributes of automobile form. Being located in the visual domain of product form, the techniques used for assessment has been a combination of self evaluation; deriving insights by seeking expert opinion; and qualitative assessment of user response through an online enquiry of the 'visual' domain of product form using a selected set of photo-images. This approach, although indicative may have certain limitations and bearing on the planning of the different experiments conducted for this research. The summary of finding at best gives indicative pointers. Comparative study of emotional response of automobile form in three dimensions is the prevalent practice amongst leading manufacturers by displaying their new concept cars in an auto-fair. Such an approach results in specific evaluation of that specific model put on display. However a similar

exercise to derive users emotional response to the visual form of the automobiles is impossible to conduct both in terms of the numbers of vehicle styles to be assessed as also the time and cost involved, making it logically impractical.

In this research five techniques were used to assess the user response to visual form of the automobile. However there may have been some other techniques, which could have been useful for comparative study and the results in terms of gathering experiential data may have been better. Further, the formulation of the questions was bilingual – in Iranian and English. This may have resulted in the visual character of the questionnaire appearing somewhat unfamiliar to the respondents located in Iran and in India. Would this have affected the response to the different questions? It is difficult to assess.

Further, the sample size of response (126 in number) at best could give a qualitative response, further hampered by the fact that most respondents (nearly 95%) were in the younger age group of 18-30 years. The results therefore can best be representational for this age group only and not necessarily pan-national. There are also limitations imposed when such a study is done using the online mode of data collection. For example in the online survey conducted for this research the responses received may have led to exclusion of older people who may not be comfortable to participate in an online survey.

This research was limited to the study of two cultural context of use - Indian and Iranian. Cross-cultural data collection conducted across various cultures, brings better understanding about cultural issues involved with data collection. Also there is certain limitation in the process of data collection, especially online data collection, in such a context.

6.3 Closing remarks and scope for further research

The findings of this research are based on a semantic framework for a study of product communication in expression of car forms. The outcome has resulted in deriving a set of visual keys as heuristic guidelines that designers could use in the generation of car forms.

This has immediate implications for its relevance for the near future. With special reference to trends drawn from the domains of technology, social, economic transportation design, car forms are likely to undergo exciting new developments in the near future. Keeping a tab on these trends, one is capable of predicting that the most probable change could be brought about with combination of changeable forms, changeable parts, moveable parts and interaction faces.

In near future designer can use common meaning and sign between cultures for creating global design. For instance in this thesis we found a heuristic set of emotional expressions for both Iranian and Indian cultures that creates ground for designing cars with common elements. Therefore designer can solve the problem of different meanings and fulfill the needs of these cultures using a common heuristic set on designing.

But in distant future designer can collect meaningful signs for developing different heuristic set for each culture. It also means designer do not need to search for similar signs between cultures and should pay attention to those parts of the research that have not been used in the heuristic set. As cars are predicted to have a flexible body, this kind of body will be able to evolve different forms for covering the user's emotional need. The cars will increasingly have intelligence built into them in a central computer. Designer may be expected to set up software's with which users can see different faces of the car on their display/control screen as a menu. The users can select one of them and with the aid of a hydraulic system can change the form of car based on their likes and dislikes. The computer can also propose a special form that can be designed to suit the user's culture.

These changes will have sociological affects' and will influence and demand new tools and methods for designing in general and design research in particular. New method and new tools will evolve to meet these challenges and offer directions for research in the near future.

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Appendix

Appendix 1:

List of cars that used in research. (first questionnaire)

Code	Year	Company	Model	URL
9L	1982	Mitsubishi	Pajero LF	http://www.mitsubishi-motors.com/
9R	1982	Mitsubishi	Pajero LF	http://www.mitsubishi-motors.com/
10L	2007	Toyota	Camry LE	http://www.toyota.co.jp/en/index.html
10R	2007	Toyota	Camry LE	http://www.toyota.co.jp/en/index.html
11R	2007	Toyota	Camry LE	http://www.toyota.co.jp/en/index.html
12L	2005	Mitsubishi	i	http://www.mitsubishi-motors.com/
12R	2005	Mitsubishi	i	http://www.mitsubishi-motors.com/
13L	2007	TATA	INDIVIA	http://www.tatamotors.com/
13R	2007	Jeep	Wrangler	http://www.jeep.com/en/
14L	2007	Mahindra	AXE	http://www.mahindra.com/
14R	2000	Mitsubishi	Pajero SWB	http://www.mitsubishi-motors.com/
15L	2001	KIA	Pride - Saba	http://www.saipacorp.com
15R	2001	KIA	Pride - Saba GLXi	http://www.saipacorp.com
16L	2007	Army car	Sepehr	http://www.ro-defa.ir/
16R	2005	Suzuki	Jimny Suv	http://www.globalsuzuki.com/
18L	2008	TOYOTA	Prado	http://www.toyota.co.jp/en/index.html
18R	2008	TOYOTA	Prado	http://www.toyota.co.jp/en/index.html
19L	2000	Daewoo	Matiz M150	http://www.gmdaewoo.co.kr/
19R	2005	Chevrolet	Matiz M200	http://www.chevrolet.com/

List of cars that used in research. (Second questionnaire)

Code	Year	Company	Model	URL
D1	2003	Volkswagen	New Beetle	http://www.volkswagen.com/
D2	2007	Toyota	FT-HS hybrid sports concept	http://www.toyota.co.jp/en/index.html
D3	2010	Acura	ZDX four-door sports coupe	http://www.acura.com/
D4	2011	Mini	Countryman	http://www.mini.com/
D5	2009	Bugatti	Veyron Fbg par Hermès	http://www.bugatti.com/
F1	2009	Lexus	LF-Ch Concept	http://www.lexus.com/
F2	2006	Mazda	Nagare Concept	http://www.mazda.com/
F3	2008	SEAT	Leon Ecomotive	http://www.seat.com/
F4	2008	Lexus	LF-A Roadster Concept	http://www.lexus.com/
F5	2001	Mercury	Cougar Zn	http://www.mercuryvehicles.com/
G1	2010	Wiesmann	Roadster MF5	http://www.wiesmann.com/
G2	2010	Mercedes-Benz	GLK	http://www.mercedes-benz.com/
G3	2009	Mitsubishi	i MiEV Sport Air Concept	http://www.mitsubishi.com/
G4	2004	Dodge	Sling shot	http://www.dodge.com/en/
G5	2008	TATA	Nano	http://www.tatamotors.com/
H1	2008	Jaguar	S-TYPE	http://www.jaguar.com/
H2	2004	Jaguar	S-Type	http://www.jaguar.com/
H3	2009	Toyota	Urban Cruiser	http://www.toyota.co.jp/en/index.html
H4	2010	Toyota	iQ3	http://www.toyota.co.jp/en/index.html
H5	2011	Toyota	Auris HSD	http://www.toyota.co.jp/en/index.html
J1	2009	BMW	EfficientDynamics	http://www.bmw.com/
J2	2012	Opel	Ampera	http://www.opel.com/
J3	2008	BMW	M1	http://www.bmw.com/
J4	2011	Bentley	Mulsanne	http://www.bentleymotors.com/
J5	2010	Alfa Romeo	2uettottanta Concept	http://www.alfaromeo.com/
K1	2005	Smart	crosstown show car	http://www.smart.com
K2	2007	Renault	Kangoo Compact Concept	http://www.renault.com/
K3	2011	Audi	A1	http://www.audi.com
K4	2008	Peugeot	RC HYmotion4	http://www.peugeot.com/
K5	2009	Toyota	iQ	http://www.toyota.co.jp/en/index.html
L1	2009	Ferrari	California	http://www.ferrari.com/
L2	2007	Lotus	Hot Wheels	http://www.lexus.com/
L3	2007	Buick	Riviera	http://www.buick.com/
L4	2009	Bugatti	Galibier Concept	http://www.bugatti.com/
L5	2011	Mercedes-Benz	SLS AMG	http://www.mercedes-benz.com/

Appendix 2: First questionnaire that used in this research:

Questionnaire پرسشنامه

This questionnaire is a personal research for my PhD
این پرسشنامه به منظور جمع آوری اطلاعات برای یک پژوهش علمی طراحی شده است.

Point: Wait a minute for the pictures to complete before you start answering the questionnaire. If took longer press the refresh button. thank you.
نکته: در صورت استفاده از اینترنت کم سرعت اول از کامل شدن تصاویر اطمینان حاصل نمایید سپس به سوالات پرسشنامه پاسخ دهید. در صورت کامل نشدن تصاویر بر دکمه refresh بالای صفحه کلیک کنید. تا سبک

1-Age: 1-سن:
 18 years old until 35 - 18 سال تا 35
 35 years old until 50 - 35 سال تا 50
 50 years old until 65 - 50 سال تا 65

2-gender: 2-جنس:
 Male - مرد یا پسر
 Female - زن یا دختر

3-Education 3-سطح سواد:
 Under the Secondary school graduate - زیر دیپلم
 Secondary school graduate - دیپلم
 Bachelor's degree - لیسانس
 Master's degree - فوق لیسانس
 PhD - دکتری

4-Job 4-شغل:
 Designer - طراح
 Different jobs - سایر مشاغل

5-Nationality 5-ملیت:
 Indian - هندی
 Iranian - ایرانی
 Different nationalities - سایر ملل

Age, Gender, Nationality, Education and Job. Q1 till Q 8

9-Which car do you think conveys a sense of speed better than the other?
9-از بین دو خودرو زیر کدام حس سرعت را بهتر نشان می دهد؟







خودرو سفید با نقوش کنار بدنه
white car with pattern (motif)
 white car
خودرو سفید

Q9

10-Which car do you think conveys a sense of speed better than the other?
 10- از بین دو خودرو زیر کدام حس سرعت را بهتر نشان می دهد؟



silver car
 -خودرو نقره ای

white car
 -خودرو سفید

11-Which car do you think communicates a sense of femininity?
 11- از بین دو خودرو زیر کدام حس دخترانه بودن را بهتر نشان می دهد؟



white car
 -خودرو سفید

blue car
 -خودرو آبی

12-Which car do you think communicates a sense of femininity?
 12- از بین دو خودرو زیر کدام حس دخترانه بودن را بهتر نشان می دهد؟

Q10 and Q11

12-Which car do you think communicates a sense of femininity?
 12- از بین دو خودرو زیر کدام حس دخترانه بودن را بهتر نشان می دهد؟



pink car
 -خودرو صورتی

white car
 -خودرو سفید

13-Which car do you think conveys a sense of tenderness and softness better than the other?
 13- از بین دو خودرو زیر کدام حس نرمی و لطافت را بهتر نشان می دهد؟



blue car
 -خودرو آبی

olive car
 -خودرو زیتونی

14-Which car do you think conveys a sense of harshness and violence better than the other?
 14- از بین دو خودرو زیر کدام حس خشونت را بهتر نشان می دهد؟

Q12 and Q13

14- از بین دو خودرو زیر کدام حس خشونت را بهتر نشان می دهد؟
 14-Which car do you think conveys a sense of harshness and violence better than the other?



dark green car
 -خودرو سبز تیره-

white car
 -خودرو سفید-

15- از بین دو خودرو زیر کدام حس خشونت را بهتر نشان می دهد؟
 15-Which car do you think conveys a sense of harshness and violence better than the other?



the car with striped air ventilator
 -خودرو با هواکش دارای خطوط راه-

the car with horizontal air ventilator
 -خودرو با هواکش دارای خط افقی-

16- از بین دو خودرو زیر کدام حس نرمی را بهتر نشان می دهد؟

Q14 and Q15

16- از بین دو خودرو زیر کدام حس نرمی را بهتر نشان می دهد؟
 16-which car do you think conveys more sense of softness?



military car
 -خودرو نظامی-

silver car
 -خودرو نقره ای-

17- از بین دو خودرو زیر کدام حس تازه گی و نو بودن را بهتر نشان می دهد؟

17-Which car do you think conveys a sense of novelty and freshness better than the other?



dark green car
 -خودرو سبز مات-

glossy green car
 -خودرو سبز براق-

18- از بین دو خودرو زیر کدام حس سرعت را بهتر نشان می دهد؟
 18-Which car do you think conveys a sense of speed better than the other?

Q16 and Q17

18- از بین دو خودرو زیر کدام حس سرعت را بهتر نشان می دهد؟
 18-Which car do you think conveys a sense of speed better than the other?



- خودرو نقره ای با نقوش کنار بدنه
 silver car with pattern (motif)

- خودرو نقره ای
 silver car

19- از بین دو خودرو زیر کدام حس جدیت را بهتر نشان می دهد؟
 19-Which car do you think conveys a sense of seriousness better than the other?



- خودرو مسی
 copper car (red)

- خودرو نقره ای
 white car

you can click after answering on the Submit ,thank you.

Q18 and Q19

Appendix 3:Result of first questionnaire:

No	age	s.	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	IP	Time
n1	18 - 35	F	9R	10L	11L		13L	14L	15L	16R	17R	18L	19R	82.115.25.227	22-Oct-08
n2	18 - 35	F	9L	10L	11L	12L	13L	14L	15L	16R	17R	18L	19R	89.165.62.110	23-Oct-08
n3	18 - 35	F	9L	10L	11R	12L	13L	14L	15L	16R	17R	18L	19R	78.39.7.214	04-Nov-08
n4	18 - 35	F	9L	10L	11R	12L	13L	14L	15L	16R	17R	18L	19R	78.39.7.214	04-Nov-08
n5	18 - 35	F	9L	10L	11L	12L	13L	14L	15L	16R	17R	18L	19R	89.165.9.219	12-Nov-08
n6	18 - 35	F	9R	10L	11L	12L	13L	14L	15L	16R	17R	18R	19R	89.85.168.48	12-Nov-08
n7	18 - 35	F	9L	10L	11R	12L	13L	14L	15L	16R	17L	18R	19R	84.47.244.148	12-Nov-08
n8	18 - 35	F	9R	10L	11L	12L	13L	14L	15L	16R	17R	18L	19L	85.185.102.81	13-Nov-08
n9	18 - 35	F	9L	10L	11R	12L	13L	14L	15L	16R	17R	18L	19L	213.207.236.26	15-Nov-08
n10	18 - 35	F	9R	10L	11L	12L	13L	14L	15L	16R	17R	18L	19R	217.218.171.11	19-Nov-08
n11	18 - 35	F	9R	10R	11R	12L	13L	14L	15L	16R	17R	18R	19R	85.185.1.5	23-Nov-08
n12	18 - 35	F	9L	10L	11L	12L	13L	14L			17R			80.71.114.50	23-Nov-08
n13	18 - 35	F	9L	10L	11R	12L	13L	14L	15L	16R	17R	18L	19R	119.40.118.201	24-Nov-08
n14	35 - 50	F	9L	10L	11L	12L	13L	14L	15L	16R	17R	18L	19R	79.132.193.66	27-Nov-08
n15	18 - 35	F	9L	10L	11R	12L	13L	14L	15L	16R	17R	18L	19R	217.219.59.170	01-Jan-09
n16	18 - 35	F	9L	10L	11L	12L	13L	14L	15L	16R	17R	18L	19R	89.165.26.143	05-Jan-09
n17	18 - 35	F	9R	10L	11R	12L	13L	14L	15L	16R	17R	18L	19R	77.237.180.125	16-Jan-09
n18	18 - 35	F	9L	10R	11L	12L	13L	14L	15L	16R	17R	18R	19R	67.187.135.225	16-Jan-09
n19	18 - 35	F	9R	10L	11L	12R	13L	14L	15L	16R	17R	18R	19R	85.18.78.57	16-Jan-09

n20	18 - 35	F	9L	10L	11R	12L	13L	14L	15L	16R	17R	18L	19R	77.237.69.69	17-Jan-09
n21	18 - 35	F	9L	10L	11R	12L	13L	14L	15L	16R	17R	18L	19R	79.127.11.68	17-Jan-09
n22	18 - 35	F	9L	10L	11L	12L	13L	14L	15L	16R	17R	18L	19R	94.182.134.38	18-Jan-09
n23	35 - 50	F	9L	10L	11R	12L	13L	14L	15L	16R	17R	18L	19R	207.216.180.52	19-Jan-09
n24	18 - 35	F	9L	10L	11R	12L	13L	14L	15L	16R	17R	18L	19R	217.219.63.10	20-Jan-09
n25	18 - 35	F	9L	10L	11R	12L	13L	14L	15L	16R	17R	18L	19R	147.188.92.28	20-Jan-09
n26	18 - 35	M	9L	10L	11R	12L	13L	14L	15L	16R	17R	18L	19R	80.191.240.9	19-Oct-08
n27	18 - 35	M	9R	10R	11R	12L	13L	14L	15L	16R	17R	18L	19R	217.219.244.22	20-Oct-08
n28	18 - 35	M	9L	10L	11R	12L	13L	14L	15L	16R	17R	18L	19L	80.7.149.92	24-Oct-08
n29	18 - 35	M	9R	10L	11R	12L	13L	14L	15R	16R	17R	18R	19R	80.191.3.7	08-Nov-08
n30	18 - 35	M	9L	10L	11R	12L	13L	14L	15R	16L	17R	18L	19R	91.184.76.121	11-Nov-08
n31	18 - 35	M	9L	10L	11R	12L	13L	14L	15L	16R	17R	18L	19R	91.184.76.121	11-Nov-08
n32	18 - 35	M	9R	10R	11L	12L	13L	14L	15L	16R	17L	18L	19R	84.241.33.118	12-Nov-08
n33	18 - 35	M	9L	10L	11R	12L	13L	14L	15L	16R	17R	18L	19R	82.115.25.137	12-Nov-08
n34	18 - 35	M	9R	10R	11R	12L	13L	14L	15L	16R	17R	18L	19R	78.110.120.29	12-Nov-08
n35	18 - 35	M	9R	10L	11R	12L	13L	14L	15L	16R	17R	18L	19R	91.98.161.27	12-Nov-08
n36	18 - 35	M	9L	10L	11R	12L	13R	14R	15L	16R	17R	18L	19L	86.109.61.232	13-Nov-08
n37	35 - 50	M	9R		11R	12L	13L	14L	15L	16R	17R	18R	19R	194.225.239.11	15-Nov-08
n38	35 - 50	M	9L	10R	11R	12L	13L	14L	15L	16R	17L	18L	19R	194.225.237.31	15-Nov-08
n39	18 - 35	M	9L	10L	11R	12L	13L	14L	15L	16R	17R	18L	19R	78.158.166.48	15-Nov-08
n40	18 - 35	M	9L	10L	11R	12L	13L	14L	15L	16R	17R	18L	19R	217.218.55.108	16-Nov-08
n41	18 - 35	M	9L	10R	11R	12L	13L	14L	15L	16R	17R	18L	19L	80.253.153.2	17-Nov-08
n42	35 - 50	M	9L	10R	11R	12L	13L	14L	15L	16R	17R	18L	19R	93.110.6.98	22-Nov-08
n43	18 - 35	M	9L	10R	11L	12L	13L	14L	15L	16R	17R	18L	19R	81.90.145.64	22-Nov-08
n44	18 - 35	M	9L	10L	11R	12L	13L	14L	15L	16R	17R	18L	19R	194.225.234.20	29-Nov-08
n45	35 - 50	M	9L		11R	12L	13L	14L	15L	16R	17R	18L	19R	80.191.240.9	03-Dec-08
n46	18 - 35	M	9L	10L	11R	12L	13L	14L	15L	16R	17R	18R	19L	77.237.66.211	04-Dec-08
n47	35 - 50	M	9R	10R	11R	12L	13L	14L	15L	16R	17R	18R	19R	89.144.177.90	09-Dec-08
n48	35 - 50	M	9L	10L	11R	12L	13L	14L	15L	16R	17R	18L	19R	87.248.156.104	26-Dec-08
n49	35 - 50	M	9L	10L	11R	12R	13L	14L	15L	16R	17R	18L	19R	213.207.218.67	16-Jan-09
n50	18 - 35	M	9L	10R	11R	12L	13L	14L	15L	16R	17R	18L	19R	213.176.7.100	16-Jan-09
n51	18 - 35	M	9L	10R	11L	12L	13L	14L	15L	16R	17R	18L	19L	94.182.138.177	16-Jan-09
n52	18 - 35	M	9R	10R	11R	12L	13L	14L	15L	16R	17R	18R	19R	91.186.207.222	16-Jan-09
n53	18 - 35	M	9L	10L	11R	12L	13L	14L	15L	16R	17R	18L	19R	84.47.247.199	16-Jan-09
n54	18 - 35	M	9L	10L	11L	12L	13L	14L	15L	16R	17R	18L	19R	91.98.139.157	17-Jan-09
n55	18 - 35	M	9R	10L	11R	12L	13L	14L	15L	16R	17R	18L	19R	91.98.210.48	17-Jan-09
n56	18 - 35	M	9L	10L	11R	12L	13L	14L	15L	16R	17R	18L	19R	80.191.57.109	17-Jan-09
n57	18 - 35	M	9L	10L	11R	12L	13L	14L	15L	16R	17R	18L	19R	80.191.57.109	17-Jan-09
n58	18 - 35	M	9L	10L	11R	12L	13L	14L	15L	16R	17R	18L	19R	213.217.34.166	17-Jan-09
n59	35 - 50	M	9L	10R	11R	12L	13L	14L	15L	16R	17R	18L	19R	80.75.2.146	17-Jan-09
n60	18 - 35	M	9L	10L	11R	12L	13L	14L	15L	16R	17R	18L	19R	217.11.21.200	17-Jan-09
n61	35 - 50	M	9R	10L	11L	12L	13L	14L	15L	16R	17L	18L	19R	86.96.227.86	18-Jan-09
n62	18 - 35	M	9L	10L	11R	12L	13L	14L	15L	16L	17L	18R	19R	212.120.196.178	18-Jan-09
n63	18 - 35	M	9R	10L	11L	12L	13L	14L	15L	16R	17R	18L	19R	213.217.34.166	20-Jan-09
n64		M	9L	10L	11R	12L	13L	14L	15L	16R	17R	18L	19R	85.185.229.4	04-Feb-09
n65	35 - 50	M	9L	10R	11R	12L	13L	14L	15L	16R	17R	18L	19R	217.218.110.179	07-Mar-09

Appendix 4: Second questionnaire that used in this research:



The screenshot shows a web browser window displaying the homepage of the Indian Institute of Technology Guwahati, Department of Design. The page features the institute's logo at the top center, which is a circular emblem with three stylized human figures in red, yellow, and blue. Below the logo, the text reads "Indian Institute of Technology Guwahati" and "Department of Design". The contact information for the department is listed as "Responsible: Mohsen Jaafaria" and "e-mail: mohsen@itg.ernet.in".

The main heading of the questionnaire is "Puzzle Questionnaire" in English and Persian. The Persian text reads "بررسنامه به شکل بازی و پازل". Below this, there is a brief description in both languages: "This questionnaire is a research on emotional design area for car design." and "این پرسشنامه به منظور جمع آوری اطلاعات برای یک پژوهش علمی در زمینه طراحی احساس گرا برای خودرو تهیه شده است." A prominent instruction in pink text states: "please do not use scroll bar of mouse in this questionnaire instead of it you can use scroll bar for windows." This instruction is repeated in Persian: "لطفا در این پرسشنامه از اسکرول بار موس برای بالا و پایین رفتن در صفحه استفاده نکنید. بجای آن از اسکرول بار صفحه ویندوز استفاده نمایید." At the bottom of the page, there is a "Next" button with a right-pointing arrow.

Introduction



The screenshot shows a web browser window displaying a questionnaire form titled "Age, Gender, Nationality & Job". The form is divided into four numbered sections:

- 1** Age: A dropdown menu is set to "14 years old". The Persian label "سن:" is visible.
- 2** Gender: A dropdown menu is set to "Female". The Persian label "جنس:" is visible.
- 3** Nationality: A dropdown menu is set to "American". The Persian label "ملیت:" is visible.
- 4** Job: A text input field with the placeholder "write your job very short". The Persian label "شغل:" is visible.

Age, Gender, Nationality and Job

Example for helping pay attention مثال کمکی با توجه زیاد بررسی شود

1- کدام یک از اشکال سبز دارای **تشابه بسیار زیاد** است با **شکل قرمز**؟
پس به آن شکل **نمره 5** را دادیم.

2- کدام یک از اشکال سبز دارای **تشابه کمتر** است با **شکل قرمز**؟
پس به آن شکل **نمره 4** را دادیم.

3- کدام یک از اشکال سبز هیچگونه تشابهی با **شکل قرمز و دایره قرمز** ندارد؟
پس به آن شکل **نمره 3** را دادیم.

4- کدام یک از اشکال سبز دارای **تشابه کمتر** است با **شکل قرمز**؟
پس به آن شکل **نمره 2** را دادیم.

5- کدام یک از اشکال سبز دارای **تشابه بسیار زیاد** است با **شکل قرمز**؟
پس به آن شکل **نمره 1** را دادیم.

Help

Test تست

1- Between pictures , each one has **high similarity** to the picture **A** ?
give it **5 marks**.

2- Between pictures , each one has **low similarity** to the picture **B** ?
give it **4 marks**.

3- If between pictures , each one has **no similarity** to the picture **A & B** ?
give it **3 marks**.

4- Between pictures , each one has **low similarity** to the picture **B** ?
give it **2 marks**.

5- Between pictures , each one has **high similarity** to the picture **B** ?
give it **1 mark**.

1- کدام یک از اشکال سبز دارای **تشابه بسیار زیاد** است با تصویر **A** ؟
به آن شکل **نمره 5** را بدهید.

2- کدام یک از اشکال سبز دارای **تشابه کمتر** است با تصویر **B** ؟
به آن شکل **نمره 4** را بدهید.

3- کدام یک از اشکال سبز هیچگونه تشابهی با تصویر **A** و **B** ندارد؟
به آن شکل **نمره 3** را بدهید.

4- کدام یک از اشکال سبز دارای **تشابه کمتر** است با تصویر **B** ؟
به آن شکل **نمره 2** را بدهید.

5- کدام یک از اشکال سبز دارای **تشابه بسیار زیاد** است با تصویر **B** ؟
به آن شکل **نمره 1** را بدهید.

Test

New Page 2 - Windows Internet Explorer

http://www.iraniandesign.com/new_page_7.asp

Question 2

A



Between cars, each one has **high similarity** to the picture **A**?
give it **5 marks**.


Between cars, each one has **low similarity** to the picture **A**?
give it **4 marks**.

If between cars, each one has **no similarity** to the picture **A & B**?
give it **3 marks**.

Between cars, each one has **low similarity** to the picture **B**?
give it **2 marks**.

Between cars, each one has **high similarity** to the picture **B**?
give it **1 mark**.

B







کدام یک از خودروها دارای **تشابه بسیار زیاد** است با تصویر **A**?
به آن خودرو **نمره 5** را بدهید.




کدام یک از خودروها دارای **تشابه کمتر** است با تصویر **A**?
به آن خودرو **نمره 4** را بدهید.

کدام یک از خودروها هیچگونه تشابهی با تصویر **A** ندارند؟
به آن خودرو **نمره 3** را بدهید.

کدام یک از خودروها دارای **تشابه کمتر** است با تصویر **B**?
به آن خودرو **نمره 2** را بدهید.

کدام یک از خودروها دارای **تشابه بسیار زیاد** است با تصویر **B**?
به آن خودرو **نمره 1** را بدهید.

Done


Q2

New Page 2 - Windows Internet Explorer

http://www.iraniandesign.com/new_page_7.asp

Question 2

A



Between cars, each one has **high similarity** to the picture **A**?
give it **5 marks**.


Between cars, each one has **low similarity** to the picture **A**?
give it **4 marks**.

If between cars, each one has **no similarity** to the picture **A & B**?
give it **3 marks**.

Between cars, each one has **low similarity** to the picture **B**?
give it **2 marks**.

Between cars, each one has **high similarity** to the picture **B**?
give it **1 mark**.

B






کدام یک از خودروها دارای **تشابه بسیار زیاد** است با تصویر **A**?
به آن خودرو **نمره 5** را بدهید.



کدام یک از خودروها دارای **تشابه کمتر** است با تصویر **A**?
به آن خودرو **نمره 4** را بدهید.

کدام یک از خودروها هیچگونه تشابهی با تصویر **A** ندارند؟
به آن خودرو **نمره 3** را بدهید.

کدام یک از خودروها دارای **تشابه کمتر** است با تصویر **B**?
به آن خودرو **نمره 2** را بدهید.

کدام یک از خودروها دارای **تشابه بسیار زیاد** است با تصویر **B**?
به آن خودرو **نمره 1** را بدهید.

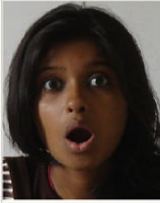

Done

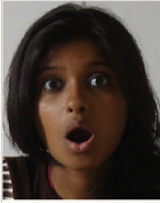
Q3

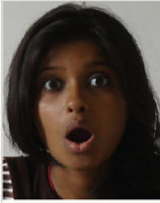
New Page 2 - Windows Internet Explorer
 http://www.iraniandesign.com/new_page_7.asp

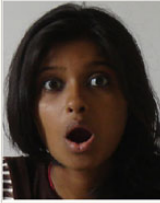
Question 4 پرسش 4

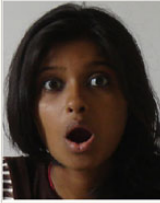
A

Between cars, each one has **high similarity** to the picture:  give it **5 marks**.


Between cars, each one has **low similarity** to the picture:  give it **4 marks**.


If between cars, each one has **no similarity** to the picture:  **A & B**? give it **3 marks**.


Between cars, each one has **low similarity** to the picture:  give it **2 marks**.


Between cars, each one has **high similarity** to the picture:  give it **1 mark**.


B





کدام یک از خودروها دارای **تشابه بسیار زیاد** است با تصویر  **A** را بدهید. **5** نمره




کدام یک از خودروها دارای **تشابه کمتر** است با تصویر  **A** را بدهید. **4** نمره

کدام یک از خودروها هیچگونه **تشابهی** با تصویر  **A** ندارد؟ **3** نمره را بدهید.

کدام یک از خودروها دارای **تشابه کمتر** است با تصویر  **B** را بدهید. **2** نمره

کدام یک از خودروها دارای **تشابه بسیار زیاد** است با تصویر  **B** را بدهید. **1** نمره


1 2 3 4 5


Q4


New Page 2 - Windows Internet Explorer
 http://www.iraniandesign.com/new_page_7.asp


Question 5 پرسش 5


A

Between cars, each one has **high similarity** to the picture:  give it **5 marks**.


Between cars, each one has **low similarity** to the picture:  give it **4 marks**.


If between cars, each one has **no similarity** to the picture:  **A & B**? give it **3 marks**.


Between cars, each one has **low similarity** to the picture:  give it **2 marks**.


Between cars, each one has **high similarity** to the picture:  give it **1 mark**.


B





کدام یک از خودروها دارای **تشابه بسیار زیاد** است با تصویر  **A** را بدهید. **5** نمره




کدام یک از خودروها دارای **تشابه کمتر** است با تصویر  **A** را بدهید. **4** نمره

کدام یک از خودروها هیچگونه **تشابهی** با تصویر  **A** ندارد؟ **3** نمره را بدهید.

کدام یک از خودروها دارای **تشابه کمتر** است با تصویر  **B** را بدهید. **2** نمره

کدام یک از خودروها دارای **تشابه بسیار زیاد** است با تصویر  **B** را بدهید. **1** نمره

1 2 3 4 5

Q5

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Question 6

A

Between cars, each one has **high similarity** to the picture **A**? give it **5 marks**.

Between cars, each one has **low similarity** to the picture **A**? give it **4 marks**.

If between cars, each one has no similarity to the picture **A & B**? give it **3 marks**.

Between cars, each one has **low similarity** to the picture **B**? give it **2 marks**.

Between cars, each one has **high similarity** to the picture **B**? give it **1 mark**.

B



کدام یک از خودروها دارای **تشابه بسیار زیاد** است با تصویر **A**? به آن خودرو **5** امتداد را بدهید.


کدام یک از خودروها دارای **تشابه کمتر** است با تصویر **A**? به آن خودرو **4** امتداد را بدهید.


کدام یک از خودروها **هیچگونه تشابهی** با تصویر **A و B** ندارند؟ به آن خودرو **3** امتداد را بدهید.

کدام یک از خودروها دارای **تشابه کم** است با تصویر **B**? به آن خودرو **2** امتداد را بدهید.

کدام یک از خودروها دارای **تشابه بسیار زیاد** است با تصویر **B**? به آن خودرو **1** امتداد را بدهید.







Done

Q6

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Question 7

A

Between cars, each one has **high similarity** to the picture **A**? give it **5 marks**.

Between cars, each one has **low similarity** to the picture **A**? give it **4 marks**.

If between cars, each one has no similarity to the picture **A, B & C**? give it **3 marks**.

Between cars, each one has **low similarity** to the picture **B**? give it **2 marks**.

Between cars, each one has **high similarity** to the picture **B**? give it **1 mark**.

B





کدام یک از خودروها دارای **تشابه بسیار زیاد** است با تصویر **A**? به آن خودرو **5** امتداد را بدهید.




کدام یک از خودروها دارای **تشابه کمتر** است با تصویر **A**? به آن خودرو **4** امتداد را بدهید.

کدام یک از خودروها **هیچگونه تشابهی** با تصویر **A, B و C** ندارند؟ به آن خودرو **3** امتداد را بدهید.

کدام یک از خودروها دارای **تشابه کم** است با تصویر **B**? به آن خودرو **2** امتداد را بدهید.

کدام یک از خودروها دارای **تشابه بسیار زیاد** است با تصویر **B**? به آن خودرو **1** امتداد را بدهید.

Done


Q7

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Question 8

A



Between cars, each one has **high similarity** to the picture **A**?
give it **5 marks**.


Between cars, each one has **low similarity** to the picture **A**?
give it **4 marks**.

If between cars, each one has **no similarity** to the picture **A & B**?
give it **3 marks**.

Between cars, each one has **low similarity** to the picture **B**?
give it **2 marks**.

Between cars, each one has **high similarity** to the picture **B**?
give it **1 mark**.

B







- کدام یک از خودروها دارای **تشابه بسیار زیاد** است با تصویر **A**?
به آن خودرو **5 نمره** را بدهید.




- کدام یک از خودروها دارای **تشابه کمتر** است با تصویر **A**?
به آن خودرو **4 نمره** را بدهید.

- کدام یک از خودروها هیچگونه تشابه‌ای با تصویر **A** و **B** ندارند؟
به آن خودرو **3 نمره** را بدهید.

- کدام یک از خودروها دارای **تشابه کمتر** است با تصویر **B**?
به آن خودرو **2 نمره** را بدهید.

- کدام یک از خودروها دارای **تشابه بسیار زیاد** است با تصویر **B**?
به آن خودرو **1 نمره** را بدهید.

1 2 3 4 5


Q8

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Question 9

A



Between cars, each one has **high similarity** to the picture **A**?
give it **5 marks**.


Between cars, each one has **low similarity** to the picture **A**?
give it **4 marks**.

If between cars, each one has **no similarity** to the picture **A & B**?
give it **3 marks**.

Between cars, each one has **low similarity** to the picture **B**?
give it **2 marks**.

Between cars, each one has **high similarity** to the picture **B**?
give it **1 mark**.

B




- کدام یک از خودروها دارای **تشابه بسیار زیاد** است با تصویر **A**?
به آن خودرو **5 نمره** را بدهید.


- کدام یک از خودروها دارای **تشابه کمتر** است با تصویر **A**?
به آن خودرو **4 نمره** را بدهید.


- کدام یک از خودروها هیچگونه تشابه‌ای با تصویر **A** و **B** ندارند؟
به آن خودرو **3 نمره** را بدهید.


- کدام یک از خودروها دارای **تشابه کمتر** است با تصویر **B**?
به آن خودرو **2 نمره** را بدهید.

- کدام یک از خودروها دارای **تشابه بسیار زیاد** است با تصویر **B**?
به آن خودرو **1 نمره** را بدهید.








1 2 3 4 5

Q9

Question 10 پرسش 10

A



Between cars, each one has **high similarity** to the picture **1**?
give it **5 marks**.


Between cars, each one has **low similarity** to the picture **2**?
give it **4 marks**.

If between cars, each one has no similarity to the picture **A, B**?
give it **3 marks**.

Between cars, each one has **low similarity** to the picture **3**?
give it **2 marks**.

Between cars, each one has **high similarity** to the picture **4**?
give it **1 mark**.

B







گام یک از خودروها دارای **تشابه بسیار زیاد** است با تصویر **1**?
به آن خودرو **5** نمره را بدهید.




گام یک از خودروها دارای **تشابه کمتر** است با تصویر **2**?
به آن خودرو **4** نمره را بدهید.

گام یک از خودروها هیچگونه **تشابهی** با تصویر **A, B** ندارد؟
به آن خودرو **3** نمره را بدهید.

گام یک از خودروها دارای **تشابه کمتر** است با تصویر **3**?
به آن خودرو **2** نمره را بدهید.

گام یک از خودروها دارای **تشابه بسیار زیاد** است با تصویر **4**?
به آن خودرو **1** نمره را بدهید.






1 2 3 4 5

Q10

Question 11 پرسش 11

A



Between cars, each one has **high similarity** to the picture **1**?
give it **5 marks**.


Between cars, each one has **low similarity** to the picture **2**?
give it **4 marks**.

If between cars, each one has no similarity to the picture **A, B**?
give it **3 marks**.

Between cars, each one has **low similarity** to the picture **3**?
give it **2 marks**.

Between cars, each one has **high similarity** to the picture **4**?
give it **1 mark**.

B







گام یک از خودروها دارای **تشابه بسیار زیاد** است با تصویر **1**?
به آن خودرو **5** نمره را بدهید.




گام یک از خودروها دارای **تشابه کمتر** است با تصویر **2**?
به آن خودرو **4** نمره را بدهید.

گام یک از خودروها هیچگونه **تشابهی** با تصویر **A, B** ندارد؟
به آن خودرو **3** نمره را بدهید.

گام یک از خودروها دارای **تشابه کمتر** است با تصویر **3**?
به آن خودرو **2** نمره را بدهید.

گام یک از خودروها دارای **تشابه بسیار زیاد** است با تصویر **4**?
به آن خودرو **1** نمره را بدهید.

1 2 3 4 5


Q11

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Question 12 پرسش 12

A



Between cars, each one has **high similarity** to the picture: **4**?
give it **5** marks.


Between cars, each one has **low similarity** to the picture: **4**?
give it **4** marks.

If between cars, each one has **no similarity** to the picture: **A & B**?
give it **5** marks.

Between cars, each one has **low similarity** to the picture: **3**?
give it **2** marks.

Between cars, each one has **high similarity** to the picture: **3**?
give it **1** mark.

B







گدام یک از خودروها دارای **تشابه بسیار زیاد** است با تصویر **3**?
به آن خودرو **نمره 5** را بدهید.




گدام یک از خودروها دارای **تشابه کم** است با تصویر **4**?
به آن خودرو **نمره 4** را بدهید.

گدام یک از خودروها **هیچگونه تشابه** با تصویر **3** ندارند؟
به آن خودرو **نمره 3** را بدهید.

گدام یک از خودروها دارای **تشابه کم** است با تصویر **3**?
به آن خودرو **نمره 2** را بدهید.

گدام یک از خودروها دارای **تشابه بسیار زیاد** است با تصویر **3**?
به آن خودرو **نمره 1** را بدهید.

Done


Q12

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Question 13 پرسش 13

A



Between cars, each one has **high similarity** to the picture: **4**?
give it **5** marks.


Between cars, each one has **low similarity** to the picture: **4**?
give it **4** marks.

If between cars, each one has **no similarity** to the picture: **A & B**?
give it **5** marks.

Between cars, each one has **low similarity** to the picture: **3**?
give it **2** marks.

Between cars, each one has **high similarity** to the picture: **3**?
give it **1** mark.

B







گدام یک از خودروها دارای **تشابه بسیار زیاد** است با تصویر **3**?
به آن خودرو **نمره 5** را بدهید.




گدام یک از خودروها دارای **تشابه کم** است با تصویر **4**?
به آن خودرو **نمره 4** را بدهید.

گدام یک از خودروها **هیچگونه تشابه** با تصویر **3** ندارند؟
به آن خودرو **نمره 3** را بدهید.

گدام یک از خودروها دارای **تشابه کم** است با تصویر **3**?
به آن خودرو **نمره 2** را بدهید.

گدام یک از خودروها دارای **تشابه بسیار زیاد** است با تصویر **3**?
به آن خودرو **نمره 1** را بدهید.

Done


Q13

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Question 14 14 پرسش

A



Between cars, each one has **high similarity** to the picture **A**?
give it **5 marks**.


Between cars, each one has **low similarity** to the picture **A**?
give it **4 marks**.

If between cars, each one has **no similarity** to the picture **A & B**?
give it **3 marks**.

Between cars, each one has **low similarity** to the picture **B**?
give it **2 marks**.

Between cars, each one has **high similarity** to the picture **B**?
give it **1 mark**.

B







گام یک از خودروها دارای **تشابه بسیار زیاد** است با تصویر **A**.
به آن خودرو **نمره 5** را بدهید.




گام یک از خودروها دارای **تشابه کم** است با تصویر **A**.
به آن خودرو **نمره 4** را بدهید.

گام یک از خودروها هیچگونه **تشابهی** با تصویر **A & B** ندارند؟
به آن خودرو **نمره 3** را بدهید.

گام یک از خودروها دارای **تشابه کم** است با تصویر **B**.
به آن خودرو **نمره 2** را بدهید.

گام یک از خودروها دارای **تشابه بسیار زیاد** است با تصویر **B**.
به آن خودرو **نمره 1** را بدهید.

Done


Q14

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Question 15 15 پرسش

A



Between cars, each one has **high similarity** to the picture **A**?
give it **5 marks**.


Between cars, each one has **low similarity** to the picture **A**?
give it **4 marks**.

If between cars, each one has **no similarity** to the picture **A & B**?
give it **3 marks**.

Between cars, each one has **low similarity** to the picture **B**?
give it **2 marks**.

Between cars, each one has **high similarity** to the picture **B**?
give it **1 mark**.

B







گام یک از خودروها دارای **تشابه بسیار زیاد** است با تصویر **A**.
به آن خودرو **نمره 5** را بدهید.




گام یک از خودروها دارای **تشابه کم** است با تصویر **A**.
به آن خودرو **نمره 4** را بدهید.

گام یک از خودروها هیچگونه **تشابهی** با تصویر **A & B** ندارند؟
به آن خودرو **نمره 3** را بدهید.

گام یک از خودروها دارای **تشابه کم** است با تصویر **B**.
به آن خودرو **نمره 2** را بدهید.

گام یک از خودروها دارای **تشابه بسیار زیاد** است با تصویر **B**.
به آن خودرو **نمره 1** را بدهید.

Done

Q15


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Question 16

پرسش 16


A


Between cars, each one has **similarity** to the picture:  give it **3 marks**.


If between cars, each one has **no similarity** to the pictures: **A & B**? give it **2 marks**.


Between cars, each one has **similarity** to the picture:  give it **1 mark**.


B


گام یک از خودروها دارای **تشابه زیاد** است با تصویر:  به آن خودرو **نمره 3** را بدهید.


گام یک از خودروها هیچگونه تشابهی با تصویر:  ندارند؟ به آن خودرو **نمره 2** را بدهید.


گام یک از خودروها دارای **تشابه زیاد** است با تصویر:  به آن خودرو **نمره 1** را بدهید.


1


1


1


1


1
2
3

Q16


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Question 17

پرسش 17


A


Between cars, each one has **similarity** to the picture:  give it **3 marks**.


If between cars, each one has **no similarity** to the pictures: **A & B**? give it **2 marks**.


Between cars, each one has **similarity** to the picture:  give it **1 mark**.


B


گام یک از خودروها دارای **تشابه زیاد** است با تصویر:  به آن خودرو **نمره 3** را بدهید.


گام یک از خودروها هیچگونه تشابهی با تصویر:  ندارند؟ به آن خودرو **نمره 2** را بدهید.


گام یک از خودروها دارای **تشابه زیاد** است با تصویر:  به آن خودرو **نمره 1** را بدهید.


1


1


1


1
2
3


1

Q17

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Question 18 پرسش 18

A

Between cars, each one has **similarity** to the picture: **A?**
give it **3 marks**.

If between cars, each one has no similarity to the pictures **A & B?**
give it **2 marks**.




Between cars, each one has **similarity** to the picture: **B?**
give it **1 mark**.



B

کدام یک از خودروها دارای **تشابه زیاد** است با تصویر **A**؟
به آن خودرو **نمره 3** را بدهید.

کدام یک از خودروها هیچگونه **تشابهی** با تصویر **A** ندارد؟
به آن خودرو **نمره 2** را بدهید.

کدام یک از خودروها دارای **تشابه زیاد** است با تصویر **B**؟
به آن خودرو **نمره 1** را بدهید.

Done

Q18

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Question 19 پرسش 19

A

Between cars, each one has **similarity** to the picture: **A?**
give it **3 marks**.

If between cars, each one has no similarity to the pictures **A & B?**
give it **2 marks**.




Between cars, each one has **similarity** to the picture: **B?**
give it **1 mark**.



B

کدام یک از خودروها دارای **تشابه زیاد** است با تصویر **A**؟
به آن خودرو **نمره 3** را بدهید.

کدام یک از خودروها هیچگونه **تشابهی** با تصویر **A** ندارد؟
به آن خودرو **نمره 2** را بدهید.

کدام یک از خودروها دارای **تشابه زیاد** است با تصویر **B**؟
به آن خودرو **نمره 1** را بدهید.

Done

Q19

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Question 20 پرستش 20

A

Between cars, each one has **similarity** to the picture: **A**?
give it **3 marks**.

If between cars, each one has no similarity to the pictures: **A & B**?
give it **2 marks**.




Between cars, each one has **similarity** to the picture: **B**?
give it **1 mark**.



B

کدام یک از خودروها دارای **تشابه زیاد** است با تصویر **A**?
به آن خودرو **نمره 3** را بدهید.

کدام یک از خودروها هیچگونه تشابهی با تصویر **A** ندارد؟
به آن خودرو **نمره 2** را بدهید.

کدام یک از خودروها دارای **تشابه زیاد** است با تصویر **B**?
به آن خودرو **نمره 1** را بدهید.

Done

Q20

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Question 21 پرستش 21

A

Between cars, each one has **similarity** to the picture: **A**?
give it **3 marks**.

If between cars, each one has no similarity to the pictures: **A & B**?
give it **2 marks**.




Between cars, each one has **similarity** to the picture: **B**?
give it **1 mark**.



B

کدام یک از خودروها دارای **تشابه زیاد** است با تصویر **A**?
به آن خودرو **نمره 3** را بدهید.

کدام یک از خودروها هیچگونه تشابهی با تصویر **A** ندارد؟
به آن خودرو **نمره 2** را بدهید.

کدام یک از خودروها دارای **تشابه زیاد** است با تصویر **B**?
به آن خودرو **نمره 1** را بدهید.

Done

Q21

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Question 22 پرسش 22

A

Between cars, each one has **similarity** to the picture: **A**?
give it **3 marks**.

If between cars, each one has no similarity to the pictures **A & B**?
give it **2 marks**.




Between cars, each one has **similarity** to the picture: **B**?
give it **1 mark**.


B

کدام یک از خودروها دارای تشابه زیاد است با تصویر **A**?
به آن خودرو **3** نمره را بدهید.

کدام یک از خودروها هیچگونه تشابه‌ای با تصویر **A** و **B** ندارند؟
به آن خودرو **2** نمره را بدهید.

کدام یک از خودروها دارای تشابه زیاد است با تصویر **B**?
به آن خودرو **1** نمره را بدهید.




Done






Q22






New Page 2 - Windows Internet Explorer






http://www.arianadesign.com/new_page_7.asp




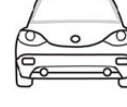

Question 23 پرسش 23

which one do you like? شما طرح کدام یک از خودروها را دوست دارید؟

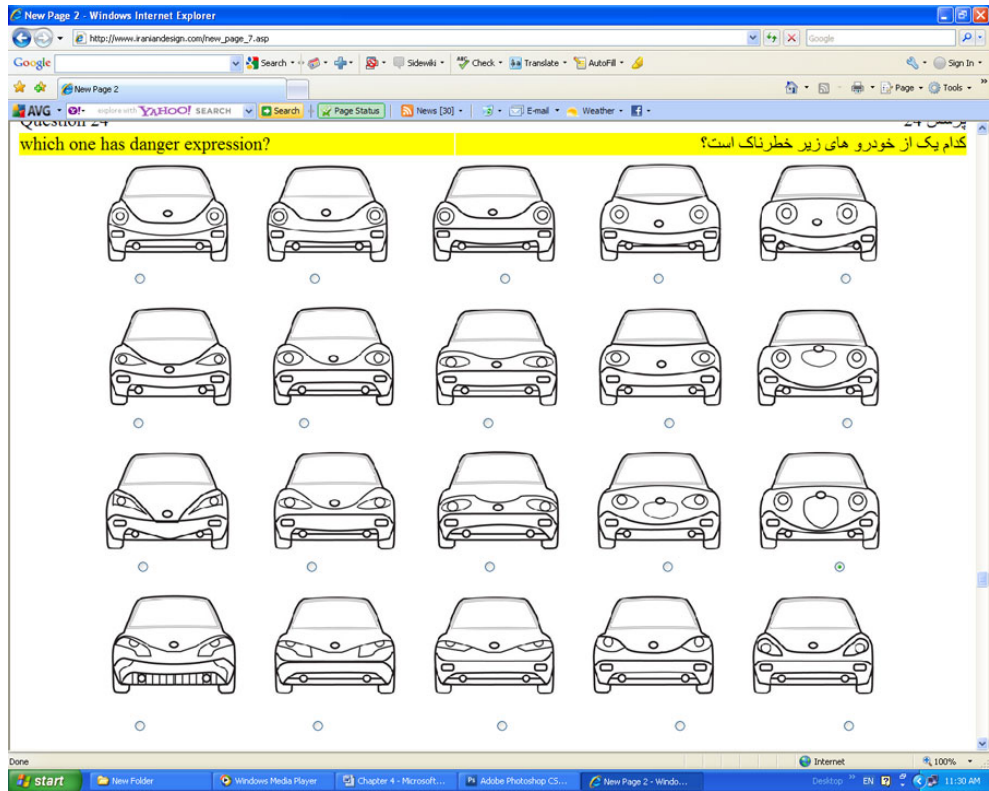






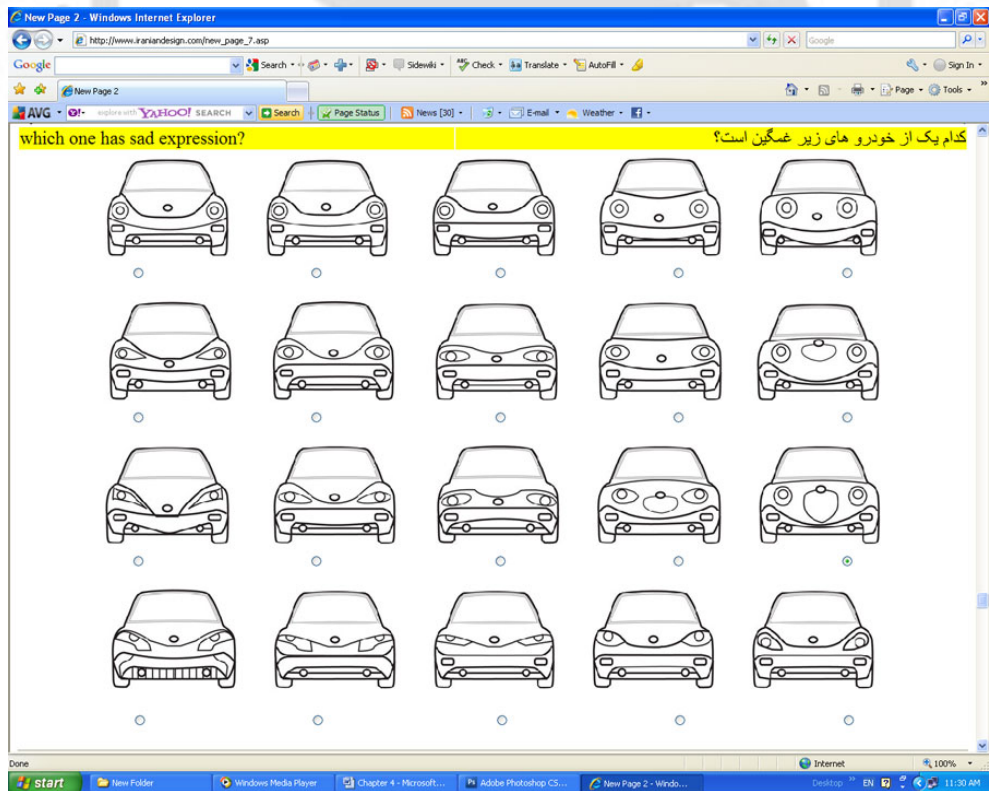






Done

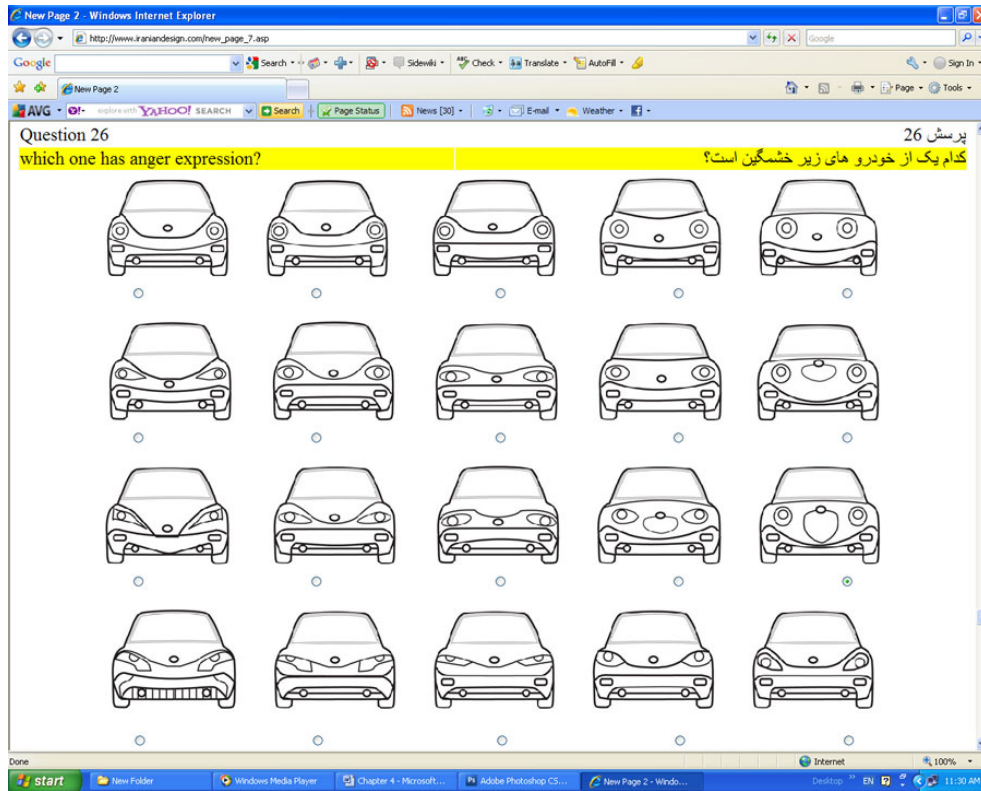
Q23



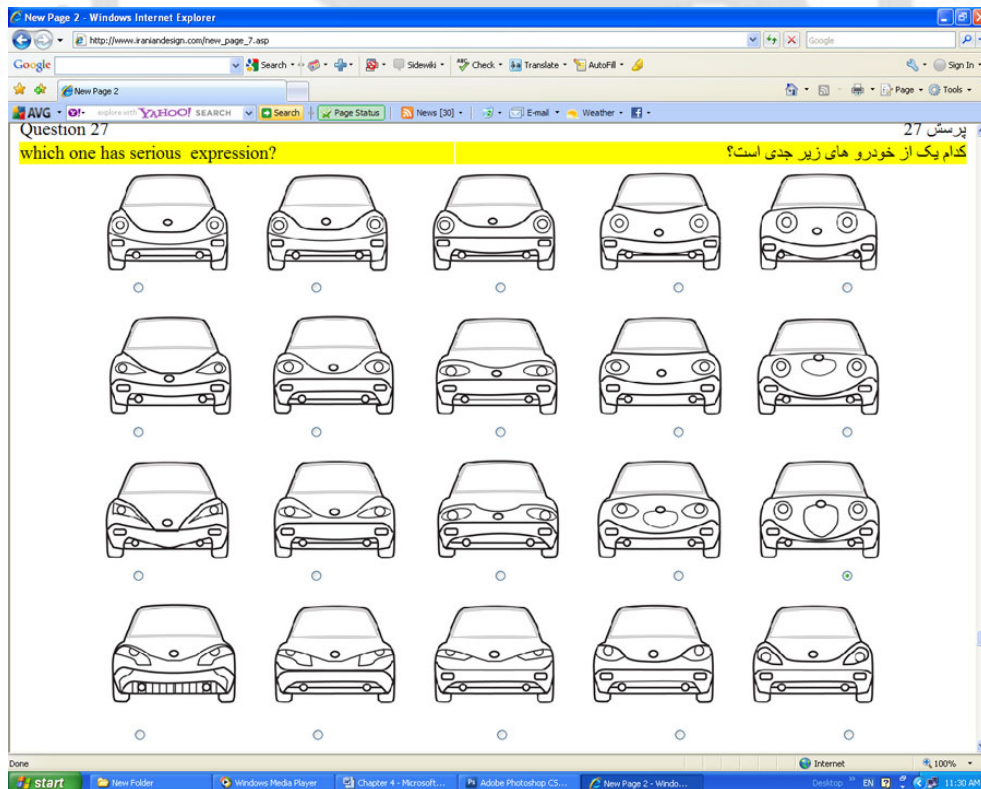
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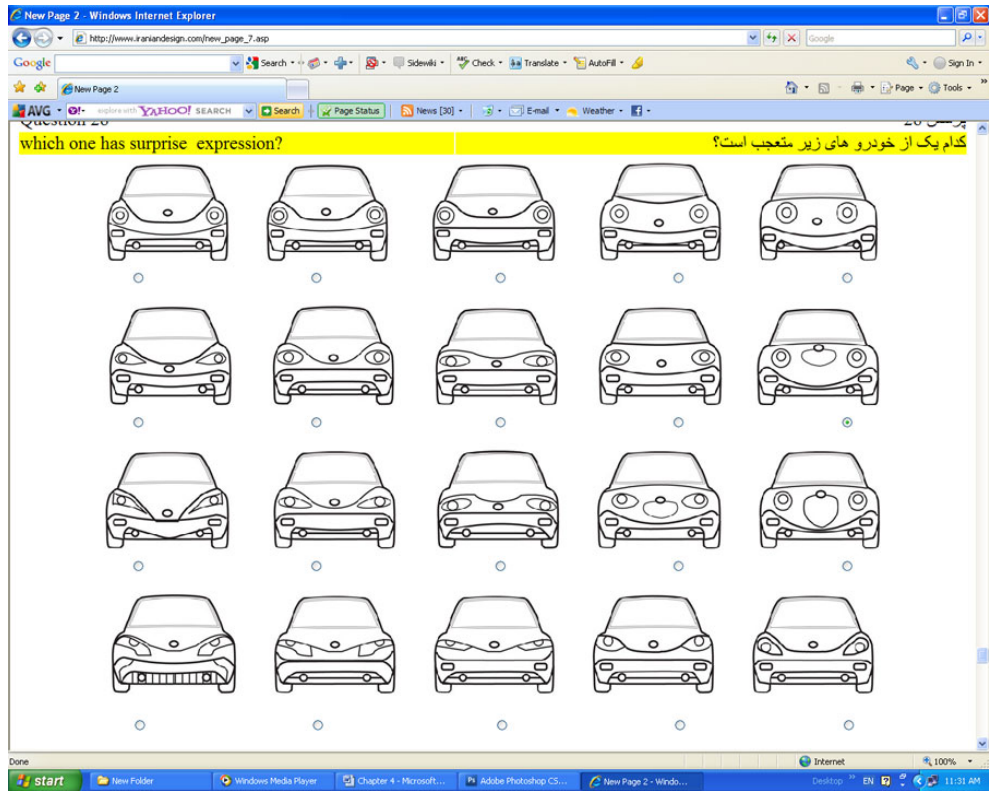
Q25



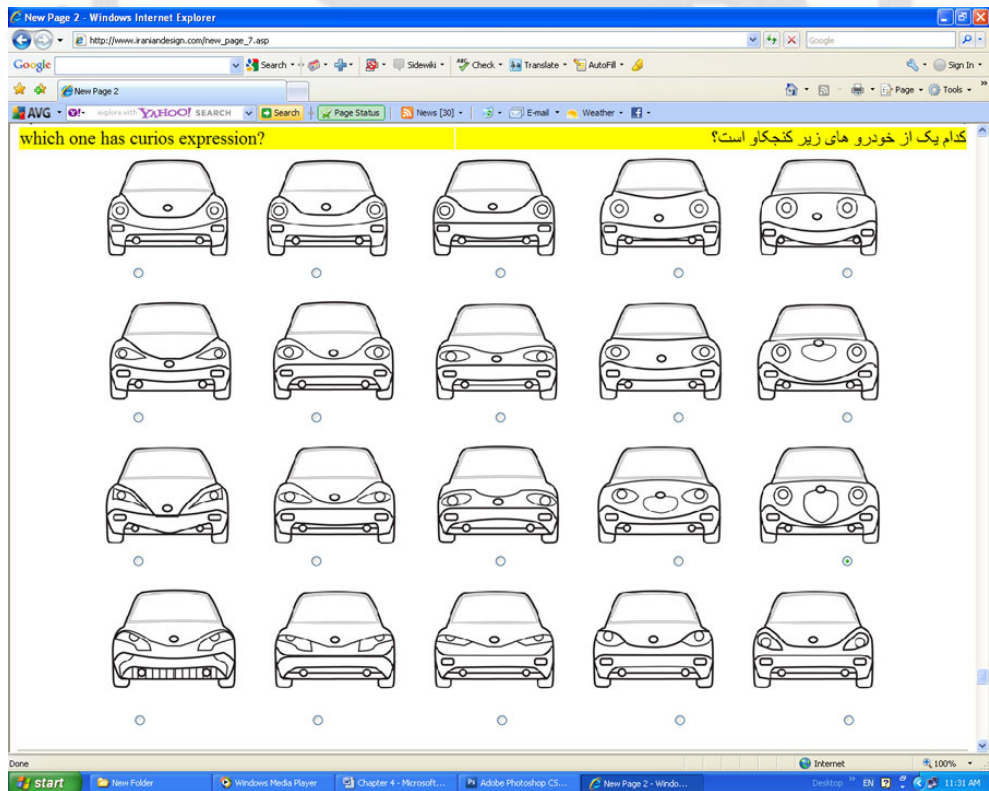
Q26



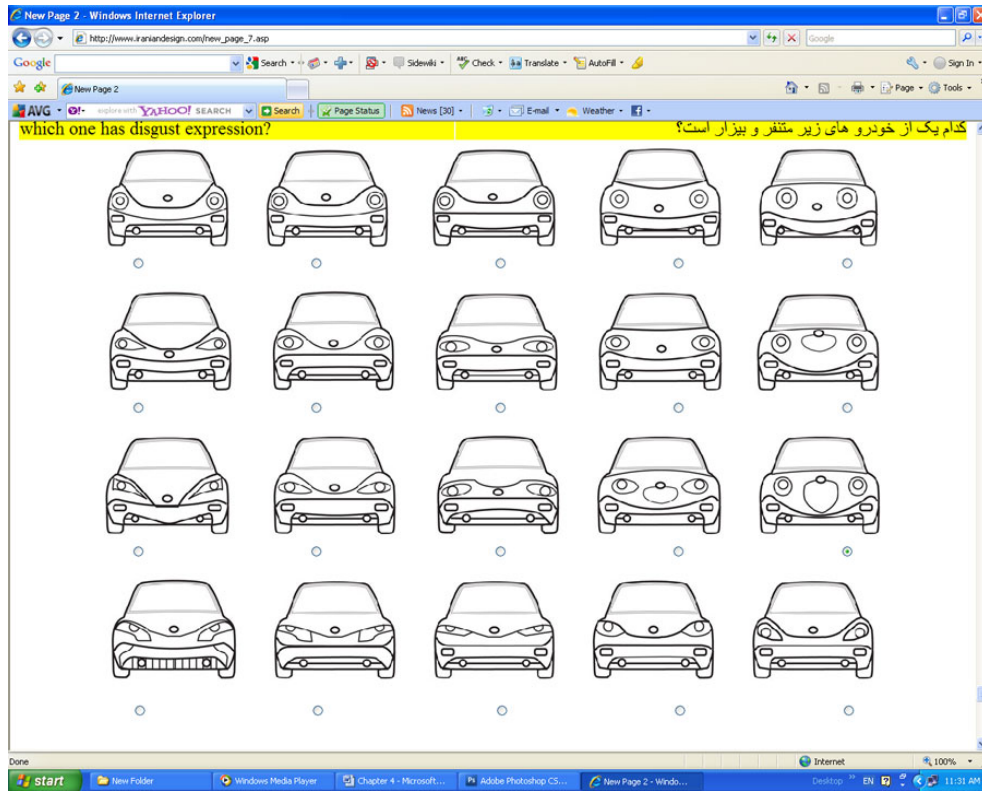
Q27



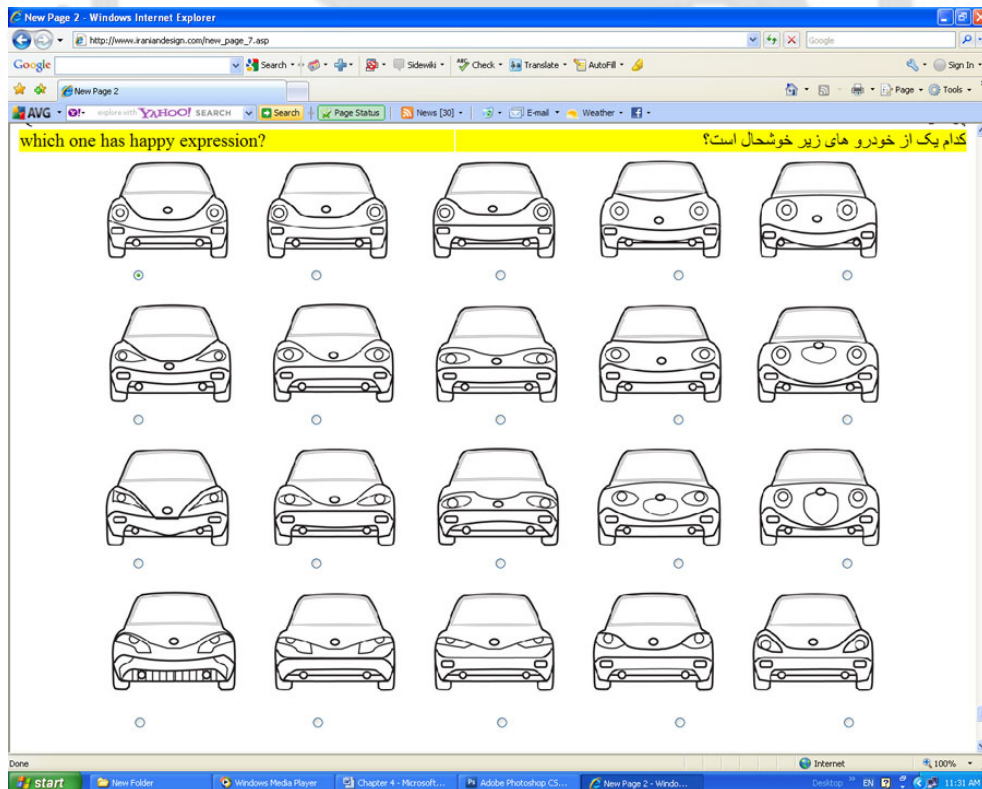
Q28



Q29



Q30












Q31



Q32 and Email

Appendix 5: List of consultants:

No	Name		field	Academic back g.	e-mail
1	Ali Reza Mohamadzade		Car Designer	Industrial Design	alireza_newedge@yahoo.com
2	Farzad Barkhordari		Car Designer	Industrial Design	barkhordary_design@yahoo.com
3	Mehdi Mojtavavi		Product Designer	Industrial Design	mehdi.mojtabavi@gmail.com
4	Parvis Hasanabadi		Terminology	Literature	parviz.hasanabadi@yahoo.com
5	Dr. Iko Avital		Professor	Design	
6	Dr. Hashem Mosadad		Professor	Industrial Design	h_mosaddad@iust.ac.ir
7	Dr. Mohsen Safaar Dezfuli		Professor	Industrial Design	ms_dezfuli@iust.ac.ir
8	Dr. Hassan Sadeghi Naeini		Professor	Ergonomic	naeini@iust.ac.ir
9	Dr. Vahid Chupankareh		Professor	Industrial Design	choopankareh@ut.ac.ir
10	Adele Bass		Professor	Design	abass@artcenter.edu

Appendix 6:Result of second questionnaire:

No	Age	Gender	Nationality	Profession	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6
n1	18	Female	Indian	Student	4	3	1	5	2	4
n2	18	Male	Iranian	student	1	3	1	5	2	4
n3	18	Female	Indian	Student	4	3	1	5	2	4
n4	18	Male	Indian	Bachelor in Design	4	3	1	5	2	4
n5	18	Male	Indian	student	4	3	1	5	2	4
n6	18	Male	Indian	Student	4	3	1	5	2	4
n7	18	Male	Indian	student	4	3	1	5	2	4
n8	19	Male	Indian	Student	4	3	1	5	2	4
n9	19	Female	Indian	Student	4	3	1	5	2	4
n10	20	Male	Indian	Design Student	4	3	1	5	2	4
n11	20	Male	Indian	Student	1	1	1	1	1	1
n12	20	Female	Indian	Student	4	3	1	5	2	4
n13	20	Male	Indian	student	4	3	1	5	1	4
n14	20	Male	Indian	Student	4	3	1	5	2	4
n15	20	Male	Indian	Student	4	3	1	5	2	4
n16	20	Male	Iranian	student	4	3	1	5	2	4
n17	20	Male	Indian	student	4	3	1	5	2	4
n18	20	Male	Indian	Design Student	4	3	1	5	2	4
n19	21	Male	Indian	Student	1	3	1	5	2	1
n20	21	Female	Indian	Student	4	3	1	5	2	4
n21	21	Male	Iranian	student	4	3	1	5	2	4
n22	21	Male	Indian	student	4	3	1	5	2	4
n23	21	Male	Indian	Student	4	3	1	5	2	4
n24	21	Male	Indian	Designer	4	3	1	5	2	4
n25	21	Male	Indian	Student	4	3	1	5	2	4
n26	21	Female	Iranian	student	4	3	1	5	2	4
n27	21	Male	Iranian	student	4	3	5	1	2	4
n28	22	Male	Iranian	mechanic	4	3	1	5	2	4
n29	22	Male	Indian	Student	2	4	1	5	2	4
n30	22	Male	Iranian	دا&#	4	3	1	5	2	4
n31	22	Male	Indian	Student	4	3	1	5	2	4
n32	22	Male	Indian	student	4	3	1	5	2	4
n33	22	Male	Iranian	musician	4	3	1	5	4	2
n34	22	Male	Indian	Designer, student	4	3	1	5	2	4
n35	22	Male	Indian	Student	4	3	1	5	2	4
n36	22	Female	Indian	Student	4	3	1	5	2	4
n37	23	Female	Iranian	student	4	3	1	5	2	4
n38	23	Female	Iranian	artist	1	4	1	2	3	5
n39	23	Male	Iranian	Industrial Designer	4	3	1	5	2	4
n40	23	Male	Indian	Student	4	3	1	5	2	4
n41	23	Male	Indian	Technical Recruiter	4	3	1	5	2	4
n42	23	Male	Indian	Student	4	3	1	5	2	4

No	age years old	gender	nationality	job	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6
n43	23	Male	Indian	product designer	4	3	1	5	2	4
n44	23	Female	Indian	Student	4	3	1	5	2	4
n45	23	Male	Indian	Student	5	2	1	5	1	4
n46	23	Male	Indian	student	4	3	1	5	2	4
n47	23	Female	Indian	Student	4	3	1	5	2	4
n48	23	Female	Iranian	د	2	3	1	5	1	4
n49	24	Female	Indian	Student	4	3	1	5	2	4
n50	24	Female	Iranian	designer	4	3	1	5	2	4
n51	24	Female	Indian	student	1	3	1	5	2	1
n52	24	Male	Indian	Student	4	3	1	5	2	4
n53	24	Male	Iranian	student	5	3	1	5	2	4
n54	24	Female	Indian	student	4	3	1	5	2	4
n55	24	Female	Iranian	designer	4	3	1	5	2	4
n56	24	Female	Indian	Student	4	3	1	5	2	4
n57	24	Male	Indian	Student	4	3	1	5	2	4
n58	25	Female	Indian	Student	4	3	1	5	2	4
n59	25	Male	Indian	student	4	3	1	5	2	4
n60	25	Male	Indian	PhD student	5	2	1	5	1	4
n61	25	Male	Indian	Student	4	3	1	5	2	4
n62	25	Female	Iranian	sales associate	1	3	1	5	4	2
n63	25	Male	Iranian	designer	4	3	1	5	2	4
n64	25	Male	Iranian	Industrial designer	4	3	1	5	2	4
n65	25	Female	Iranian	student	4	3	1	5	2	4
n66	25	Female	Indian	Student	4	3	1	5	2	4
n67	26	Male	Indian	student	4	3	1	5	2	4
n68	26	Female	Iranian	industrial designer	4	3	1	5	2	4
n69	26	Female	Iranian	student	4	3	1	5	2	4
n70	26	Female	Indian	transport designer	4	3	1	5	2	4
n71	26	Male	Indian	Student	4	3	1	5	1	3
n72	26	Female	Iranian	designer	4	3	1	5	2	4
n73	27	Male	Iranian	Designer	4	3	1	5	2	4
n74	27	Male	Indian	student	4	3	1	5	2	4
n75	27	Male	Indian	Designer/Illustrator	4	3	1	5	1	3
n76	27	Male	Indian	Student	4	3	1	5	1	4
n77	27	Male	Indian	Student	4	3	1	5	2	4
n78	27	Male	Iranian	graphic designer	4	3	1	5	4	2
n79	27	Male	Iranian	designer	4	3	1	5	2	1
n80	28	Female	Iranian	Research Student	4	3	1	5	2	4
n81	28	Male	Indian	Student	4	3	1	5	2	4
n82	28	Female	Iranian	industrial designer	4	3	1	5	2	4
n83	28	Female	Iranian	sale manager	4	3	1	5	2	1
n84	28	Male	Indian	student	4	3	1	5	2	4

No	age years old	gender	nationality	job	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6
n85	29	Male	Indian	Student	4	3	1	5	2	4
n86	29	Male	Iranian	game maker	4	3	1	5	2	1
n87	29	Male	Indian	student	4	3	1	5	2	4
n88	29	Male	Iranian	industrial designer	1	3	1	2	1	5
n89	30	Female	Iranian	designer	1	1	1	1	1	1
n90	30	Female	Iranian	sales manager	1	3	1	5	4	2
n91	30	Female	Iranian	designer	4	3	1	5	2	4
n92	30	Male	Iranian	Student	4	3	1	5	2	4
n93	31	Male	Iranian	Engineer	4	3	1	5	2	4
n94	31	Male	Iranian	student	4	3	1	5	2	4
n95	31	Female	Iranian	designer	4	3	1	5	2	4
n96	31	Female	Iranian	Industrial Designer	4	3	1	5	2	4
n97	31	Female	Iranian	Designer	4	3	1	5	2	4
n98	32	Male	Iranian	engineer	4	3	1	5	2	4
n99	32	Male	Iranian	designer	1	3	1	5	1	2
n100	32	Male	Iranian	IT Professional	4	3	1	5	2	4
n101	32	Male	Iranian	Industrial Designer	4	3	1	5	2	1
n102	32	Male	Iranian	Interaction Designer	1	3	4	2	4	5
n103	32	Female	Iranian	sales manager	1	3	4	5	1	2
n104	33	Female	Iranian	industrial designer	2	3	5	1	3	4
n105	33	Male	Iranian	طر	2	3	4	5	1	5
n106	33	Female	Iranian	housewife	2	3	5	1	4	2
n107	33	Male	Iranian	PhD student	4	3	1	5	2	4
n108	33	Female	Iranian	house wife	1	3	1	5	2	1
n109	34	Male	Indian	designer	2	4	1	5	2	4
n110	34	Male	Iranian	teacher	1	3	1	5	2	4
n111	34	Male	Iranian	Design Department	2	3	1	5	4	5
n112	34	Female	Iranian	khaneh dar	1	3	1	5	4	2
n113	34	Female	Iranian	industrial designer	1	3	1	5	2	4
n114	35	Female	Iranian	interior design	4	3	1	5	2	4
n115	35	Female	Iranian	nurse	4	3	1	5	2	1
n116	35	Male	Iranian	industrial designer	1	4	1	5	3	2
n117	36	Male	Iranian	designer	4	3	1	5	2	4
n118	36	Male	Iranian	designer	4	3	1	5	2	4
n119	38	Female	Iranian	designer	1	3	1	5	1	2
n120	39	Male	Iranian	Industrial Designer	1	2	3	5	3	4
n121	40	Male	Iranian	Industrial designer	4	3	1	5	2	1
n122	40	Female	Iranian	house wife	4	3	1	5	2	4
n123	45	Female	Iranian	teacher	4	3	1	5	2	4
n124	46	Female	Iranian	teacher	1	5	2	4	3	3
n125	50	Female	Iranian	Professor	4	3	1	5	2	4
n126	54	Male	Indian	doctor	1	1	1	1	1	1

No	Q2	Q2	Q2	Q2	Q2	Q2	Q2	Q3	Q3	Q3	Q3	Q3	Q3	Q3
	H2	D1	J1	F1	L5	K4	G5	H2	D1	J1	F1	L5	K4	G5
n1	3	1	4	5	4	4	3	5	4	3	3	4	1	5
n2	2	1	1	4	1	5	3	4	4	3	1	5	1	2
n3	3	2	1	4	5	1	2	5	5	4	3	4	1	1
n4	4	1	4	3	2	2	1	1	5	4	3	4	2	5
n5	1	4	3	5	1	5	4	5	4	3	3	4	1	5
n6	3	2	1	4	5	1	2	3	5	1	1	3	4	5
n7	2	4	2	5	4	2	1	1	5	2	4	1	2	5
n8	2	3	5	4	2	4	1	1	5	4	3	2	1	5
n9	1	1	5	5	2	3	1	1	3	3	4	1	1	3
n10	2	3	5	4	2	4	1	5	4	3	2	4	3	4
n11	4	1	4	4	1	5	1	3	5	1	1	3	4	5
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n13	5	1	2	5	2	4	4	4	5	2	1	4	2	5
n14	3	3	5	2	2	3	1	1	5	4	3	4	2	5
n15	4	3	4	2	2	5	1	1	4	4	3	5	4	2
n16	2	1	5	5	4	5	1	5	5	4	1	4	1	4
n17	1	1	3	5	1	3	1	5	5	2	4	5	3	3
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n25	5	1	5	4	4	5	1	5	5	2	4	4	1	5
n26	2	1	3	5	2	3	1	2	1	3	3	1	3	5
n27	3	5	2	4	2	3	1	1	3	5	1	5	3	4
n28	5	2	4	1	3	3	2	5	5	3	4	2	1	3
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n30	3	2	1	5	4	4	5	4	3	1	1	5	3	1
n31	4	3	4	2	2	5	1	4	5	4	4	4	3	5
n32	3	1	5	5	3	4	1	1	5	3	3	3	1	5
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n34	4	1	3	2	3	3	1	1	3	3	4	1	1	3
n35	4	1	4	3	2	2	1	5	4	3	2	4	3	4
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n37	3	1	3	5	2	4	1	3	5	3	1	4	2	5
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n39	2	5	1	2	3	4	3	4	1	5	2	2	1	3
n40	4	1	3	2	3	2	1	4	5	2	3	3	2	4
n41	3	1	4	5	2	4	1	4	5	2	1	3	2	5
n42	4	3	3	2	3	2	4	5	1	4	3	4	4	1

N0	Q2	Q2	Q2	Q2	Q2	Q2	Q2	Q3	Q3	Q3	Q3	Q3	Q3	Q3
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n44	3	1	5	5	3	4	1	3	3	3	3	4	3	4
n45	2	4	2	5	4	2	1	3	2	5	3	1	4	1
n46	1	1	5	5	2	3	1	4	5	3	2	5	3	5
n47	4	1	3	2	3	3	1	1	5	3	4	4	3	5
n48	3	1	1	1	2	5	4	3	5	1	4	1	1	2
n49	3	1	4	5	4	4	3	1	5	3	3	3	1	5
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n51	2	1	4	4	1	5	3	3	2	5	3	1	4	1
n52	1	4	3	5	1	5	4	4	5	4	4	4	3	5
n53	3	1	5	1	1	5	2	5	1	4	3	2	1	3
n54	3	2	2	3	3	2	4	1	4	4	3	5	4	2
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n60	5	2	2	4	3	2	2	1	5	3	3	1	5	4
n61	5	1	2	5	3	2	1	5	2	2	2	4	3	2
n62	2	1	1	4	3	5	1	1	2	1	5	1	4	3
n63	3	2	4	5	2	3	1	2	3	2	3	4	3	5
n64	4	5	2	1	3	3	1	2	4	4	5	2	1	5
n65	3	1	4	4	3	5	2	5	2	3	3	4	3	1
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n70	1	1	4	5	4	4	1	1	1	3	4	4	3	2
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n73	4	4	3	2	5	3	1	2	2	1	3	1	4	5
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n79	1	1	5	4	1	3	2	3	5	1	1	1	2	4
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n81	1	1	1	5	3	4	2	5	5	2	4	5	3	3
n82	2	1	5	5	3	5	1	4	5	1	3	5	2	4
n83	4	3	1	2	5	4	3	1	2	4	5	3	3	3
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NO	Q2	Q2	Q2	Q2	Q2	Q2	Q2	Q3	Q3	Q3	Q3	Q3	Q3	Q3
	H2	D1	J1	F1	L5	K4	G5	H2	D1	J1	F1	L5	K4	G5
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n86	2	3	5	3	3	5	1	3	3	3	1	4	3	5
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n92	3	1	2	4	5	3	1	3	4	5	4	2	1	4
n93	3	1	4	4	3	5	2	5	4	3	1	4	3	3
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n103	1	1	2	1	1	5	4	1	5	3	1	1	4	2
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n105	5	1	3	2	2	3	2	4	5	4	2	2	4	3
n106	4	5	2	1	4	2	3	4	3	2	1	4	3	5
n107	2	1	3	5	4	3	2	4	4	3	2	3	1	5
n108	4	1	3	5	1	2	1	1	5	3	1	2	4	1
n109	2	1	3	5	4	5	3	3	3	3	3	4	3	4
n110	2	1	1	4	1	5	3	3	5	2	1	4	1	1
n111	2	1	5	4	3	5	1	4	5	2	2	3	1	5
n112	4	1	5	1	3	1	2	1	5	4	2	1	3	1
n113	2	1	3	5	4	3	2	1	5	1	1	1	3	4
n114	3	1	5	4	3	2	2	1	3	4	4	5	3	3
n115	5	3	1	1	2	1	4	5	1	1	4	3	2	1
n116	4	1	5	1	3	3	1	1	5	4	5	3	3	5
n117	3	1	3	5	3	4	1	1	5	3	1	3	2	5
n118	1	1	3	5	3	3	1	1	5	3	1	3	3	5
n119	5	2	3	2	1	2	1	1	1	3	2	1	5	4
n120	2	1	3	1	4	5	1	5	2	3	1	2	4	2
n121	5	1	4	3	2	1	1	5	3	4	1	1	1	2
n122	2	1	4	5	2	3	2	2	4	2	3	3	1	5
n123	2	1	4	5	1	1	3	5	4	1	1	1	2	3
n124	2	1	3	5	3	4	3	5	3	3	2	1	2	4
n125	4	1	3	4	3	5	2	5	4	1	3	3	2	4
n126	1	1	1	5	3	4	2	4	5	3	2	1	1	4

No	Q4	Q4	Q4	Q4	Q4	Q4	Q4	Q5	Q5	Q5	Q5	Q5	Q5	Q5
	H2	D1	J1	F1	L5	K4	G5	H2	D1	J1	F1	L5	K4	G5
n1	2	4	4	2	5	5	4	3	3	2	2	3	5	3
n2	5	1	2	1	1	3	4	1	2	5	3	1	1	4
n3	2	4	2	4	5	2	5	3	3	5	4	3	3	1
n4	5	3	2	3	4	4	3	3	1	5	4	3	2	1
n5	2	4	4	2	5	5	4	5	1	5	4	5	4	1
n6	5	3	1	2	1	4	3	3	2	4	1	5	4	2
n7	2	4	2	4	5	2	5	1	4	5	2	4	4	1
n8	4	3	3	2	5	5	3	4	2	4	4	4	3	2
n9	5	3	1	2	1	4	3	3	1	5	4	3	5	2
n10	5	4	2	1	4	3	1	2	2	5	4	2	4	4
n11	5	4	2	1	4	3	1	2	2	3	5	1	4	1
n12	2	4	4	4	4	2	4	3	3	5	4	3	3	1
n13	5	1	4	2	5	4	1	2	1	2	4	2	5	1
n14	5	3	4	2	2	4	3	3	1	2	4	4	2	3
n15	5	3	4	3	2	3	1	1	4	5	2	4	4	1
n16	5	4	1	2	1	3	2	3	2	5	5	4	5	1
n17	5	3	3	3	2	3	3	5	1	5	2	2	4	3
n18	5	3	4	3	2	3	1	2	3	5	4	4	4	1
n19	5	1	3	3	4	3	3	2	2	5	4	2	4	4
n20	5	3	3	2	2	4	3	3	1	5	4	3	5	2
n21	4	5	2	2	4	3	1	2	2	4	4	1	5	3
n22	5	1	2	2	3	3	1	3	1	3	4	3	2	1
n23	5	1	3	3	4	3	5	2	3	5	4	4	4	1
n24	1	4	3	2	2	3	4	4	1	5	3	3	5	1
n25	5	1	2	2	3	3	1	4	1	5	4	3	1	1
n26	5	1	3	3	3	3	5	3	1	5	4	3	5	1
n27	5	3	1	5	1	4	2	1	5	3	1	3	2	4
n28	4	5	1	2	1	3	3	3	3	5	2	4	4	1
n29	5	1	4	2	5	4	1	2	1	2	4	2	5	1
n30	5	3	3	3	1	3	3	3	1	1	4	3	5	3
n31	4	3	3	2	5	5	3	2	3	5	4	4	4	1
n32	5	1	3	3	5	3	1	3	1	2	4	3	5	1
n33	5	4	3	1	2	3	3	3	1	5	4	3	3	2
n34	5	3	3	2	2	4	3	3	3	2	2	3	5	3
n35	5	5	1	2	4	2	1	3	1	1	1	3	5	3
n36	5	1	3	3	5	3	1	4	1	5	3	3	5	1
n37	5	1	3	3	4	4	2	3	1	3	4	4	5	2
n38	5	1	4	2	1	2	5	4	1	1	3	5	1	1
n39	5	3	1	2	4	3	4	1	5	2	4	4	5	3
n40	5	4	2	2	3	3	1	4	3	5	2	2	5	1
n41	5	5	1	2	4	2	1	2	2	3	5	1	4	1
n42	5	3	4	2	2	4	3	2	3	1	1	5	2	2

NO	Q4	Q4	Q4	Q4	Q4	Q4	Q4	Q5	Q5	Q5	Q5	Q5	Q5	Q5
	H2	D1	J1	F1	L5	K4	G5	H2	D1	J1	F1	L5	K4	G5
n43	4	3	3	2	5	5	3	3	1	5	4	3	5	2
n44	2	4	5	1	4	2	5	3	1	5	3	3	4	1
n45	5	1	3	3	4	3	5	3	2	4	1	5	4	2
n46	5	1	3	3	4	3	5	3	3	5	4	3	3	1
n47	5	3	3	3	2	3	3	3	1	5	4	3	2	1
n48	1	5	1	4	1	3	2	1	5	4	2	1	3	1
n49	5	3	3	2	2	3	3	3	1	2	4	3	5	1
n50	4	2	1	2	3	5	3	2	2	5	3	4	5	1
n51	2	4	5	1	4	2	5	2	3	1	1	5	2	2
n52	5	3	4	3	2	3	1	5	1	5	4	5	4	1
n53	4	1	3	1	4	5	2	3	1	2	5	4	3	2
n54	5	3	3	2	2	3	3	3	1	2	4	4	2	3
n55	5	4	3	3	1	3	2	2	1	5	4	3	4	3
n56	1	4	3	2	2	3	4	1	2	5	4	3	4	1
n57	5	4	3	3	4	3	2	3	2	5	5	2	5	1
n58	5	5	3	3	1	3	4	3	1	5	4	3	4	1
n59	5	4	2	2	3	3	1	4	3	5	2	2	5	1
n60	2	2	3	3	3	3	2	3	2	5	5	2	5	1
n61	2	2	3	3	3	3	2	3	4	2	2	2	4	1
n62	1	4	1	5	1	2	1	4	2	1	5	3	1	1
n63	5	1	3	3	3	3	2	3	3	5	4	2	5	1
n64	5	1	3	2	4	5	2	4	3	5	2	3	4	1
n65	4	2	3	1	5	3	2	3	1	4	4	3	5	2
n66	5	3	2	3	4	4	3	3	1	3	4	3	2	1
n67	5	4	4	2	3	4	1	3	1	5	3	3	4	1
n68	5	1	3	3	2	3	2	3	3	4	3	1	5	2
n69	5	4	3	2	4	3	1	3	3	5	4	3	4	1
n70	5	5	3	3	1	3	4	3	1	5	4	3	4	1
n71	5	4	4	2	3	4	1	3	4	2	2	2	4	1
n72	5	1	3	2	4	3	1	1	2	4	4	1	5	3
n73	5	3	3	2	1	4	1	1	1	1	1	1	1	1
n74	5	3	4	2	4	4	3	4	1	5	4	3	1	1
n75	3	3	3	1	3	3	1	3	1	1	1	3	5	3
n76	5	3	4	2	4	4	3	5	1	5	2	2	4	3
n77	5	1	3	3	1	3	2	5	1	5	3	3	5	1
n78	5	4	1	4	5	3	3	3	1	5	5	3	4	2
n79	1	4	3	1	2	1	5	1	2	1	5	3	4	1
n80	5	2	1	1	4	3	3	3	1	4	3	2	5	1
n81	3	3	3	1	3	3	1	4	1	2	2	2	4	1
n82	5	3	4	1	1	2	5	2	1	5	3	1	5	4
n83	5	2	3	3	1	3	3	3	4	1	2	3	3	5
n84	5	3	4	2	2	4	3	3	4	2	2	2	4	1

N0	Q4	Q4	Q4	Q4	Q4	Q4	Q4	Q5	Q5	Q5	Q5	Q5	Q5	Q5
	H2	D1	J1	F1	L5	K4	G5	H2	D1	J1	F1	L5	K4	G5
n85	5	1	3	3	4	3	3	5	1	5	3	3	5	1
n86	5	3	3	3	1	3	3	2	2	5	3	3	5	1
n87	2	4	4	4	4	2	4	4	1	2	2	2	4	1
n88	1	2	3	3	1	5	4	1	1	2	1	4	5	1
n89	5	2	3	3	4	3	1	3	1	4	4	3	5	2
n90	5	2	3	4	1	3	5	1	3	5	1	5	1	3
n91	5	4	2	2	4	3	1	2	1	3	4	5	4	2
n92	5	3	1	1	4	4	3	3	2	1	2	3	5	1
n93	5	1	3	1	4	3	2	3	3	5	5	1	4	2
n94	4	2	3	2	3	5	1	4	2	3	2	4	5	1
n95	5	2	3	2	4	1	2	3	1	4	2	3	5	2
n96	5	1	2	1	3	3	3	2	1	5	5	3	5	1
n97	1	5	1	2	1	3	4	1	2	4	1	1	5	3
n98	3	3	3	3	3	3	3	3	3	3	3	3	3	3
n99	5	4	3	3	1	2	2	2	1	4	4	2	5	3
n100	3	2	3	3	3	3	5	3	2	5	4	3	4	3
n101	5	1	3	1	4	2	1	2	1	3	1	4	5	1
n102	2	4	3	1	5	3	4	3	4	5	2	1	5	2
n103	2	4	1	1	1	5	1	2	4	5	1	1	3	1
n104	5	2	3	4	1	3	1	2	1	5	3	4	5	3
n105	5	4	3	3	2	3	3	3	2	5	5	4	4	1
n106	5	1	3	4	4	2	3	4	5	4	1	1	2	3
n107	5	3	3	2	4	3	3	3	1	5	4	3	4	2
n108	5	2	1	3	1	4	1	3	1	2	1	4	5	1
n109	5	4	3	3	4	3	2	4	2	4	4	4	3	2
n110	4	1	3	1	5	1	2	3	2	5	4	1	1	1
n111	5	2	3	1	4	3	3	3	1	4	4	3	5	1
n112	5	1	1	2	4	1	3	1	1	4	1	3	5	2
n113	5	2	3	3	4	3	1	3	2	5	3	3	4	1
n114	5	3	2	1	4	3	3	3	2	4	4	3	5	1
n115	5	2	1	1	1	3	4	1	3	5	1	1	2	4
n116	5	3	4	3	1	1	3	3	1	2	1	4	5	1
n117	5	1	3	3	4	4	1	2	1	5	4	4	4	1
n118	5	1	3	3	4	4	2	2	1	5	4	2	4	1
n119	5	1	3	1	4	1	2	1	4	5	1	1	3	2
n120	1	3	1	2	5	4	1	2	3	5	2	3	2	1
n121	1	3	1	2	4	5	1	1	3	4	2	5	1	1
n122	5	2	3	3	1	3	1	3	2	5	4	3	4	1
n123	5	1	1	1	4	3	2	1	3	2	4	5	1	1
n124	5	4	3	3	2	3	1	1	3	4	4	1	5	2
n125	5	2	3	1	4	3	2	4	2	1	3	2	5	3
n126	5	1	3	3	1	3	2	1	2	5	4	3	4	1

No	Q6	Q6	Q6	Q6	Q6	Q6	Q6	Q7	Q7	Q7	Q7	Q7	Q7	Q7
	H2	D1	J1	F1	L5	K4	G5	H2	D1	J1	F1	L5	K4	G5
n1	5	5	4	3	3	4	5	1	3	5	4	3	3	3
n2	4	2	3	1	5	1	1	1	4	5	1	2	1	3
n3	3	5	2	3	5	3	5	3	3	2	2	3	3	3
n4	3	5	2	2	2	3	5	2	3	5	4	2	2	3
n5	5	5	4	4	4	2	5	5	4	5	4	4	1	4
n6	3	5	4	2	1	2	5	3	3	1	4	5	2	3
n7	2	2	4	4	4	4	1	1	4	2	1	1	2	4
n8	3	5	2	3	5	3	5	3	3	2	2	3	3	3
n9	3	5	4	2	2	4	3	5	3	2	5	4	2	1
n10	4	3	3	4	4	3	1	4	5	4	2	2	4	4
n11	1	5	4	2	2	2	4	4	1	2	4	4	2	1
n12	3	5	4	2	1	2	5	3	3	1	4	5	2	3
n13	4	5	2	2	5	4	5	3	4	2	4	4	3	1
n14	4	5	2	2	5	4	5	3	4	2	4	4	3	1
n15	2	4	5	1	2	2	5	2	4	5	2	2	3	2
n16	4	4	3	3	3	3	5	3	3	5	4	4	5	2
n17	4	3	3	2	5	3	3	3	4	2	3	3	3	1
n18	4	5	5	2	4	3	2	4	1	3	4	1	5	1
n19	1	5	5	3	3	3	3	5	1	3	3	4	3	1
n20	3	5	4	2	3	4	5	4	3	2	2	3	3	3
n21	5	2	2	4	4	3	1	1	2	5	4	2	3	4
n22	1	5	2	3	3	2	5	3	3	3	4	1	2	4
n23	4	3	3	2	5	3	3	3	4	2	3	3	3	1
n24	5	2	4	3	4	3	2	4	2	5	3	4	5	1
n25	1	4	3	1	4	2	5	1	2	3	3	4	5	1
n26	1	5	3	3	3	3	4	3	3	4	4	3	4	3
n27	2	1	4	2	4	3	5	1	3	5	1	5	2	4
n28	3	3	2	1	4	2	5	1	2	4	3	5	3	3
n29	2	5	4	3	2	2	5	5	1	2	4	3	4	2
n30	3	5	5	2	2	3	4	4	2	1	3	4	3	2
n31	5	5	4	4	4	2	5	5	4	5	4	4	1	4
n32	5	5	4	3	3	4	5	1	3	5	4	3	3	3
n33	3	5	3	4	1	3	4	4	1	3	4	5	3	2
n34	3	5	4	2	3	4	5	4	3	2	2	3	3	3
n35	5	2	4	3	4	3	2	4	2	5	3	4	5	1
n36	3	5	5	1	5	2	2	1	3	2	2	2	2	4
n37	3	4	1	2	4	2	5	3	2	5	4	1	5	2
n38	3	2	1	4	1	5	1	1	1	5	2	4	1	3
n39	5	4	1	3	2	3	3	1	3	2	5	4	1	3
n40	2	5	4	4	4	2	5	5	1	2	2	3	4	1
n41	1	4	3	1	4	2	5	1	2	3	3	4	5	1
n42	2	2	4	4	4	4	1	1	4	2	1	1	2	4

N0	Q6	Q6	Q6	Q6	Q6	Q6	Q6	Q7	Q7	Q7	Q7	Q7	Q7	Q7
	H2	D1	J1	F1	L5	K4	G5	H2	D1	J1	F1	L5	K4	G5
n43	3	4	3	2	4	2	5	5	1	4	3	2	4	2
n44	3	1	3	4	2	3	5	3	2	3	3	4	3	1
n45	4	5	2	3	5	2	2	3	5	2	2	4	3	4
n46	3	5	2	3	5	3	5	3	3	2	2	3	3	3
n47	5	4	2	2	3	2	2	3	3	2	3	2	1	2
n48	3	1	5	1	1	4	2	2	1	4	1	5	3	1
n49	1	5	2	3	3	2	5	3	3	3	4	1	2	4
n50	4	1	5	2	4	3	1	4	5	2	3	1	4	1
n51	2	4	5	1	2	2	5	2	4	5	2	2	3	2
n52	4	3	3	4	4	3	1	4	5	4	2	2	4	4
n53	3	5	3	1	2	3	4	3	1	3	4	5	2	3
n54	3	5	4	2	2	4	3	5	3	2	5	4	2	1
n55	4	5	3	3	4	3	5	2	3	5	4	1	4	3
n56	3	2	4	4	3	4	2	4	2	2	3	3	5	2
n57	3	4	3	2	4	2	5	5	1	4	3	2	4	2
n58	3	5	2	2	2	3	5	2	3	5	4	2	2	3
n59	4	5	2	3	5	2	2	3	5	2	2	4	3	4
n60	5	4	2	2	3	2	2	3	3	2	3	2	1	2
n61	4	5	5	2	4	3	2	4	1	3	4	1	5	1
n62	3	2	5	5	3	1	4	5	4	1	1	1	2	3
n63	3	3	3	2	4	3	5	4	5	3	3	1	4	2
n64	2	1	3	4	3	1	5	2	5	4	3	4	3	1
n65	3	5	3	3	1	3	1	3	1	1	5	1	3	2
n66	3	2	4	4	3	4	2	4	2	2	3	3	5	2
n67	2	5	4	3	2	2	5	5	1	2	4	3	4	2
n68	1	3	3	4	5	3	5	3	4	5	3	3	4	2
n69	1	1	3	4	2	3	5	2	2	3	5	1	4	4
n70	3	1	3	4	2	3	5	3	2	3	3	4	3	1
n71	3	4	3	3	3	3	2	4	2	3	3	3	3	4
n72	4	4	2	1	5	3	2	3	5	4	4	2	1	2
n73	1	5	3	1	5	3	4	3	3	2	5	2	1	4
n74	1	5	4	2	2	2	4	4	1	2	4	4	2	1
n75	1	5	5	3	3	3	3	5	1	3	3	4	3	1
n76	4	5	5	2	4	3	2	4	1	3	4	1	5	1
n77	3	5	1	2	4	3	4	3	2	5	4	3	4	1
n78	3	5	3	3	2	3	4	1	4	4	5	3	4	3
n79	5	1	3	4	2	1	1	1	4	5	4	1	1	3
n80	3	5	1	4	4	3	2	4	1	1	4	5	3	2
n81	3	4	3	2	4	2	5	5	1	4	3	2	4	2
n82	1	2	3	5	4	3	5	5	4	3	1	1	2	5
n83	3	3	5	4	2	3	3	3	3	3	3	3	3	3
n84	3	2	4	4	3	4	2	4	2	2	3	3	5	2

NO	Q6	Q6	Q6	Q6	Q6	Q6	Q6	Q7	Q7	Q7	Q7	Q7	Q7	Q7
	H2	D1	J1	F1	L5	K4	G5	H2	D1	J1	F1	L5	K4	G5
n85	3	5	5	1	5	2	2	1	3	2	2	2	2	4
n86	3	1	4	1	3	3	5	3	3	3	5	1	1	1
n87	2	5	4	4	4	2	5	5	1	2	2	3	4	1
n88	1	1	1	3	1	2	5	2	3	5	3	1	1	1
n89	3	5	3	3	4	3	1	1	2	3	3	5	3	2
n90	2	5	3	1	5	3	5	2	1	5	5	4	3	1
n91	1	5	4	4	4	3	4	2	1	4	5	4	3	2
n92	3	4	3	1	3	3	5	4	3	3	4	1	1	3
n93	3	1	3	3	4	3	3	3	2	3	3	1	3	5
n94	3	1	2	4	3	3	5	2	4	3	5	1	1	5
n95	2	4	3	5	1	2	2	2	3	5	2	4	1	3
n96	4	3	3	3	4	4	4	4	3	2	3	5	4	3
n97	1	2	3	5	4	3	1	5	1	1	2	4	3	1
n98	3	3	3	3	3	3	3	3	3	3	3	3	3	3
n99	4	5	3	3	2	3	1	2	1	5	3	5	4	3
n100	3	3	3	2	3	3	3	2	3	4	3	3	3	1
n101	4	5	3	1	1	1	2	2	1	3	5	4	1	1
n102	2	3	4	1	4	4	5	2	4	5	5	2	3	1
n103	1	2	5	1	3	4	1	1	4	1	5	2	1	3
n104	1	5	2	3	4	2	3	4	2	3	5	2	3	1
n105	3	5	3	3	3	3	1	1	4	1	3	3	3	1
n106	3	4	1	2	3	2	1	3	4	5	1	2	5	4
n107	4	5	3	3	2	3	1	3	2	5	4	3	3	1
n108	4	5	2	1	1	3	1	3	1	5	4	1	2	5
n109	3	4	3	3	3	3	2	4	2	3	3	3	3	4
n110	1	5	3	2	4	1	1	3	4	5	1	2	1	1
n111	4	1	3	3	5	3	1	3	3	5	4	1	3	3
n112	1	4	2	3	1	1	5	3	4	1	5	1	1	2
n113	4	5	3	1	3	3	5	1	3	4	5	2	3	3
n114	4	5	3	2	3	4	1	3	3	5	3	3	3	3
n115	1	3	5	1	1	2	4	2	3	1	1	4	5	1
n116	3	5	4	5	3	4	5	1	2	4	1	5	3	2
n117	3	5	3	1	3	3	5	1	1	5	3	2	5	1
n118	3	5	3	3	3	3	5	3	1	5	4	4	5	1
n119	4	3	1	5	1	1	2	4	1	5	1	2	3	1
n120	4	5	3	2	4	3	1	5	4	5	1	3	2	1
n121	1	1	5	2	4	1	3	5	3	1	1	4	1	2
n122	3	5	3	1	3	3	4	3	2	5	5	3	4	1
n123	5	4	3	1	1	2	1	3	1	4	5	2	1	1
n124	1	3	3	3	4	3	5	1	4	3	3	2	3	1
n125	4	3	5	2	1	3	4	5	2	1	3	3	4	3
n126	3	5	1	2	4	3	4	3	2	5	4	3	4	1

No	Q8	Q8	Q8	Q8	Q8	Q8	Q8	Q9	Q9	Q9	Q9	Q9	Q9	Q9
	H2	D1	J1	F1	L5	K4	G5	H2	D1	J1	F1	L5	K4	G5
n1	5	4	5	4	4	2	4	1	1	4	5	3	4	1
n2	1	2	1	5	1	4	3	3	2	4	5	1	1	1
n3	4	4	5	4	4	2	1	4	1	4	5	3	4	1
n4	3	1	5	4	3	3	3	3	1	4	5	3	4	1
n5	5	4	5	4	4	2	4	1	4	2	5	4	4	1
n6	2	3	5	1	1	4	3	3	5	1	4	2	1	5
n7	4	4	5	4	4	2	1	1	4	4	2	2	2	4
n8	4	2	5	4	4	5	2	4	2	4	5	2	1	2
n9	2	3	5	1	1	4	3	1	3	2	5	3	3	1
n10	2	2	5	4	3	4	1	1	4	4	4	2	4	4
n11	2	2	5	4	3	4	1	4	1	4	2	3	3	1
n12	4	1	2	2	2	5	1	1	1	3	5	3	3	1
n13	3	1	3	5	4	4	1	1	1	3	5	3	5	1
n14	2	4	2	2	4	2	4	1	1	3	5	2	2	3
n15	1	4	5	2	2	5	1	3	4	5	5	3	4	1
n16	3	3	5	4	2	5	3	2	2	4	4	1	5	3
n17	5	1	3	3	3	5	1	1	3	2	3	3	3	4
n18	1	4	5	2	2	5	1	3	4	5	5	3	4	1
n19	3	1	5	3	4	4	1	1	4	2	2	4	2	5
n20	3	3	3	2	4	5	3	1	4	2	5	4	4	1
n21	3	2	5	4	1	4	2	1	2	4	5	2	4	3
n22	3	3	2	2	3	5	3	2	3	3	5	3	2	1
n23	3	2	5	4	3	5	2	2	1	4	5	3	5	1
n24	1	3	2	3	2	4	3	4	1	2	2	4	2	4
n25	3	3	2	2	3	5	3	3	5	1	4	2	1	5
n26	3	1	4	4	3	4	1	3	1	4	5	3	3	1
n27	5	3	2	5	2	4	1	2	5	1	4	1	3	5
n28	3	2	4	1	1	5	3	2	2	4	5	3	4	1
n29	3	1	3	5	4	4	1	4	1	2	2	4	2	4
n30	3	3	3	4	3	5	2	3	3	1	5	3	3	3
n31	4	2	5	4	4	5	2	4	2	4	5	2	1	2
n32	3	1	5	4	4	4	1	1	1	4	5	3	4	1
n33	2	3	4	3	1	5	3	2	1	5	4	3	3	1
n34	3	3	3	2	4	5	3	4	1	4	5	3	4	1
n35	3	3	1	2	4	5	1	1	1	3	5	3	5	1
n36	3	1	5	4	4	4	1	2	3	3	5	3	2	1
n37	2	3	1	4	2	5	3	3	1	5	5	3	4	2
n38	1	2	1	4	1	5	3	4	1	1	5	2	3	1
n39	2	5	1	3	3	4	5	2	5	1	3	3	5	4
n40	3	1	2	2	5	5	1	4	1	2	2	3	4	1
n41	3	3	1	2	4	5	1	1	3	4	5	2	4	1
n42	2	4	2	2	4	2	4	1	1	3	5	2	2	3

N0	Q8	Q8	Q8	Q8	Q8	Q8	Q8	Q9	Q9	Q9	Q9	Q9	Q9	Q9
	H2	D1	J1	F1	L5	K4	G5	H2	D1	J1	F1	L5	K4	G5
n43	4	2	5	4	4	5	2	4	2	4	5	2	1	2
n44	1	4	5	4	1	4	5	4	3	2	5	5	3	1
n45	3	2	5	4	3	5	2	2	1	4	5	3	5	1
n46	3	2	5	4	3	5	2	2	1	4	5	3	5	1
n47	5	1	3	3	3	5	1	1	3	4	5	2	4	1
n48	2	1	1	1	3	5	4	1	3	1	1	2	5	4
n49	4	3	5	2	2	5	3	3	5	1	5	1	4	4
n50	1	1	4	5	2	5	3	2	1	3	5	4	4	4
n51	1	4	5	4	1	4	5	3	5	1	5	1	4	4
n52	1	4	5	2	2	5	1	3	4	5	5	3	4	1
n53	1	1	1	1	1	1	1	3	2	5	4	3	2	1
n54	4	3	5	2	2	5	3	1	3	2	5	3	3	1
n55	3	1	4	4	2	5	3	1	2	4	5	3	4	3
n56	1	3	2	3	2	4	3	5	2	4	5	3	3	3
n57	3	1	3	4	4	4	2	1	4	4	2	2	2	4
n58	3	3	5	2	2	5	3	3	1	4	5	3	4	1
n59	3	1	2	2	5	5	1	4	3	2	5	5	3	1
n60	5	2	4	4	4	4	1	4	3	5	4	3	4	2
n61	5	2	4	4	4	4	1	1	3	2	3	3	3	4
n62	5	1	4	3	5	5	3	4	5	4	5	1	5	5
n63	3	1	4	4	3	5	3	2	1	3	5	4	3	4
n64	2	1	3	5	3	3	4	1	3	3	4	2	3	5
n65	3	2	5	4	3	4	1	1	5	3	4	2	3	4
n66	3	1	5	4	3	3	3	3	2	4	5	3	4	1
n67	2	1	2	2	3	5	1	5	1	1	3	5	5	1
n68	2	1	5	3	2	5	2	2	2	4	5	3	4	1
n69	3	2	5	5	4	4	1	3	2	4	5	3	4	1
n70	3	3	5	2	2	5	3	1	1	3	5	3	3	1
n71	2	1	2	2	3	5	1	1	4	4	4	2	4	4
n72	3	1	4	4	4	5	2	3	2	4	5	3	4	1
n73	1	3	5	3	2	4	1	1	1	4	5	1	4	2
n74	5	1	5	2	2	5	4	1	1	4	3	3	4	1
n75	3	3	3	3	4	5	3	5	2	4	5	3	3	3
n76	5	1	5	2	2	5	4	1	1	4	3	3	4	1
n77	3	1	4	4	3	5	2	4	3	5	4	3	4	2
n78	3	2	4	4	1	5	3	1	2	5	4	3	4	2
n79	1	1	3	2	4	1	5	2	3	1	5	1	4	1
n80	2	3	4	1	1	5	3	1	3	3	5	3	1	4
n81	3	3	3	3	4	5	3	5	1	1	3	5	5	1
n82	3	4	5	1	1	5	2	3	1	3	5	4	5	2
n83	3	1	3	3	3	3	2	1	2	3	5	3	3	3
n84	2	4	2	2	4	2	4	1	1	3	5	2	2	3

N0	Q8	Q8	Q8	Q8	Q8	Q8	Q8	Q9	Q9	Q9	Q9	Q9	Q9	Q9
	H2	D1	J1	F1	L5	K4	G5	H2	D1	J1	F1	L5	K4	G5
n85	3	1	5	3	4	4	1	4	1	4	2	3	3	1
n86	3	1	5	4	1	4	3	2	2	4	5	3	4	1
n87	4	1	2	2	2	5	1	4	1	2	2	3	4	1
n88	1	3	1	2	4	1	5	1	4	1	1	1	3	3
n89	3	2	3	3	3	3	1	1	1	5	5	4	4	3
n90	2	1	5	4	3	5	1	5	1	2	5	4	3	1
n91	3	2	5	4	1	4	2	1	2	4	5	4	3	2
n92	3	3	5	1	3	3	3	1	5	3	3	3	4	5
n93	3	1	3	3	2	5	2	2	1	3	4	3	5	2
n94	5	1	3	2	4	5	1	4	2	5	3	3	3	1
n95	4	2	5	4	4	5	1	3	1	4	5	3	4	1
n96	1	2	5	5	4	5	2	2	1	5	4	3	5	2
n97	2	3	5	1	1	4	3	1	3	4	5	1	1	2
n98	3	3	3	3	3	3	3	3	3	3	3	3	3	3
n99	3	2	5	4	4	5	1	3	1	4	5	3	4	2
n100	3	2	3	3	3	3	3	2	1	3	5	3	3	3
n101	1	2	3	1	4	5	1	2	1	3	5	1	4	1
n102	1	4	5	3	2	5	4	3	4	5	1	2	5	4
n103	5	1	4	2	1	3	1	4	1	5	3	1	2	1
n104	3	3	5	1	4	5	2	3	1	5	4	4	5	2
n105	1	4	3	5	1	3	3	4	1	3	5	3	3	3
n106	5	1	3	5	3	2	4	5	4	2	1	3	1	4
n107	1	3	4	3	2	5	3	3	1	4	4	3	5	2
n108	3	4	5	4	1	5	2	4	1	3	5	1	2	5
n109	3	1	3	4	4	4	2	1	4	2	2	4	2	5
n110	1	4	3	1	1	5	2	2	5	1	4	3	1	1
n111	3	1	4	4	3	5	2	2	1	5	4	3	4	3
n112	3	1	1	4	2	5	1	2	1	4	5	1	1	3
n113	2	1	5	4	3	3	3	1	3	3	5	2	3	4
n114	3	3	5	1	3	4	3	2	3	4	5	3	3	1
n115	1	4	5	1	2	3	1	3	4	1	1	2	5	1
n116	3	3	5	2	1	5	3	2	1	1	5	3	4	2
n117	3	1	4	5	5	5	1	2	1	3	5	3	3	1
n118	2	1	4	4	5	4	1	1	1	4	5	3	4	1
n119	1	4	2	1	3	5	1	5	1	3	2	1	4	1
n120	2	3	5	1	4	5	3	2	1	3	5	2	4	5
n121	4	1	5	1	3	1	2	1	1	3	5	2	4	1
n122	3	2	4	3	3	5	1	3	1	4	5	3	3	2
n123	1	2	5	4	1	3	1	4	1	3	5	2	1	1
n124	3	1	3	4	2	5	2	1	2	4	5	4	3	3
n125	4	1	5	1	3	4	2	1	3	5	4	3	3	2
n126	3	1	4	4	3	5	2	3	2	4	5	3	4	1

No	Q10	Q10	Q10	Q10	Q10	Q10	Q10	Q11	Q11	Q11	Q11	Q11	Q11	Q11
	H2	D1	J1	F1	L5	K4	G5	H2	D1	J1	F1	L5	K4	G5
n1	5	3	1	3	3	2	5	3	4	3	3	3	3	4
n2	1	2	3	1	4	1	5	4	5	1	2	1	3	1
n3	4	3	2	1	3	1	5	5	2	4	2	4	4	1
n4	1	2	3	2	1	4	3	5	3	3	2	4	4	3
n5	5	5	1	1	4	4	5	5	4	4	4	3	4	4
n6	4	3	1	2	3	5	1	4	3	4	3	5	2	1
n7	5	5	4	1	4	1	5	5	1	4	4	4	4	1
n8	4	3	2	1	3	2	3	5	1	4	3	1	3	3
n9	2	1	4	4	2	2	2	5	2	3	3	3	3	1
n10	1	2	4	4	3	4	2	5	1	2	3	5	2	1
n11	3	5	2	3	2	1	5	5	1	2	3	5	2	1
n12	3	3	3	3	3	3	1	3	4	3	3	3	3	4
n13	5	5	4	3	4	1	2	5	2	3	3	4	3	1
n14	2	5	1	1	2	1	5	5	4	4	4	3	4	4
n15	4	5	3	1	5	1	3	4	3	4	3	5	2	1
n16	4	4	1	2	3	2	5	4	4	2	2	3	3	3
n17	5	2	3	4	3	1	5	5	1	4	3	1	3	3
n18	4	5	3	1	5	1	3	5	1	2	4	3	2	1
n19	5	4	1	1	2	1	4	2	5	2	3	2	3	5
n20	5	5	1	1	4	4	5	5	2	3	3	3	3	1
n21	3	4	2	4	5	2	1	3	5	2	1	4	2	4
n22	3	2	4	3	2	4	2	5	3	3	2	3	4	1
n23	1	5	1	3	3	3	5	5	4	4	4	2	2	4
n24	2	5	2	4	2	3	5	1	1	3	1	2	3	2
n25	4	3	1	2	3	5	1	2	4	3	3	1	3	1
n26	1	4	3	3	1	3	5	5	1	3	3	3	3	1
n27	5	3	2	1	1	2	3	3	5	1	3	1	4	2
n28	5	4	3	2	2	1	5	4	5	1	1	3	2	3
n29	2	5	2	4	2	3	5	5	1	2	3	3	4	3
n30	2	4	3	3	2	3	4	4	3	2	3	3	3	3
n31	4	3	2	1	3	2	3	5	1	4	4	4	4	1
n32	5	3	1	3	3	2	5	5	1	3	3	4	3	3
n33	4	3	3	1	1	2	5	5	3	3	3	2	3	1
n34	4	3	2	1	3	1	5	3	3	3	3	5	5	2
n35	5	5	4	3	4	1	2	5	3	3	2	4	3	3
n36	3	2	4	3	2	4	2	5	3	3	2	4	4	3
n37	2	5	3	3	1	3	4	5	4	2	3	5	3	1
n38	3	1	2	1	1	4	5	5	2	4	1	1	3	1
n39	1	3	3	3	5	1	4	5	3	2	3	2	4	1
n40	1	4	4	4	3	2	5	5	1	2	3	2	4	1
n41	2	1	3	4	1	5	2	5	4	2	1	3	1	4
n42	2	5	1	1	2	1	5	5	3	4	2	3	4	3

N0	Q10	Q10	Q10	Q10	Q10	Q10	Q10	Q11	Q11	Q11	Q11	Q11	Q11	Q11
	H2	D1	J1	F1	L5	K4	G5	H2	D1	J1	F1	L5	K4	G5
n43	4	3	2	1	3	2	3	5	3	4	2	3	4	3
n44	2	5	1	2	2	1	5	3	2	3	2	3	4	2
n45	1	5	1	3	3	3	5	2	4	5	5	3	4	1
n46	1	5	1	3	3	3	5	5	2	3	3	3	3	1
n47	2	1	3	4	1	5	2	5	1	3	3	4	3	3
n48	1	5	1	3	4	1	2	5	4	1	1	3	2	1
n49	4	5	1	2	5	4	1	5	3	3	3	3	3	3
n50	2	2	3	2	1	4	5	5	3	3	2	2	4	1
n51	4	5	1	2	5	4	1	2	4	5	5	3	4	1
n52	4	5	3	1	5	1	3	5	3	4	2	3	4	3
n53	2	1	4	4	3	3	5	5	1	4	1	1	4	2
n54	2	1	4	4	2	2	2	5	4	2	3	4	4	2
n55	4	3	3	2	5	1	3	5	1	3	2	4	3	3
n56	1	5	2	2	3	1	4	5	3	3	2	3	4	1
n57	5	5	4	1	4	1	5	1	1	2	3	3	3	5
n58	1	2	3	2	1	4	3	3	3	3	3	5	5	2
n59	2	5	1	2	2	1	5	2	5	2	3	2	3	5
n60	3	2	2	1	1	1	2	3	2	3	2	3	4	2
n61	5	2	3	4	3	1	5	5	1	2	4	3	2	1
n62	2	5	3	1	3	4	5	5	4	2	3	1	3	4
n63	3	3	3	3	1	3	5	5	2	3	3	3	3	3
n64	2	5	2	3	3	1	1	5	3	2	1	2	3	4
n65	3	3	3	4	1	2	5	5	2	3	1	4	3	1
n66	2	4	3	4	1	3	5	1	1	3	1	2	3	2
n67	1	4	2	4	5	1	5	5	1	2	3	2	4	1
n68	1	1	4	4	3	3	5	4	4	2	3	1	3	3
n69	3	2	5	4	1	5	1	4	2	3	3	3	5	1
n70	3	3	3	3	3	3	1	5	3	3	3	3	3	3
n71	1	2	4	4	3	4	2	5	1	2	4	3	2	1
n72	3	1	4	3	2	3	5	5	3	2	3	3	3	1
n73	3	5	1	2	4	3	1	5	4	3	3	3	1	2
n74	4	3	1	2	2	2	5	5	1	2	3	3	4	3
n75	1	5	2	2	3	1	4	5	3	3	2	4	3	3
n76	4	3	1	2	2	2	5	5	4	2	1	3	1	4
n77	3	2	2	1	1	1	2	5	2	3	3	4	3	1
n78	2	1	3	3	3	3	5	5	4	3	3	3	3	2
n79	1	1	3	1	4	2	5	5	4	1	1	1	3	2
n80	2	4	5	3	1	1	2	3	2	3	1	3	4	2
n81	1	4	2	4	5	1	5	5	4	2	3	4	4	2
n82	4	5	3	2	5	3	1	5	1	3	3	4	3	1
n83	3	3	1	2	3	3	5	3	3	3	3	3	3	3
n84	2	5	1	1	2	1	5	3	4	3	3	3	3	4

NO	Q10	Q10	Q10	Q10	Q10	Q10	Q10	Q11	Q11	Q11	Q11	Q11	Q11	Q11
	H2	D1	J1	F1	L5	K4	G5	H2	D1	J1	F1	L5	K4	G5
n85	3	5	2	3	2	1	5	5	2	4	2	4	4	1
n86	3	3	3	3	3	1	5	3	5	3	3	3	1	3
n87	1	4	4	4	3	2	5	5	4	4	4	2	2	4
n88	3	1	4	1	1	1	1	3	1	2	1	1	3	1
n89	1	1	3	3	2	3	5	5	3	1	3	1	1	2
n90	2	4	1	5	5	3	1	5	1	4	2	4	3	1
n91	1	2	2	4	5	3	4	5	4	2	2	1	3	4
n92	4	2	3	3	2	1	5	5	2	3	3	4	3	1
n93	3	3	5	3	5	1	1	5	2	3	3	3	3	2
n94	3	4	3	2	3	1	5	1	3	1	4	2	5	3
n95	4	1	3	3	5	2	1	5	2	2	3	2	3	1
n96	3	4	1	2	2	1	4	4	1	3	2	3	3	4
n97	4	1	2	1	5	3	1	2	4	3	1	1	3	5
n98	3	3	3	3	3	3	3	3	3	3	3	3	3	3
n99	1	2	3	3	4	3	5	5	4	3	3	2	4	1
n100	3	3	3	4	2	3	5	3	3	3	3	3	3	3
n101	5	4	3	1	2	1	1	5	1	3	1	4	1	2
n102	2	3	5	4	1	4	2	5	1	4	2	3	4	3
n103	1	1	4	5	3	1	1	3	4	2	4	1	1	2
n104	1	1	3	4	2	3	5	5	5	3	2	4	3	1
n105	4	1	3	3	5	3	4	5	4	3	3	3	3	1
n106	4	4	2	3	5	2	5	4	5	1	2	4	3	2
n107	5	1	3	3	5	4	4	4	3	3	3	3	3	3
n108	1	5	3	1	2	4	1	5	2	4	3	1	1	1
n109	5	4	1	1	2	1	4	2	4	3	3	1	3	1
n110	3	1	2	1	4	1	5	5	3	1	1	4	1	2
n111	3	4	1	1	3	2	5	5	2	3	3	4	1	2
n112	1	1	4	1	2	3	5	5	1	1	1	4	3	2
n113	3	3	1	4	2	3	5	5	3	1	3	4	3	2
n114	3	3	3	3	2	1	3	5	3	1	3	4	3	3
n115	1	1	1	3	2	4	5	5	1	2	1	4	3	1
n116	3	1	3	2	3	3	1	5	2	3	3	3	3	1
n117	2	1	3	3	2	3	5	5	1	3	3	4	3	1
n118	1	1	3	3	2	3	5	5	1	3	3	4	4	2
n119	1	1	5	2	3	4	1	1	4	2	3	1	5	1
n120	3	3	4	4	1	3	5	5	3	3	2	4	3	1
n121	2	4	5	1	1	1	3	5	3	1	2	1	4	1
n122	2	5	3	3	1	2	4	5	1	3	3	2	3	4
n123	4	5	3	1	1	1	2	4	1	3	1	2	1	5
n124	2	1	3	3	4	3	5	5	4	2	2	1	3	1
n125	4	1	3	2	3	3	2	4	3	1	2	5	3	2
n126	2	4	3	4	1	3	5	1	1	2	3	3	3	5

No	Q12	Q12	Q12	Q12	Q12	Q12	Q12	Q13	Q13	Q13	Q13	Q13	Q13	Q13
	H2	D1	J1	F1	L5	K4	G5	H2	D1	J1	F1	L5	K4	G5
n1	3	1	5	2	3	2	1	4	5	2	1	4	3	1
n2	2	1	1	4	3	5	1	1	5	2	4	3	1	1
n3	4	1	5	4	4	4	1	4	2	2	2	3	4	2
n4	3	1	5	2	3	2	1	1	5	4	3	4	2	4
n5	4	4	5	4	4	4	3	5	5	4	4	4	1	4
n6	1	1	1	1	1	1	1	1	1	1	1	1	1	1
n7	4	1	5	4	4	4	1	4	5	2	2	4	1	5
n8	5	4	5	5	2	1	3	4	5	2	2	4	1	5
n9	3	3	5	4	2	3	3	4	5	2	2	2	1	2
n10	1	5	5	4	2	5	4	2	5	5	4	4	2	5
n11	1	1	1	1	1	1	1	1	5	4	4	2	2	5
n12	3	3	5	3	2	4	3	4	5	4	4	3	1	4
n13	5	2	3	4	3	4	3	4	5	4	4	4	2	4
n14	4	2	5	3	4	4	3	4	2	4	4	3	4	3
n15	2	1	5	3	4	3	1	4	5	2	3	3	3	3
n16	3	3	5	4	4	5	3	4	5	3	3	2	3	3
n17	3	1	3	4	2	3	3	2	2	4	3	5	3	3
n18	2	1	5	3	4	3	1	2	4	3	1	5	5	3
n19	3	3	2	3	4	5	3	1	5	2	2	3	4	5
n20	4	4	5	4	4	4	3	4	5	2	4	2	4	3
n21	1	2	5	4	2	4	3	4	4	2	2	5	3	1
n22	5	3	2	3	3	4	2	4	5	4	4	3	1	4
n23	3	4	5	3	4	3	4	4	2	4	4	3	4	3
n24	3	1	5	2	4	4	3	5	5	3	2	2	3	4
n25	4	3	4	3	4	3	4	2	5	4	2	2	4	5
n26	3	3	5	5	3	5	3	1	5	3	3	5	3	4
n27	3	2	1	3	1	4	5	3	1	5	3	5	2	4
n28	3	3	5	4	4	5	3	4	5	3	1	3	3	1
n29	4	4	2	3	4	2	4	1	3	5	4	2	5	2
n30	5	3	4	4	5	4	3	3	5	3	3	2	3	3
n31	5	4	5	5	2	1	3	4	5	2	3	3	3	3
n32	3	3	5	4	2	3	3	3	5	3	4	2	3	4
n33	1	2	4	5	5	3	3	1	5	3	3	2	4	1
n34	4	3	3	2	3	3	1	3	5	3	1	3	3	4
n35	1	5	5	4	2	5	4	2	4	3	1	5	5	3
n36	2	3	5	4	3	1	3	3	3	3	3	3	3	3
n37	2	1	4	5	3	4	3	1	5	2	3	4	3	5
n38	1	2	5	1	3	1	4	1	5	1	1	4	3	1
n39	2	4	1	3	1	5	3	4	3	5	3	5	3	3
n40	5	3	2	3	3	4	2	1	5	1	4	1	3	1
n41	3	3	5	4	1	5	2	1	3	5	4	2	5	2
n42	4	2	5	3	4	4	3	5	5	2	2	4	2	5

N0	Q12	Q12	Q12	Q12	Q12	Q12	Q12	Q13	Q13	Q13	Q13	Q13	Q13	Q13
	H2	D1	J1	F1	L5	K4	G5	H2	D1	J1	F1	L5	K4	G5
n43	5	4	5	5	2	1	3	2	5	4	2	2	4	5
n44	4	2	5	2	4	4	1	3	3	2	3	5	4	5
n45	3	4	5	3	4	3	4	5	5	4	4	4	1	4
n46	3	4	5	3	4	3	4	4	5	2	3	3	3	3
n47	3	3	5	4	1	5	2	3	5	3	1	3	3	4
n48	1	1	2	1	3	5	4	2	5	1	1	3	4	1
n49	3	4	5	1	2	4	5	4	5	4	4	4	2	4
n50	2	2	5	5	4	1	3	4	5	3	2	3	1	3
n51	3	4	5	1	2	4	5	1	5	1	4	1	3	1
n52	2	1	5	3	4	3	1	5	5	3	2	2	3	4
n53	5	3	5	2	3	5	1	4	5	3	1	3	3	2
n54	5	2	2	4	3	4	3	4	5	2	4	2	4	3
n55	3	3	5	4	4	4	3	3	4	3	3	3	3	5
n56	4	4	5	3	4	3	4	3	5	3	3	4	2	1
n57	5	2	2	4	3	4	3	1	5	4	3	4	2	4
n58	3	1	5	2	4	4	3	4	5	4	4	2	4	1
n59	4	4	5	3	4	3	4	4	5	4	4	2	4	1
n60	4	4	3	3	2	1	3	4	5	2	2	2	1	2
n61	4	4	3	3	2	1	3	2	2	4	3	5	3	3
n62	5	4	3	5	2	5	1	3	1	4	5	2	5	4
n63	1	1	5	4	4	4	2	1	5	3	3	3	3	4
n64	3	2	5	4	4	5	2	2	5	3	3	3	3	1
n65	1	3	3	4	4	3	5	1	5	3	3	4	4	2
n66	5	2	5	2	2	2	4	3	5	3	4	2	3	4
n67	4	4	2	3	4	2	4	5	5	2	2	4	2	5
n68	3	3	4	2	4	5	3	4	5	3	2	3	3	4
n69	1	3	5	4	2	1	3	1	5	3	3	2	3	4
n70	3	3	5	3	2	4	3	3	3	3	3	3	3	3
n71	3	1	3	4	2	3	3	2	5	4	2	2	4	5
n72	3	1	5	5	3	4	2	3	5	2	2	2	1	4
n73	1	3	5	3	2	4	3	4	5	3	2	1	3	3
n74	5	2	5	2	2	2	4	1	5	2	2	3	4	5
n75	3	3	2	3	4	5	3	3	3	2	3	5	4	5
n76	5	1	2	2	4	4	2	1	1	1	1	1	1	1
n77	4	3	3	2	3	3	1	2	4	3	1	5	5	3
n78	2	3	5	4	3	5	3	4	5	3	3	2	3	4
n79	2	3	5	1	1	4	1	4	5	1	2	3	1	1
n80	4	2	3	5	4	5	3	3	5	3	4	3	3	2
n81	5	2	3	4	3	4	3	2	5	5	4	4	2	5
n82	2	1	5	4	4	5	1	1	5	3	3	5	3	4
n83	3	3	5	4	3	3	3	3	5	3	3	3	3	3
n84	4	2	5	3	4	4	3	4	2	4	4	3	4	3

N0	Q12	Q12	Q12	Q12	Q12	Q12	Q12	Q13	Q13	Q13	Q13	Q13	Q13	Q13
	H2	D1	J1	F1	L5	K4	G5	H2	D1	J1	F1	L5	K4	G5
n85	4	2	5	2	4	4	1	1	5	4	4	2	2	5
n86	3	3	3	5	1	3	3	3	5	1	3	3	3	5
n87	5	1	2	2	4	4	2	4	2	2	2	3	4	2
n88	1	4	4	5	1	2	1	2	5	1	3	1	1	4
n89	3	3	4	5	1	5	1	4	5	3	3	4	3	1
n90	5	1	2	4	3	5	1	2	5	4	1	1	3	5
n91	1	2	5	4	4	3	2	1	5	2	4	4	3	2
n92	3	3	5	2	3	3	3	1	5	3	2	3	3	4
n93	3	3	5	4	3	5	3	3	5	3	2	3	3	3
n94	5	2	3	1	1	4	1	4	1	5	2	3	1	3
n95	2	1	5	4	3	3	4	1	5	4	4	2	3	4
n96	2	2	5	4	3	4	3	1	5	3	4	4	3	4
n97	3	2	5	4	1	1	1	2	4	1	1	1	3	5
n98	3	3	3	3	3	3	3	3	5	3	1	4	2	3
n99	3	1	4	5	4	4	2	1	5	4	3	3	3	2
n100	1	3	4	3	3	3	3	4	5	3	3	3	3	3
n101	1	2	5	1	4	3	1	1	4	3	2	1	1	5
n102	3	4	5	3	1	2	1	1	5	4	4	2	3	2
n103	4	3	1	1	2	4	1	5	3	2	4	1	1	1
n104	1	1	2	3	4	2	3	1	5	4	3	2	4	3
n105	3	3	3	5	3	4	2	4	5	3	3	3	3	2
n106	2	5	3	1	1	4	2	3	4	2	5	1	3	4
n107	3	3	5	5	3	4	3	3	5	3	3	3	2	3
n108	5	4	5	2	1	5	3	5	5	4	2	1	3	2
n109	4	3	4	3	4	3	4	4	5	2	1	4	3	1
n110	1	1	5	2	5	4	1	3	5	1	1	4	1	2
n111	3	2	5	4	3	4	3	3	5	3	2	3	4	4
n112	2	3	4	5	1	1	1	2	5	1	1	3	1	4
n113	1	3	5	4	2	3	3	4	5	3	2	1	3	3
n114	1	3	3	5	3	3	3	3	5	3	1	3	3	1
n115	1	2	3	1	1	5	4	5	4	1	2	1	3	1
n116	3	2	5	4	4	5	2	1	5	3	3	2	3	4
n117	3	1	5	4	3	4	1	3	5	3	3	3	3	4
n118	2	1	5	4	4	4	1	4	5	3	2	4	3	4
n119	1	4	5	1	1	3	2	1	4	1	5	2	3	1
n120	3	3	5	1	1	4	4	3	5	3	1	2	3	4
n121	3	1	5	2	1	4	1	1	1	1	2	3	4	5
n122	3	3	5	4	2	1	3	3	5	3	3	4	2	1
n123	5	2	1	1	3	4	1	5	1	1	3	4	2	1
n124	2	1	4	4	3	5	3	4	4	3	3	1	3	4
n125	3	2	4	5	3	3	3	3	5	3	4	3	3	3
n126	2	3	5	4	3	1	3	3	5	3	3	4	2	1

No	Q14	Q14	Q14	Q14	Q14	Q14	Q14	Q15	Q15	Q15	Q15	Q15	Q15	Q15
	H2	D1	J1	F1	L5	K4	G5	H2	D1	J1	F1	L5	K4	G5
n1	1	1	4	4	3	5	3	4	2	4	4	4	4	2
n2	2	1	3	4	1	5	1	1	2	5	1	4	3	1
n3	3	2	4	4	4	5	2	5	3	3	3	3	3	3
n4	1	1	5	4	2	5	1	1	4	5	4	3	2	4
n5	3	5	5	5	3	5	4	5	4	1	4	5	4	4
n6	3	3	2	1	4	5	1	3	2	5	4	3	4	1
n7	1	4	5	2	4	2	4	5	1	4	4	5	4	1
n8	4	1	5	4	4	5	1	4	3	5	2	4	5	3
n9	2	1	4	4	4	5	3	3	2	1	4	5	3	2
n10	1	4	4	2	2	3	4	1	3	5	2	1	5	3
n11	1	5	1	4	1	4	1	4	1	4	3	5	4	1
n12	3	2	4	4	4	5	2	1	3	5	2	1	5	3
n13	4	1	5	4	4	5	1	4	1	4	4	2	4	1
n14	5	4	5	4	5	5	1	5	1	4	4	5	2	3
n15	1	1	5	4	2	5	1	4	3	5	2	4	5	3
n16	3	3	5	3	3	5	3	3	3	5	4	3	4	1
n17	3	5	3	5	2	3	4	5	1	3	3	2	3	4
n18	2	1	4	4	4	5	3	5	1	5	4	3	3	1
n19	3	3	2	1	4	5	1	4	1	4	4	2	4	1
n20	2	1	4	4	4	5	3	3	2	4	2	5	4	3
n21	3	1	4	5	2	4	2	3	2	5	4	2	4	1
n22	3	3	4	4	1	4	1	1	3	3	3	5	4	1
n23	3	5	5	5	3	5	4	5	1	4	4	5	2	3
n24	3	2	3	2	3	4	1	3	2	4	2	5	4	3
n25	3	5	3	5	2	3	4	3	2	5	4	3	4	1
n26	3	3	3	5	3	3	3	2	1	5	4	3	5	2
n27	3	5	1	3	1	4	2	3	2	1	3	1	4	5
n28	3	2	4	5	5	4	1	2	3	4	4	5	3	1
n29	4	2	2	2	3	5	1	3	4	2	4	3	3	1
n30	3	2	5	4	5	4	1	3	2	4	4	3	5	1
n31	3	1	5	3	3	5	1	1	4	5	4	3	2	4
n32	4	1	3	4	2	5	3	4	1	3	3	2	4	4
n33	2	3	4	1	5	1	1	3	1	5	5	2	4	1
n34	3	1	5	3	3	5	1	3	1	5	3	3	5	1
n35	5	1	3	5	3	5	2	4	1	2	2	5	4	1
n36	2	1	4	5	2	5	2	4	1	5	3	5	4	1
n37	2	1	3	5	4	5	2	2	1	2	3	4	3	5
n38	1	1	4	1	5	2	3	3	2	4	1	1	1	5
n39	1	4	2	3	3	4	5	1	4	4	3	5	5	3
n40	3	1	2	3	3	5	4	1	4	4	2	5	5	1
n41	4	5	3	3	1	2	1	3	3	4	5	2	4	1
n42	1	4	5	2	4	2	4	4	1	3	3	2	4	4

N0	Q14	Q14	Q14	Q14	Q14	Q14	Q14	Q15	Q15	Q15	Q15	Q15	Q15	Q15
	H2	D1	J1	F1	L5	K4	G5	H2	D1	J1	F1	L5	K4	G5
n43	4	2	5	2	3	5	1	4	3	5	2	4	5	3
n44	1	4	4	2	2	3	4	3	1	5	3	3	5	1
n45	4	2	5	2	3	5	1	5	4	1	4	5	4	4
n46	3	2	4	4	4	5	2	4	1	5	3	5	4	1
n47	5	4	4	3	4	5	1	5	1	5	4	3	3	1
n48	1	1	3	1	2	5	4	1	1	5	4	3	2	1
n49	4	2	4	1	5	3	1	4	1	5	3	5	4	1
n50	2	2	4	4	3	5	1	2	1	5	3	4	5	1
n51	1	5	1	4	1	4	1	4	1	2	2	2	3	1
n52	4	2	5	2	3	5	1	5	1	3	3	2	3	4
n53	3	1	4	3	4	5	2	3	2	5	3	4	4	1
n54	5	1	3	5	3	5	2	3	1	4	2	5	3	1
n55	3	2	4	5	3	3	4	2	2	4	4	3	5	3
n56	4	1	4	2	4	5	2	5	1	4	4	5	4	1
n57	3	1	2	3	3	5	4	3	1	4	3	1	5	1
n58	3	3	4	4	1	4	1	2	1	4	5	2	5	2
n59	2	3	4	3	2	3	1	3	4	2	4	3	3	1
n60	4	2	3	4	3	3	2	4	2	4	4	4	4	2
n61	4	5	3	3	1	2	1	3	3	4	5	2	4	1
n62	5	1	4	5	5	3	2	5	1	3	4	2	5	1
n63	2	1	4	4	3	5	3	2	2	5	4	3	4	1
n64	2	1	4	4	3	5	1	3	2	4	3	5	4	1
n65	3	3	4	4	1	5	2	1	3	5	4	2	4	2
n66	2	3	4	3	2	3	1	5	1	5	4	3	3	1
n67	5	4	5	4	5	5	1	5	1	4	3	5	5	1
n68	2	3	4	3	4	5	1	1	2	5	3	4	4	3
n69	3	2	4	4	3	5	1	4	2	3	3	5	3	1
n70	1	1	4	4	3	5	3	5	3	3	3	3	3	3
n71	3	2	3	2	3	4	1	4	1	2	2	2	3	1
n72	3	1	3	3	2	4	5	3	2	5	4	4	1	1
n73	1	2	4	4	3	5	3	3	2	4	3	4	5	1
n74	5	4	4	3	4	5	1	1	4	4	2	5	5	1
n75	3	2	3	4	3	5	2	3	1	4	3	1	5	1
n76	3	2	3	4	3	5	2	5	1	4	3	5	5	1
n77	4	1	3	4	2	5	3	3	1	4	2	5	3	1
n78	2	2	3	4	3	3	5	2	1	4	4	5	4	3
n79	1	2	1	1	4	5	3	2	1	4	3	1	5	1
n80	3	3	5	3	3	3	1	4	2	4	5	3	5	1
n81	4	2	3	4	3	3	2	1	3	3	3	5	4	1
n82	2	1	4	5	3	5	3	1	2	5	3	4	5	1
n83	3	3	3	3	3	5	3	3	3	3	3	4	5	2
n84	3	1	2	3	3	5	4	5	1	4	4	5	2	3

N0	Q14	Q14	Q14	Q14	Q14	Q14	Q14	Q15	Q15	Q15	Q15	Q15	Q15	Q15
	H2	D1	J1	F1	L5	K4	G5	H2	D1	J1	F1	L5	K4	G5
n85	4	1	4	2	4	5	2	4	1	4	3	5	4	1
n86	2	1	5	4	3	5	1	2	1	3	4	3	3	1
n87	4	2	2	2	3	5	1	4	1	2	2	5	4	1
n88	1	4	2	3	1	5	1	5	1	2	3	1	4	1
n89	2	2	5	3	5	5	3	3	3	3	3	4	1	2
n90	1	1	5	4	2	5	3	1	1	5	4	5	5	1
n91	1	2	2	4	5	3	4	5	4	4	2	2	3	1
n92	3	3	4	3	2	5	1	3	3	5	3	4	4	1
n93	3	3	3	4	4	3	1	3	3	3	3	4	4	2
n94	3	1	5	2	3	4	1	3	2	1	1	5	3	4
n95	1	2	4	3	3	5	1	2	2	3	4	5	4	1
n96	2	1	4	3	3	5	2	2	2	4	3	2	4	3
n97	1	1	4	3	1	5	2	1	1	5	4	2	3	1
n98	1	4	3	3	2	3	5	2	2	4	3	4	5	1
n99	3	1	2	2	5	5	4	3	4	5	2	3	5	1
n100	2	3	4	3	3	5	3	3	3	4	3	3	3	1
n101	1	2	3	5	1	4	1	5	2	3	1	4	1	1
n102	5	2	3	2	4	3	1	3	1	4	2	4	5	1
n103	2	3	4	1	1	5	1	5	1	3	1	2	1	4
n104	2	1	5	3	4	5	3	2	1	5	4	4	5	3
n105	2	1	4	4	3	5	4	2	1	5	3	5	4	1
n106	1	3	2	4	5	3	2	2	5	3	1	1	2	3
n107	3	3	4	3	3	3	2	3	3	3	3	4	3	3
n108	3	4	5	2	1	5	1	1	4	2	3	1	5	1
n109	2	1	4	5	2	5	2	2	1	4	5	2	5	2
n110	1	1	4	1	3	5	2	1	1	4	1	3	5	2
n111	2	2	4	5	3	4	1	3	2	4	3	4	5	1
n112	2	1	4	1	3	5	1	2	1	4	1	5	3	1
n113	3	2	4	4	4	5	1	3	2	5	4	5	4	1
n114	3	1	4	3	4	5	2	3	2	5	3	3	4	1
n115	1	5	1	1	2	3	4	1	1	5	1	2	3	4
n116	4	3	5	2	3	5	1	3	2	5	4	3	5	1
n117	2	1	4	4	4	5	1	4	1	4	4	5	4	1
n118	4	1	4	4	4	5	2	4	1	4	4	5	5	1
n119	1	3	1	5	2	4	1	5	2	4	3	1	1	1
n120	2	1	4	4	4	5	4	2	3	4	3	4	5	1
n121	4	3	2	1	1	5	1	5	1	2	4	1	1	3
n122	3	2	4	5	3	3	1	4	1	5	3	4	3	1
n123	1	2	5	4	1	3	1	5	1	1	1	2	4	3
n124	1	2	3	3	4	3	5	2	1	4	5	2	4	1
n125	2	3	1	4	3	5	1	4	1	5	2	4	5	2
n126	4	2	4	1	5	3	1	3	2	1	4	5	3	2

N0	Q16 f1	Q16 f2	Q16 f3	Q16 f4	Q16 f5	Q17 g1	Q17 g2	Q17 g3	Q17 g4	Q17 g5	Q18 h1	Q18 h2	Q18 h3	Q18 h4	Q18 h5
n1	3	3	3	1	1	3	3	1	3	1	3	3	1	2	1
n2	3	1	1	1	2	3	2	1	1	1	3	1	1	2	1
n3	3	3	1	3	1	3	2	1	3	3	3	3	1	2	2
n4	3	3	1	3	1	3	2	1	3	3	3	3	1	1	1
n5	1	1	2	3	3	3	3	3	3	3	3	3	3	3	1
n6	1	2	3	1	3	2	3	1	2	1	3	3	1	2	1
n7	1	3	1	1	3	1	3	1	1	3	3	3	1	3	1
n8	1	1	2	3	3	3	3	3	3	3	3	3	1	3	2
n9	3	3	1	3	1	3	2	1	1	1	3	3	1	2	1
n10	3	1	1	2	1	2	3	1	2	3	3	3	1	3	2
n11	3	1	1	2	3	1	2	1	3	3	3	3	1	1	1
n12	3	2	1	2	1	3	2	1	2	1	3	3	1	2	1
n13	3	1	1	2	3	1	2	1	3	3	3	3	3	1	1
n14	1	1	1	1	3	3	3	1	1	3	3	1	3	3	1
n15	3	2	1	3	3	3	1	3	2	3	3	3	3	3	1
n16	2	1	2	2	3	3	2	1	2	2	3	3	2	2	1
n17	3	2	1	2	3	1	3	2	3	2	3	3	1	2	2
n18	3	2	1	3	1	3	1	2	3	1	3	3	1	2	2
n19	3	1	3	1	3	1	2	3	2	3	3	3	3	1	1
n20	1	2	1	3	2	3	1	1	1	2	3	3	1	2	2
n21	3	2	1	3	1	1	3	1	3	2	2	2	1	3	3
n22	3	1	2	1	3	1	2	3	3	2	3	3	1	2	1
n23	3	2	1	3	1	3	1	2	3	1	3	3	1	3	1
n24	1	2	1	3	2	3	1	1	1	2	3	3	1	2	1
n25	3	2	1	3	3	1	3	1	2	1	3	3	1	1	1
n26	2	3	2	2	2	1	2	1	3	2	3	3	1	1	1
n27	2	2	2	3	1	3	2	2	3	1	1	2	2	3	2
n28	2	2	1	3	2	2	3	1	3	2	3	1	2	1	3
n29	3	3	2	2	1	1	2	2	3	2	3	3	1	1	1
n30	3	1	1	2	2	1	3	3	2	1	3	3	1	2	1
n31	3	3	1	3	1	3	3	1	3	3	3	3	1	3	1
n32	3	1	3	3	2	1	3	3	3	3	3	3	2	1	2
n33	3	2	1	2	1	1	2	2	2	3	3	3	1	2	1
n34	3	2	1	3	1	1	1	1	3	2	3	3	3	1	2
n35	3	2	1	3	1	1	1	1	3	2	3	3	1	1	1
n36	3	1	1	2	1	2	3	1	2	3	3	3	1	2	1
n37	3	2	1	3	1	3	2	1	1	2	3	3	1	2	1
n38	1	2	1	3	1	1	1	1	2	3	3	1	1	2	1
n39	3	1	2	3	3	3	2	1	3	1	3	1	2	2	1
n40	3	3	1	3	1	1	3	1	3	3	3	3	3	1	2
n41	3	3	1	1	2	1	2	3	3	2	3	3	1	1	2
n42	3	2	1	3	3	3	1	3	2	3	3	3	1	3	1

N0	Q16 f1	Q16 f2	Q16 f3	Q16 f4	Q16 f5	Q17 g1	Q17 g2	Q17 g3	Q17 g4	Q17 g5	Q18 h1	Q18 h2	Q18 h3	Q18 h4	Q18 h5
n43	3	2	1	3	3	3	1	3	2	3	3	3	1	3	1
n44	1	3	1	1	3	1	3	1	1	3	3	3	1	2	1
n45	3	3	1	3	1	3	3	1	3	3	3	3	1	3	1
n46	3	3	1	3	1	3	3	1	3	3	3	3	1	3	1
n47	3	1	2	1	3	2	1	2	1	3	3	1	2	2	3
n48	1	3	1	1	2	3	2	1	1	1	1	3	1	2	1
n49	1	2	3	1	3	2	3	1	2	1	3	3	1	2	1
n50	3	1	2	1	3	1	3	1	2	1	3	3	1	2	1
n51	3	1	2	1	3	2	1	2	1	3	3	1	2	2	3
n52	3	2	1	3	1	3	1	2	3	1	3	3	1	3	1
n53	2	1	2	3	2	1	3	3	2	2	3	2	1	1	1
n54	3	3	1	1	3	1	2	3	3	2	3	3	1	2	1
n55	3	2	1	3	2	3	2	1	3	1	3	3	2	2	1
n56	1	1	1	1	3	1	3	1	3	1	3	2	2	2	1
n57	3	2	1	2	2	1	3	3	2	1	3	3	1	1	3
n58	3	1	1	1	2	3	1	1	1	3	3	3	1	2	2
n59	3	3	3	1	1	3	3	1	3	1	3	1	3	3	1
n60	3	2	1	2	1	3	2	1	2	1	3	3	3	1	2
n61	3	1	3	3	2	1	3	3	3	3	3	3	2	1	2
n62	1	2	1	2	3	3	3	1	1	2	3	3	1	2	1
n63	3	2	1	2	1	1	2	3	2	3	3	3	1	2	1
n64	2	3	2	2	1	1	2	1	3	1	1	1	2	2	3
n65	3	2	1	2	2	2	2	1	3	2	3	2	2	2	1
n66	1	1	1	1	3	1	3	1	3	1	3	3	2	2	1
n67	3	3	1	3	1	1	3	1	3	3	3	3	1	1	3
n68	3	1	2	3	2	1	2	1	3	3	3	2	1	1	1
n69	3	3	1	2	1	1	2	1	3	2	3	2	2	1	3
n70	3	2	1	3	3	1	3	1	2	1	3	3	1	2	1
n71	3	2	1	2	3	1	3	2	3	2	1	1	1	1	1
n72	3	3	1	3	2	3	1	3	2	3	3	3	1	2	1
n73	3	1	1	3	2	2	2	1	3	3	3	3	2	1	2
n74	3	1	3	1	3	1	2	3	2	3	3	3	1	1	1
n75	3	3	2	2	1	1	2	2	3	2	3	2	2	2	1
n76	3	1	2	1	3	1	2	3	3	2	3	3	1	1	2
n77	3	3	1	1	3	1	2	3	3	2	3	3	3	1	2
n78	2	3	2	2	1	1	2	3	2	3	3	3	1	1	1
n79	1	2	1	3	1	3	2	1	1	1	1	3	1	2	1
n80	1	3	2	3	1	1	2	1	3	3	3	3	1	1	1
n81	3	3	1	1	2	1	2	3	3	2	3	3	1	1	1
n82	1	3	2	1	2	1	3	2	3	2	3	3	1	2	1
n83	2	2	2	1	2	1	3	2	2	2	3	3	2	2	1
n84	1	1	1	1	3	1	3	1	3	1	3	3	1	1	1

N0	Q16 f1	Q16 f2	Q16 f3	Q16 f4	Q16 f5	Q17 g1	Q17 g2	Q17 g3	Q17 g4	Q17 g5	Q18 h1	Q18 h2	Q18 h3	Q18 h4	Q18 h5
n85	3	1	1	1	2	3	1	1	1	3	3	3	1	1	1
n86	3	2	1	2	3	1	3	3	2	2	3	2	1	2	2
n87	1	1	1	1	3	3	3	1	1	3	1	1	1	1	1
n88	1	2	1	1	3	1	1	1	2	3	3	3	1	2	1
n89	3	2	2	2	1	1	2	2	3	2	3	3	2	1	1
n90	3	1	1	2	3	1	1	3	2	3	3	3	1	2	1
n91	2	2	3	2	3	1	3	2	3	1	3	3	1	2	1
n92	3	2	2	1	3	1	2	2	3	3	3	3	2	1	2
n93	3	2	1	2	2	2	1	3	1	2	3	3	1	2	2
n94	3	2	1	2	2	3	3	2	1	2	3	3	2	1	1
n95	3	2	2	1	2	3	3	1	3	2	3	2	1	2	1
n96	3	2	1	2	1	3	2	2	1	1	3	3	1	2	1
n97	3	1	2	1	1	3	1	2	1	1	3	2	1	1	1
n98	1	3	2	2	1	1	2	2	3	2	3	2	2	1	2
n99	3	3	2	1	1	2	2	1	3	1	3	3	2	1	2
n100	3	3	1	3	3	2	2	2	2	2	2	2	1	2	2
n101	1	2	1	3	1	1	2	1	3	1	1	3	1	2	1
n102	1	3	2	3	2	1	2	3	3	3	3	2	2	1	2
n103	1	1	3	2	1	1	3	2	1	1	3	1	2	1	1
n104	3	3	1	2	1	1	2	3	2	3	3	3	1	2	1
n105	3	2	1	2	3	1	2	2	3	2	3	2	1	1	1
n106	3	1	2	2	3	2	1	3	1	2	3	3	2	2	1
n107	3	2	2	2	1	2	2	1	2	3	3	3	2	1	1
n108	1	1	2	3	1	1	1	2	3	1	3	3	2	2	1
n109	3	3	1	3	1	3	2	1	1	1	3	3	1	2	1
n110	3	1	1	1	2	1	2	1	3	1	1	3	1	1	2
n111	3	2	1	3	1	1	1	3	3	2	3	3	2	2	1
n112	3	2	1	1	1	1	3	1	2	1	3	1	2	1	1
n113	2	2	1	3	2	1	2	2	3	3	3	3	1	2	1
n114	3	2	2	1	2	1	2	2	2	3	3	2	2	1	2
n115	1	3	1	1	2	1	1	2	3	1	1	3	2	1	1
n116	3	2	1	3	1	1	2	3	2	3	3	3	1	1	1
n117	3	3	1	3	1	1	2	3	3	3	3	3	2	1	1
n118	3	3	1	3	1	1	3	3	3	3	3	3	2	1	1
n119	1	3	2	1	1	1	3	2	1	1	3	2	1	1	1
n120	3	2	1	3	1	1	2	2	3	3	3	1	1	2	1
n121	1	3	1	2	1	1	1	3	2	1	3	1	1	1	2
n122	3	2	1	2	1	1	2	3	3	1	3	3	1	1	1
n123	3	1	1	2	1	3	1	1	1	2	3	1	1	1	2
n124	3	1	2	2	2	3	2	1	2	2	3	2	2	1	2
n125	3	1	2	3	3	3	2	3	3	2	3	1	1	1	1
n126	3	2	1	2	2	1	3	3	2	1	3	3	2	2	1

No	Q19 j1	Q19 j2	Q19 j3	Q19 j4	Q19 j5	Q20 d1	Q20 d2	Q20 d3	Q20 d4	Q20 d5	Q21 k1	Q21 k2	Q21 k3	Q21 k4	Q21 k5
n1	3	2	3	1	3	1	1	1	2	3	3	1	1	2	3
n2	1	2	3	1	1	1	1	1	3	2	1	1	3	2	1
n3	3	3	1	1	1	3	1	1	3	2	1	1	2	2	3
n4	3	1	3	2	3	3	3	3	1	2	1	1	1	1	1
n5	3	3	2	3	1	3	3	3	3	3	3	3	1	3	3
n6	3	2	1	3	1	3	3	2	1	2	3	1	3	2	2
n7	3	3	1	1	3	3	1	3	1	3	3	1	1	3	1
n8	3	1	3	1	3	1	2	2	3	2	2	1	3	2	3
n9	3	3	3	2	3	3	2	2	2	1	3	1	3	2	2
n10	3	1	3	1	3	1	3	2	2	1	1	1	3	3	3
n11	3	3	1	3	1	3	1	3	1	2	3	1	1	1	3
n12	3	2	1	3	1	1	1	1	2	3	3	1	1	2	3
n13	1	3	1	1	3	3	3	3	1	2	1	3	2	3	3
n14	3	3	1	3	1	3	3	1	3	2	1	3	2	2	1
n15	3	3	2	3	1	1	3	1	3	2	1	1	3	3	2
n16	3	3	2	2	1	1	3	2	2	2	1	2	3	2	3
n17	1	3	3	1	2	3	2	2	1	1	2	1	3	2	2
n18	3	3	1	1	1	3	2	2	2	1	3	1	3	2	2
n19	1	3	1	1	3	3	3	3	1	2	1	3	2	3	3
n20	3	3	1	1	1	3	2	2	2	1	3	1	3	2	2
n21	3	2	3	1	1	2	1	2	3	2	1	2	3	2	3
n22	3	1	3	2	3	3	3	1	3	2	1	3	2	2	1
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n24	3	3	3	1	3	3	2	2	1	3	1	1	2	3	2
n25	1	1	1	3	1	3	3	2	1	2	3	1	3	2	2
n26	3	3	3	1	3	2	3	3	2	3	1	2	3	2	3
n27	2	1	2	2	3	3	2	2	1	2	1	1	2	3	2
n28	3	3	3	1	3	2	2	1	3	3	2	1	3	3	3
n29	3	1	1	3	1	3	3	3	1	3	1	3	3	1	1
n30	1	3	2	1	3	3	1	3	2	2	1	2	3	2	1
n31	3	3	1	2	3	3	1	3	3	2	3	3	1	1	2
n32	2	3	2	2	3	3	3	3	1	1	1	1	1	2	2
n33	2	3	2	1	3	2	3	2	2	1	2	1	1	2	3
n34	1	3	3	2	3	3	3	1	1	2	1	1	3	2	2
n35	1	1	1	3	1	3	3	1	1	2	1	1	3	2	2
n36	3	1	3	2	3	1	3	2	2	1	1	1	3	3	3
n37	3	2	3	2	1	3	1	2	2	1	3	2	3	1	2
n38	2	1	1	1	3	1	3	1	1	2	1	1	3	1	2
n39	3	3	3	2	2	2	2	3	1	2	1	1	3	2	3
n40	1	1	1	2	3	3	3	2	1	1	1	1	1	3	1
n41	3	2	2	1	3	1	3	1	3	2	1	1	3	3	2
n42	3	3	3	2	3	3	3	3	3	3	3	3	1	3	3

N0	Q19 j1	Q19 j2	Q19 j3	Q19 j4	Q19 j5	Q20 d1	Q20 d2	Q20 d3	Q20 d4	Q20 d5	Q21 k1	Q21 k2	Q21 k3	Q21 k4	Q21 k5
n43	3	3	1	2	3	3	3	2	1	1	3	1	3	3	1
n44	3	3	3	2	3	3	1	3	1	3	3	1	1	3	1
n45	3	3	3	2	3	3	1	2	3	3	1	1	3	2	3
n46	3	3	3	2	3	3	1	2	3	3	1	1	3	2	3
n47	1	3	1	1	3	3	1	2	2	2	1	2	3	2	2
n48	1	2	1	3	1	1	1	3	1	2	1	1	3	2	1
n49	3	3	3	1	3	1	1	1	2	3	3	3	3	3	1
n50	3	3	1	2	1	2	3	1	3	1	1	1	3	2	3
n51	1	3	1	1	3	3	2	1	3	2	2	1	3	2	1
n52	3	3	1	2	3	3	1	2	3	3	1	1	3	2	3
n53	3	3	1	2	3	2	3	3	1	1	2	2	3	1	1
n54	3	2	3	1	3	3	1	3	3	2	3	3	1	1	2
n55	3	2	3	1	3	2	3	3	2	1	1	3	3	2	2
n56	3	2	1	2	3	3	3	2	1	1	3	1	3	3	1
n57	3	1	1	1	3	3	3	1	1	1	1	1	1	2	3
n58	1	3	3	1	2	3	3	1	2	2	1	1	1	3	1
n59	3	3	1	3	1	3	3	3	1	3	1	3	3	1	1
n60	1	1	1	2	3	1	1	1	2	3	3	3	3	3	1
n61	2	3	2	2	3	3	3	3	1	1	1	1	1	2	2
n62	3	1	1	2	3	3	3	3	1	2	3	3	2	1	1
n63	3	3	3	1	3	2	3	3	1	2	1	2	3	3	2
n64	3	2	3	1	3	1	3	3	1	2	1	1	3	2	3
n65	2	3	2	2	1	3	2	1	2	2	1	2	3	2	2
n66	3	2	1	2	3	3	3	2	1	1	3	1	3	3	1
n67	3	1	1	1	3	3	3	1	1	1	1	1	1	2	3
n68	3	2	3	1	3	3	3	1	2	3	1	2	3	3	3
n69	3	2	3	1	3	2	3	2	2	1	1	1	3	2	3
n70	3	3	3	2	3	3	3	3	1	2	1	2	3	2	2
n71	1	3	1	1	3	3	2	2	1	1	2	1	3	2	2
n72	3	2	2	1	2	3	2	2	3	1	1	3	1	2	2
n73	3	3	3	1	2	3	3	1	1	2	1	2	3	3	2
n74	3	1	1	3	1	3	3	2	1	1	1	1	1	3	1
n75	3	2	1	2	3	3	1	2	2	2	1	2	3	2	2
n76	3	2	2	1	3	3	2	2	1	3	1	1	2	3	2
n77	1	3	3	2	3	3	3	3	1	2	1	2	3	2	2
n78	3	3	3	1	3	3	3	2	2	1	3	3	3	2	2
n79	1	1	1	2	3	1	3	1	1	2	1	1	1	2	3
n80	1	2	1	3	1	3	3	3	2	2	3	1	2	1	3
n81	3	1	3	2	3	3	3	3	1	2	1	1	1	1	1
n82	3	1	2	2	3	1	3	3	1	2	1	3	1	3	2
n83	1	2	3	2	3	2	2	3	2	1	3	3	3	2	2
n84	1	1	1	3	1	1	1	1	2	3	3	1	1	2	3

N0	Q19 j1	Q19 j2	Q19 j3	Q19 j4	Q19 j5	Q20 d1	Q20 d2	Q20 d3	Q20 d4	Q20 d5	Q21 k1	Q21 k2	Q21 k3	Q21 k4	Q21 k5
n85	3	3	1	3	1	3	1	3	1	2	3	1	1	1	3
n86	3	3	3	1	3	1	3	2	2	1	1	2	3	2	2
n87	1	3	1	1	3	3	3	1	2	2	1	1	1	3	1
n88	1	2	3	1	3	3	1	3	2	1	1	3	1	2	1
n89	3	3	3	1	2	3	3	2	1	2	1	2	3	2	2
n90	2	3	3	2	3	3	2	3	1	2	1	1	1	2	3
n91	3	2	3	1	1	3	3	2	1	2	3	3	1	2	1
n92	3	1	3	2	3	3	3	2	1	2	2	2	3	1	1
n93	3	2	2	1	2	2	2	2	3	1	2	1	3	2	3
n94	2	3	3	1	3	1	2	3	2	2	3	2	1	1	1
n95	3	1	3	1	2	2	3	3	1	1	1	1	3	3	1
n96	3	3	3	1	3	3	3	3	1	2	1	3	3	2	2
n97	1	1	3	1	2	2	3	1	1	3	1	2	3	1	1
n98	2	2	3	1	2	3	2	2	2	1	1	2	3	2	2
n99	3	2	3	1	3	3	2	3	1	2	1	3	2	2	2
n100	3	2	2	2	2	2	2	2	2	1	2	2	2	2	3
n101	1	1	3	2	1	1	3	1	1	2	1	1	3	2	1
n102	2	2	3	1	3	3	3	2	1	2	1	3	3	2	2
n103	3	1	1	2	1	1	1	3	2	1	3	2	1	1	1
n104	3	2	3	1	3	3	2	3	1	2	1	3	3	2	2
n105	3	3	3	1	3	1	3	3	2	1	1	3	2	2	2
n106	3	1	2	1	3	1	3	3	2	2	1	2	3	3	2
n107	3	3	3	1	3	3	3	3	1	2	2	2	3	3	1
n108	3	2	3	1	3	3	1	1	3	2	2	1	3	1	1
n109	3	3	3	2	3	3	1	1	3	2	1	1	2	2	3
n110	1	1	2	1	3	1	3	1	1	2	1	1	3	1	2
n111	3	3	3	1	3	3	3	2	1	2	2	1	2	3	2
n112	3	2	1	2	1	2	1	3	1	1	1	1	3	1	2
n113	3	2	3	1	3	2	3	3	2	1	1	2	3	2	2
n114	3	2	2	1	2	1	3	2	2	2	1	2	2	2	3
n115	1	2	1	1	3	1	3	1	1	2	2	1	1	3	1
n116	3	3	3	1	3	3	3	3	1	2	1	1	3	2	2
n117	3	3	3	1	3	3	3	3	1	1	1	1	3	3	3
n118	3	3	3	1	3	3	3	3	1	1	1	1	3	3	1
n119	1	1	2	1	3	3	2	1	1	1	1	2	3	1	1
n120	3	1	3	2	3	3	1	2	2	2	1	3	3	2	3
n121	1	1	3	2	1	3	1	2	1	1	1	3	1	2	1
n122	3	2	1	2	3	3	3	3	1	2	1	1	2	3	1
n123	3	1	2	1	1	1	3	2	1	1	3	1	1	2	1
n124	3	3	3	1	3	3	3	2	1	2	1	2	3	2	3
n125	1	3	3	3	2	3	3	3	1	2	1	3	2	2	3
n126	3	2	1	2	3	1	2	2	3	2	2	1	3	2	3

No	Q22 L1	Q22 L2	Q22 L3	Q22 L4	Q22 L5	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30	Q31
n1	2	2	1	3	1	c3	c11	c14	c18	c12	c3	c8	c12	c13
n2	1	3	1	1	2	c11	c16	c13	c16	c7	c5	c6	c18	c4
n3	1	2	1	3	1	c18	c11	c13	c16	c11	c15	c5	c20	c14
n4	2	3	3	3	1	c18	c11	c13	c16	c18	c15	c4	c8	c1
n5	1	1	3	3	1	c11	c5	c2	c16	c11	c4	c8	c14	c16
n6	2	3	3	2	1	c18	c18	c13	c16	c11	c15	c4	c8	c1
n7	3	3	3	3	1	c11	c13	c5	c8	c10	c14	c12	c6	c9
n8	3	3	3	3	1	c18	c16	c13	c17	c9	c10	c5	c6	c15
n9	1	3	3	3	1	c20	c15	c17	c10	c20	c14	c14	c9	c20
n10	2	3	3	1	2	c2	c16	c13	c18	c19	c5	c6	c12	c15
n11	2	3	2	2	2	c2	c5	c13	c16	c2	c15	c10	c12	c5
n12	2	3	1	2	1	c8	c1	c8	c20	c9	c7	c9	c4	c1
n13	3	3	1	3	1	c1	c20	c13	c6	c1	c15	c4	c19	c1
n14	3	3	1	3	1	c15	c16	c13	c20	c3	c15	c11	c17	c9
n15	3	1	3	3	1	c3	c16	c13	c19	c18	c10	c4	c17	c4
n16	3	3	2	2	1	c15	c11	c14	c16	c12	c13	c5	c17	c15
n17	3	3	1	2	1	c3	c16	c19	c11	c1	c5	c14	c13	c10
n18	3	3	2	2	3	c9	c16	c13	c11	c19	c5	c1	c18	c14
n19	3	2	1	2	2	c11	c6	c13	c16	c17	c5	c20	c11	c12
n20	2	3	3	1	2	c2	c16	c13	c18	c19	c5	c6	c12	c15
n21	2	2	3	2	1	c20	c18	c13	c16	c20	c14	c11	c8	c5
n22	1	2	1	3	1	c18	c11	c13	c16	c11	c15	c5	c20	c14
n23	1	3	1	3	3	c20	c11	c13	c16	c3	c15	c7	c11	c5
n24	3	3	3	3	1	c18	c11	c13	c18	c17	c10	c4	c11	c5
n25	2	3	1	3	1	c15	c16	c13	c18	c12	c14	c4	c19	c5
n26	1	3	2	3	1	c6	c16	c13	c16	c3	c15	c8	c12	c14
n27	1	2	3	1	1	c1	c1	c13	c16	c7	c15	c14	c6	c5
n28	2	3	3	1	2	c19	c16	c14	c16	c19	c1	c18	c17	c8
n29	3	3	3	3	1	c18	c11	c13	c18	c17	c10	c4	c11	c5
n30	2	3	3	2	1	c11	c17	c13	c16	c20	c15	c18	c11	c10
n31	1	3	1	3	3	c20	c11	c13	c16	c3	c15	c7	c11	c5
n32	3	3	3	3	2	c20	c17	c13	c16	c3	c15	c10	c12	c1
n33	2	3	2	2	1	c18	c20	c13	c18	c1	c15	c4	c20	c10
n34	3	3	2	2	1	c18	c18	c8	c16	c17	c5	c20	c6	c2
n35	3	3	1	3	1	c9	c11	c13	c11	c18	c10	c19	c17	c5
n36	3	3	1	2	1	c3	c16	c19	c11	c1	c5	c14	c13	c10
n37	2	3	2	3	1	c18	c16	c13	c11	c17	c5	c6	c12	c15
n38	2	1	1	3	1	c20	c16	c13	c16	c17	c3	c15	c11	c10
n39	3	3	3	2	1	c11	c18	c13	c16	c19	c4	c15	c17	c5
n40	2	3	3	3	1	c18	c11	c13	c16	c18	c15	c4	c8	c1
n41	2	2	1	3	1	c3	c11	c14	c18	c12	c3	c8	c12	c13
n42	1	1	1	3	1	c15	c11	c16	c19	c13	c5	c6	c11	c12

NO	Q22	Q22	Q22	Q22	Q22	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30	Q31
	L1	L2	L3	L4	L5									
n43	3	3	1	3	1	c9	c11	c13	c11	c18	c10	c19	c17	c5
n44	3	3	2	2	3	c9	c16	c13	c11	c19	c5	c1	c18	c14
n45	3	3	1	3	1	c1	c20	c13	c6	c1	c15	c4	c19	c1
n46	3	3	3	3	1	c18	c16	c13	c18	c17	c15	c5	c16	c10
n47	2	2	2	3	1	c20	c16	c13	c11	c12	c15	c3	c17	c14
n48	1	1	1	3	2	c18	c11	c13	c17	c19	c15	c6	c16	c10
n49	3	3	3	3	1	c11	c13	c5	c8	c10	c14	c12	c6	c9
n50	2	3	1	3	1	c18	c16	c13	c17	c12	c3	c6	c16	c10
n51	2	3	1	2	1	c8	c1	c8	c20	c9	c7	c9	c4	c1
n52	1	3	3	3	2	c15	c16	c13	c11	c3	c5	c15	c18	c5
n53	1	3	1	3	2	c2	c16	c13	c11	c20	c3	c2	c18	c5
n54	2	3	1	3	1	c15	c16	c13	c18	c12	c14	c4	c19	c5
n55	2	3	2	3	2	c11	c16	c13	c16	c19	c14	c9	c18	c9
n56	3	3	1	3	1	c9	c11	c13	c11	c18	c10	c19	c17	c5
n57	3	3	3	3	2	c20	c17	c13	c16	c3	c15	c10	c12	c1
n58	3	3	3	3	1	c18	c11	c13	c20	c19	c5	c12	c1	c9
n59	1	3	3	3	1	c20	c15	c17	c10	c20	c14	c14	c9	c20
n60	3	2	1	2	2	c11	c6	c13	c16	c17	c5	c20	c11	c12
n61	3	3	3	3	1	c18	c16	c13	c18	c17	c15	c5	c16	c10
n62	1	3	1	3	2	c5	c11	c13	c11	c19	c5	c14	c17	c10
n63	2	3	3	2	2	c18	c18	c13	c17	c7	c5	c6	c20	c15
n64	2	3	2	1	3	c18	c11	c13	c16	c19	c15	c2	c6	c10
n65	2	2	2	3	1	c11	c17	c13	c16	c18	c15	c15	c16	c5
n66	3	3	2	2	3	c9	c16	c13	c11	c19	c5	c1	c18	c14
n67	1	1	1	3	1	c15	c11	c16	c19	c13	c5	c6	c11	c12
n68	2	3	1	3	3	c17	c16	c13	c17	c19	c5	c14	c20	c11
n69	2	2	3	1	2	c16	c5	c16	c18	c20	c16	c20	c18	c20
n70	3	3	3	3	1	c18	c16	c13	c17	c9	c10	c5	c6	c15
n71	1	1	3	3	1	c11	c5	c2	c16	c11	c4	c8	c14	c16
n72	1	3	1	3	2	c7	c16	c13	c17	c6	c15	c10	c19	c14
n73	2	3	2	1	2	c18	c18	c16	c20	c19	c15	c14	c11	c5
n74	3	3	1	3	1	c15	c16	c13	c20	c3	c15	c11	c17	c9
n75	2	3	2	2	2	c2	c5	c13	c16	c2	c15	c10	c12	c5
n76	2	3	3	2	1	c18	c18	c13	c16	c11	c15	c4	c8	c1
n77	3	3	2	2	1	c18	c18	c8	c16	c17	c5	c20	c6	c2
n78	2	3	1	3	1	c20	c16	c13	c16	c7	c15	c1	c12	c5
n79	2	1	1	3	1	c16	c11	c13	c6	c19	c5	c3	c6	c14
n80	2	3	1	3	1	c14	c20	c13	c16	c19	c5	c6	c20	c15
n81	3	3	3	3	1	c18	c16	c13	c18	c17	c15	c5	c16	c10
n82	2	3	3	3	1	c11	c16	c13	c16	c18	c15	c14	c20	c10
n83	2	3	2	3	2	c18	c16	c13	c16	c18	c5	c20	c17	c15
n84	1	3	1	3	3	c20	c11	c13	c16	c3	c15	c7	c11	c5

N0	Q22 L1	Q22 L2	Q22 L3	Q22 L4	Q22 L5	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30	Q31
n85	1	3	3	3	2	c15	c16	c13	c11	c3	c5	c15	c18	c5
n86	2	2	3	3	1	c11	c11	c13	c16	c19	c20	c3	c17	c10
n87	3	1	3	3	1	c3	c16	c13	c19	c18	c10	c4	c17	c4
n88	1	2	1	3	1	c18	c6	c13	c11	c16	c15	c18	c11	c5
n89	2	2	1	3	2	c18	c18	c19	c16	c17	c18	c18	c16	c18
n90	1	3	1	2	1	c18	c6	c13	c16	c18	c15	c6	c12	c14
n91	1	3	3	2	1	c18	c17	c13	c16	c8	c3	c1		c10
n92	2	3	2	2	1	c11	c20	c13	c20	c11	c4	c10	c20	c5
n93	3	3	2	3	1	c18	c3	c13	c20	c18	c15	c9	c12	c1
n94	2	2	1	3	2	c13	c16	c1	c17	c8	c11	c15	c11	c15
n95	2	3	1	3	2	c3	c11	c13	c16	c18	c4	c2	c12	c9
n96	2	3	3	2	1	c2	c18	c13	c11	c19	c15	c5	c11	c9
n97	2	3	1	1	1	c11	c16	c13	c16	c19	c15	c10	c18	c5
n98	1	3	2	2	2	c12	c16	c13	c16	c19	c6	c6	c11	c15
n99	3	1	3	2	2	c18	c17	c13	c16	c12	c15	c5	c16	c10
n100	2	3	2	2	2	c18	c18	c13	c16	c3	c5	c14	c12	c5
n101	1	1	3	2	1		c1	c13	c11		c5			c1
n102	2	1	3	3	2	c17	c6	c17	c18	c4	c15	c5	c15	c5
n103	2	1	1	3	1	c7	c16	c13	c16	c5	c15	c14	c11	c10
n104	3	3	3	2	1	c18	c17	c13	c18	c19	c3	c2	c12	c5
n105	3	3	2	1	2	c2	c20	c13	c16	c18	c15	c7	c12	c5
n106	2	1	3	3	2	c11	c16	c13	c11	c6	c15	c19	c17	c1
n107	2	2	2	2	1	c17	c16	c13	c11	c17	c12	c19	c16	c15
n108	3	3	3	1	2	c11	c16	c13	c11	c19	c15	c12	c17	c14
n109	3	3	3	3	1	c18	c11	c13	c20	c19	c5	c12	c1	c9
n110	2	1	1	3	1	c11	c14	c14	c17	c18	c11	c20	c19	c6
n111	2	2	2	2	1	c11	c16	c13	c19	c12	c15	c18	c17	c10
n112	1	1	2	3	1	c11	c16	c13	c16	c19	c3	c4	c12	c5
n113	2	3	1	2	2	c1	c17	c13	c6	c16	c5	c18	c19	c1
n114	1	3	2	2	2	c3	c16	c8	c11	c20	c15	c5	c11	c10
n115	2	1	3	1	1	c11	c11	c13	c16	c7	c15	c5	c16	c10
n116	2	3	2	3	1	c9	c16	c13	c20	c7	c15	c7	c18	c10
n117	3	3	3	3	3	c1	c16	c13	c17	c18	c15	c5	c11	c9
n118	3	3	2	3	3	c17	c16	c13	c17	c19	c15	c5	c11	c9
n119	1	1	2	3	1	c1	c16	c13	c17	c19	c12	c7	c13	c5
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n121	1	1	1	3	2	c20	c16	c13	c11	c20	c10	c3	c14	c15
n122	2	3	2	3	1	c8	c16	c13	c11	c19	c15	c14	c17	c10
n123	2	3	1	1	1	c15	c18	c13	c17	c19	c4	c14	c7	c15
n124	1	2	2	2	2	c16	c13	c13	c19	c1	c4	c15	c12	c10
n125	3	3	1	2	2	c5	c20	c9	c16	c13	c3	c8	c7	c8
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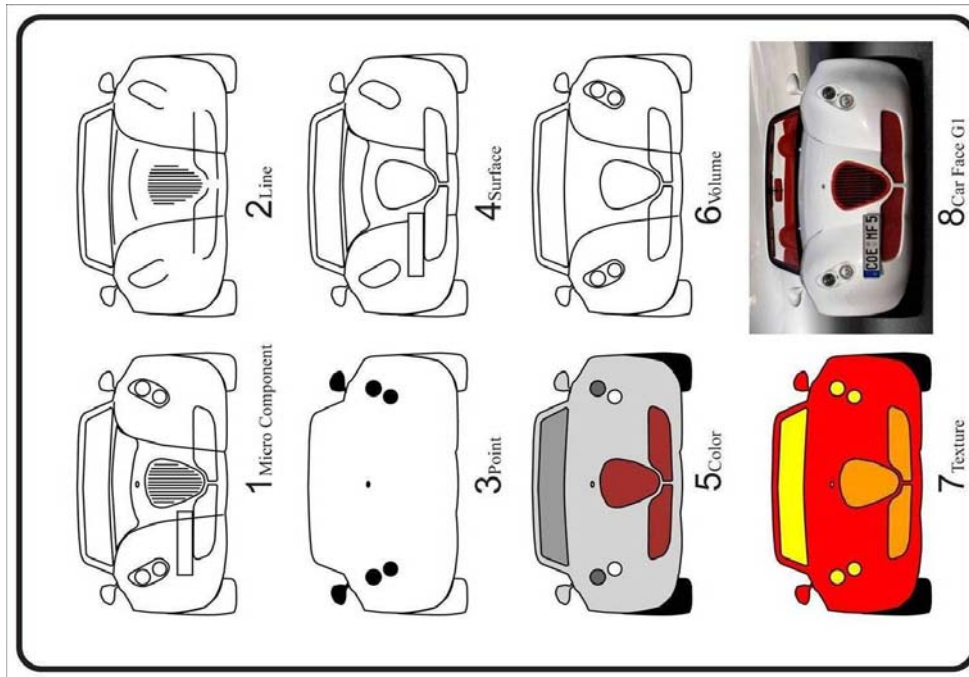
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n3	red	d.lahoti@iitg.ernet.in	92.50.7.147	03-Aug-10
n4	black	ketan3692@gmail.com	122.167.113.208	01-Aug-10
n5	black	naveen.70546@gmail.com	86.96.227.91	02-Aug-10
n6	black	nikhilatiit@gmail.com	91.98.179.148	02-Aug-10
n7	grey	rajesh.koolfrnd@gmail.com	92.50.7.147	03-Aug-10
n8	red	disha@iitg.ernet.in	94.182.167.230	03-Aug-10
n9	purple	j.akshat@iitg.ernet.in	86.57.111.5	01-Aug-10
n10	red	15rohitsharma@gmail.com	60.48.113.104	30-Jul-10
n11	black	a.bandi@iitg.ernet.in	117.198.51.5	01-Aug-10
n12	purple	a.soni@iitg.ernet.in	86.96.227.91	02-Aug-10
n13	yellow	abhishek.g@iitg.ac.in	188.75.69.66	31-Jul-10
n14	white	g.gopal@iitg.ernet.in	94.182.167.230	03-Aug-10
n15	white	k.gaurav@iitg.ernet.in	94.182.23.213	01-Aug-10
n16	white	kamranghaffari@yahoo.com	164.100.170.4	10-Aug-10
n17	green	kr.pankaj@iitg.ernet.in	98.126.73.12	02-Aug-10
n18	blue	t.theophilus@iitg.ernet.in	120.140.80.107	03-Aug-10
n19	black	ankita@iitg.ernet.in	120.140.80.107	03-Aug-10
n20	red	c.babu@iitg.ernet.in	91.98.179.148	02-Aug-10
n21	black	deniz.goknar@hotmail.com	178.18.16.146	06-Aug-10
n22	red	ghltshubh@gmail.com	85.133.179.195	01-Aug-10
n23	white	h.mangalampalli@iitg.ernet.in	94.184.96.30	03-Aug-10
n24	black	k.rishabh@iitg.ernet.in	86.57.111.5	01-Aug-10
n25	blue	i.kumar@iitg.ernet.in	94.184.96.30	01-Aug-10
n26	cram	pegah.boroomand@yahoo.com	180.149.62.245	10-Oct-10
n27	red	smallville100@hotmail.it	164.100.170.4	17-Jul-10
n28	black	alihosseiny@ymail.com	164.100.170.4	03-Aug-10
n29	black	anuraj@iitg.ernet.in	85.133.179.195	03-Aug-10
n30	red	ehsanshabanian@gmail.com	94.183.225.150	06-Aug-10
n31	white	h.goyal@iitg.ernet.in	94.184.96.30	03-Aug-10
n32	black	kiran_s_here@hotmail.com	173.244.197.210	02-Aug-10
n33		mehradi@yahoo.com	212.95.144.13	12-Aug-10
n34	black	pushpender.hudda@gmail.com	83.170.105.81	03-Aug-10
n35	blue	rode@iitg.ernet.in	94.184.96.30	02-Aug-10
n36	green	s.ajit@iitg.ernet.in	80.191.71.56	03-Aug-10
n37	cram	azarshirzade@gmail.com	94.241.130.70	04-Aug-10
n38	red	elielham66@yahoo.com	94.183.253.165	06-Aug-10
n39	grey	fnahviid@gmail.com	71.22.166.27	07-Aug-10
n40	black	gaikwad@iitg.ernet.in	86.57.111.5	01-Aug-10
n41	purple	its_arpitsharma@yahoo.co.in	213.97.45.92	01-Aug-10
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n46	black	thisismepritam@gmail.com	94.182.167.230	03-Aug-10
n47	grey	trupti@iitg.ernet.in	80.191.71.56	03-Aug-10
n48	white	yasaman.nemati@yahoo.com	85.133.197.122	04-Aug-10
n49	grey	a.langthasa@iitg.ernet.in	81.91.156.144	02-Aug-10
n50	grey	azadeamjadi@yahoo.com	85.133.199.218	03-Aug-10
n51	purple	jagriti0314@gmail.com	164.100.170.4	01-Aug-10
n52	yellow	k.nandamuri@iitg.ernet.in	98.126.73.12	02-Aug-10
n53	white	kasi_aras@yahoo.com	81.100.169.148	07-Aug-10
n54	blue	manusthorat@yahoo.co.in	217.218.159.179	02-Aug-10
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n56	blue	shobhan@iitg.ernet.in	98.126.73.12	30-Jul-10
n57	black	v.harshal@iitg.ernet.in	86.96.227.91	01-Aug-10
n58	orange	a.panigrahi@iitg.ernet.in	83.170.105.81	03-Aug-10
n59	purple	acharjee.rajib@gmail.com	79.132.209.208	31-Jul-10
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n62	green	lilcrazys4u@aol.com	217.219.72.197	11-Aug-10
n63	grey	mohammad_1363ir@yahoo.com	95.14.41.56	25-Sep-10
n64	red	navid_y_60@yahoo.com	210.212.8.60	08-Oct-10
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n67	white	dipanka@iitg.ernet.in	188.158.74.187	01-Aug-10
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n69	orange	mahtab_p13@yahoo.com	217.219.72.197	11-Aug-10
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n72	brown	samoradi.id@gmail.com	180.149.62.245	11-Oct-10
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n74	white	cdpmech@gmail.com	95.141.222.26	31-Jul-10
n75	black	ceilingdreams@gmail.com	59.162.23.19	01-Aug-10
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n77	black	rajkumar@iitg.ernet.in	94.182.23.213	31-Jul-10
n78	black	rashid.rahnama@gmail.com	180.149.62.245	11-Oct-10
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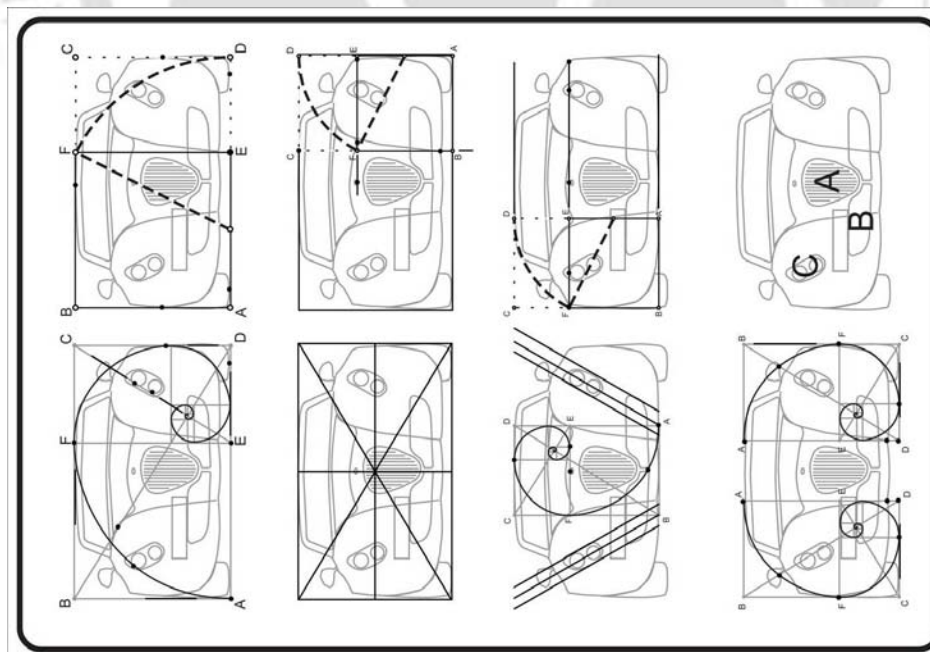
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n88	purple	tarahan@gmail.com	173.32.83.72	04-Aug-10
n89	black	goli_sm@yahoo.com	91.99.73.244	07-Aug-10
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n99	black	behroozid@yahoo.com	86.181.20.60	05-Aug-10
n100	red	blue_as_sky@yahoo.com	70.170.18.68	06-Aug-10
n101	red	e-mail	82.115.28.82	06-Aug-10
n102	black	hello@m-abbasi.com	213.207.233.129	07-Aug-10
n103	white	narges_mon2002@yahoo.com	125.20.82.166	08-Oct-10
n104	orange	anahita.nsa@gmail.com	85.133.224.231	03-Aug-10
n105	blue	babak.jk@gmail.com	92.50.18.78	04-Aug-10
n106	grey	e-mail	78.142.140.194	06-Aug-10
n107	black	kaveh_talebi@yahoo.com	109.110.176.86	10-Aug-10
n108	black	pantea_mz_56@yahoo.com	180.149.62.245	08-Oct-10
n109	orange	ameet_rajwade@yahoo.com	174.142.10.42	31-Jul-10
n110	black	babaee55_r@yahoo.com	217.218.120.34	04-Aug-10
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n112	black	parisa_foroohar@yahoo.com	180.149.62.245	08-Oct-10
n113	blue	shadi_nazouri@yahoo.com	180.149.62.245	12-Oct-10
n114	black	mahshamlou@yahoo.com	217.219.72.197	11-Aug-10
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n121	purple	jalal202003@yahoo.com	99.227.15.106	09-Aug-10
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n126	grey	drmiahmed@yahoo.co.in	117.198.51.5	01-Aug-10

Appendix 7: Detailed study of Experiment 2a:

Extraction by geometric proportion, golden ratio and analysis of visual form.



← Figure 5.2a.18: Visual analysis for G1



← Figure 5.2a.19: Golden ratio and Visual Hierarchy analysis for G1

In part 2 (line) vertical parallel lines on the grille and outline of lights deliver a wild and dangerous feeling, but if we closely observe the same place at part 4 (surface) and 6 (volume) the wild expression diminishes to plain angry expression, as we proceed to the small circular lights in part 3 (point), 5 (color) and 7 (texture) we see the angry expression transform into a very stupid expression. Here the form of grille could intensify the stupid expression, but because of these expressions, this design develops contrasting meanings. The close and round lines like grille and the next lights have the capacity to steal the attention of a user and keep it rooted for quite sometime. As many contrasting expressions are teamed up together, we eventually derive an angry and stupid expression.

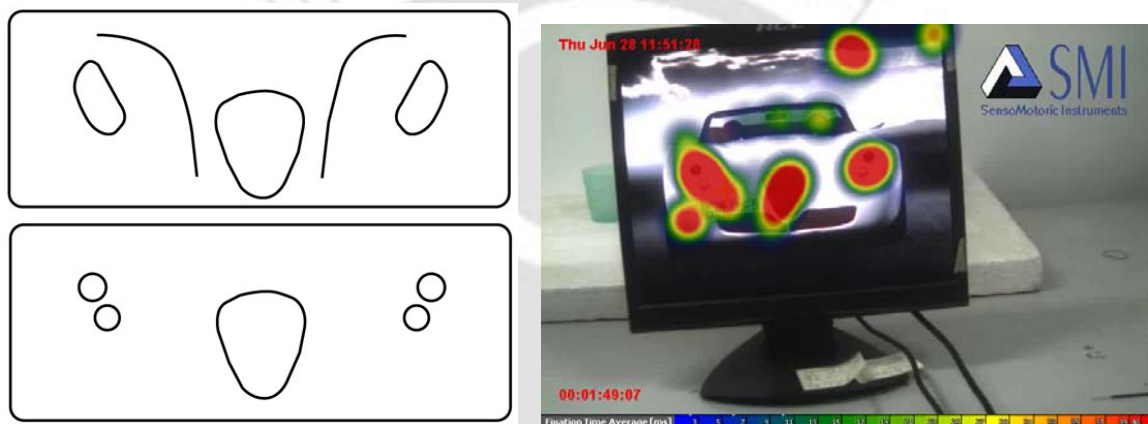
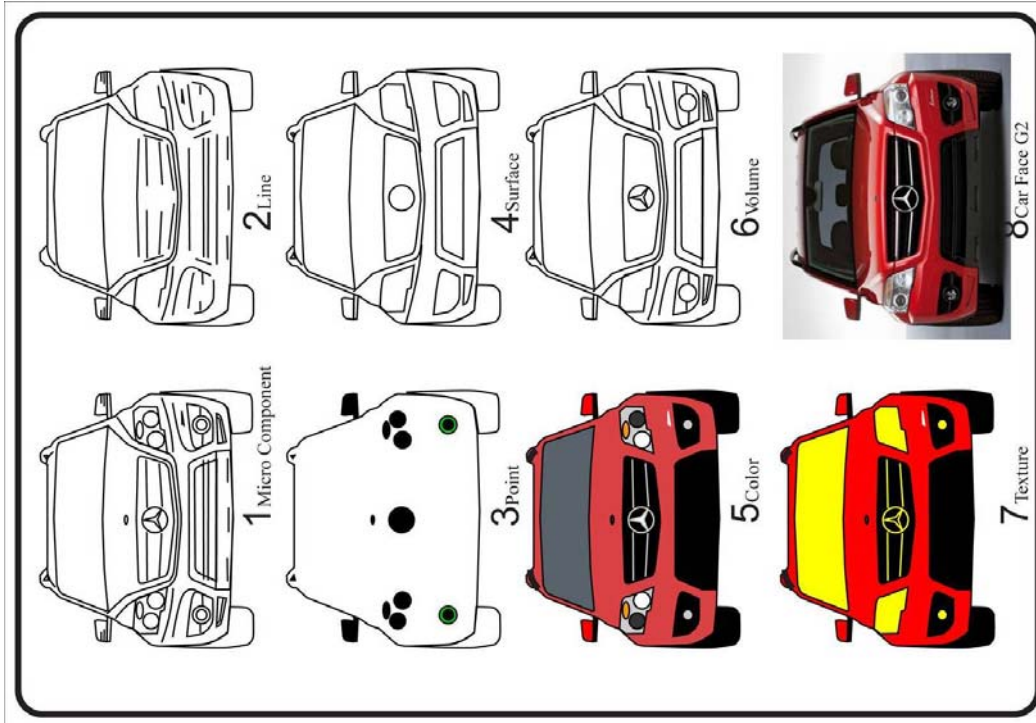
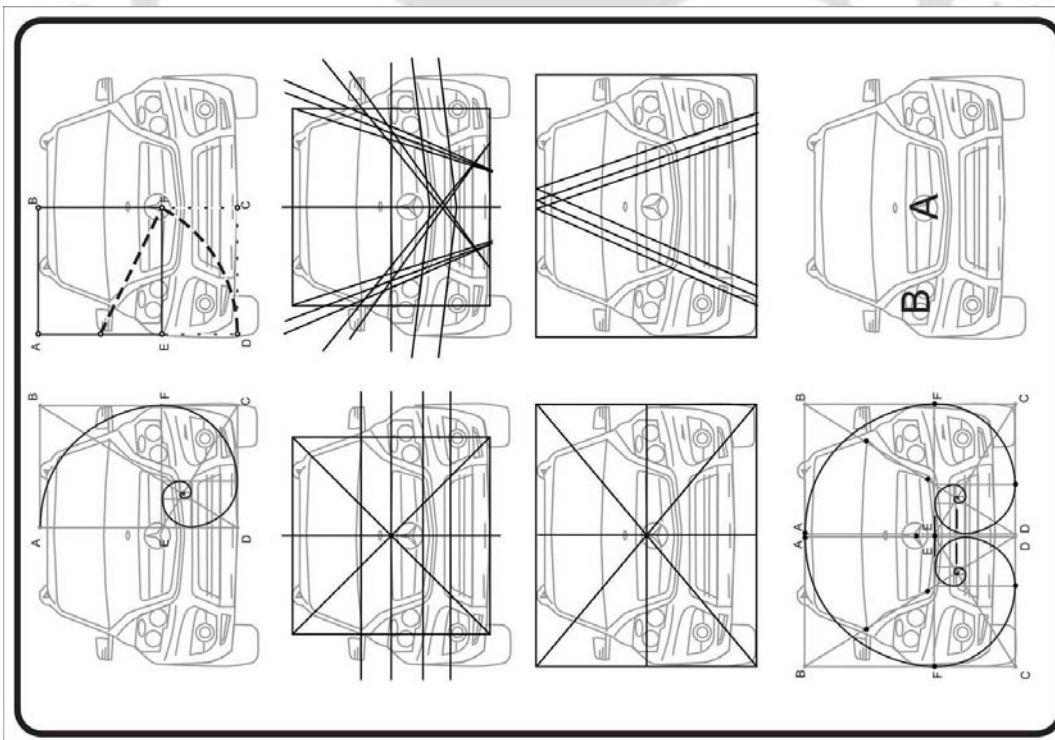


Figure 5.2a.20: Graphical key of G1(Left), Eye tracking analysis of G1 (Right)

Proportion analysis reveals that the, G1 is powerful in terms of both geometric and golden ratio. The visual hierarchy analysis further reveals that the eye movement first goes to the location of grille “A” because of the direction of form on the hood and the presence of contrast of form and color (grille and body). The eye then wanders from grille “A” to lower grille “B” and lights “C” because of the color. Hence it may be concluded that grille “A” is a very attractive search icon within the peripheral field of vision. The result of machine eye tracking analysis shows the eye jump from grille “A” to lights “C” and lower grille “B”. In terms of sequences it is 60% same with the result of visual hierarchy analysis and in terms of importance of elements both result shows same locations which is visible in the above figure.



← Figure 5.2a.21: Visual analysis for G2



← Figure 5.2a.22: Golden ratio and Visual Hierarchy analysis for G2

The use of luxurious forms like fittings and even complex forms and arcs leads to expressions like expensive and elegance. As far as relation of forms is concerned, G2 creates a focus on the grille and logo place. In part 3 (point) and 4 (surface) point of logo is central point of car face. Professional users can identify the car even with out logo because of the distinctive, design identity of grille. This can be termed as a positive feature. Grille frame, logo and lights with special silver-plating express glory of car already evident in part 7 (texture). In parts 2 (line), 5 (color) and 7 (texture) horizontal lines on the grille like face of Apache Warrior (in American) will shows a serious expression while in others the expressions are not as potent as expected. Powerful expression are evident in part 4 (surface) and 6 (volume) and the presence of light just elevates the level of seriousness. In part 2 (line) the line under the lights and grille signifies happiness and a smile. However in part 5 (color), due to the presence of contrast of color there is a balanced expression which reflects some amount of sincerity..

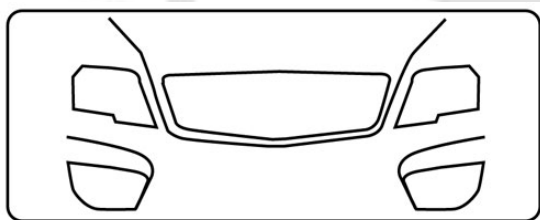
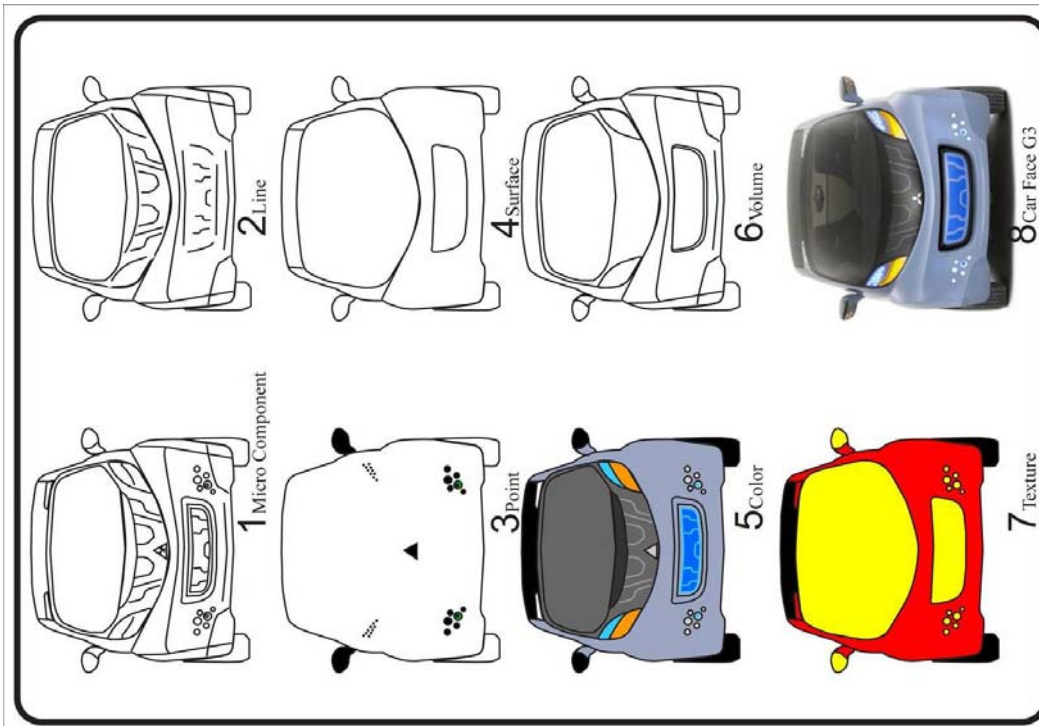
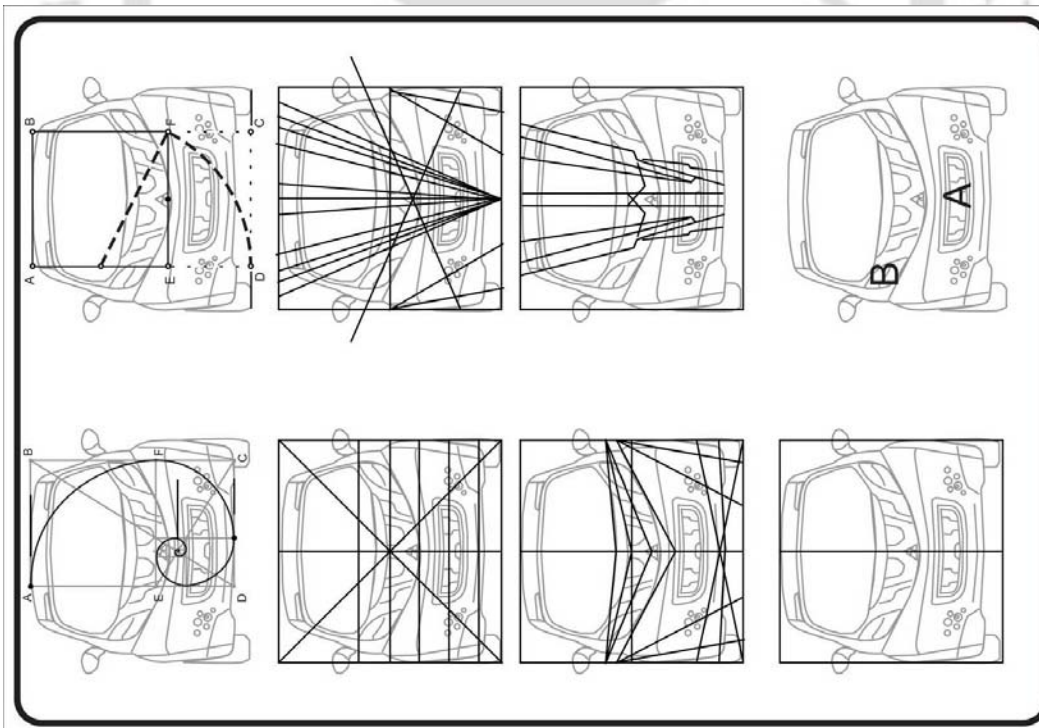


Figure 5.2a.23: Graphical key of G2 (Left), Eye tracking analysis of G2 (Right)

Proportion analysis reveals that the, G2 is powerful in terms of both geometric and golden ratio. The visual hierarchy analysis shows, that the first eye movement goes to the location of logo “A” because of the circular shape as well as the existence of the golden ratio area. The eye tracks from logo “A” to lights “B” because of the color and direction of the grille’s lines. It maybe hence be concluded that the icon logo “A” is a very attractive search icon within the peripheral field of vision. The result of machine eye tracking analysis shows the eye jump from logo “A” to lights “B”. In terms of sequences it is 100% same with the result of self assessment eye movement analysis and in terms of importance of elements both result shows same locations which is visible in the above figure.



← Figure 5.2a.24: Visual analysis for G3



← Figure 5.2a.25: Golden ratio and Visual Hierarchy analysis for G3

Self assessment analysis of visual form of the grille in part 2 (line) shows an open mouth and sharp teeth with dangerous and wild expression. In Part 3 (point) because of the shape of surfaces, the expression looks more like a cat face, part 4 (surfaces) and 7 (texture) with a happy, smiling and funny expression. Without lines however the surface again expresses danger. The color and shape of lights in parts 5 (color) and grille in part 6 (volume) eventually leads to a dangerous expression.

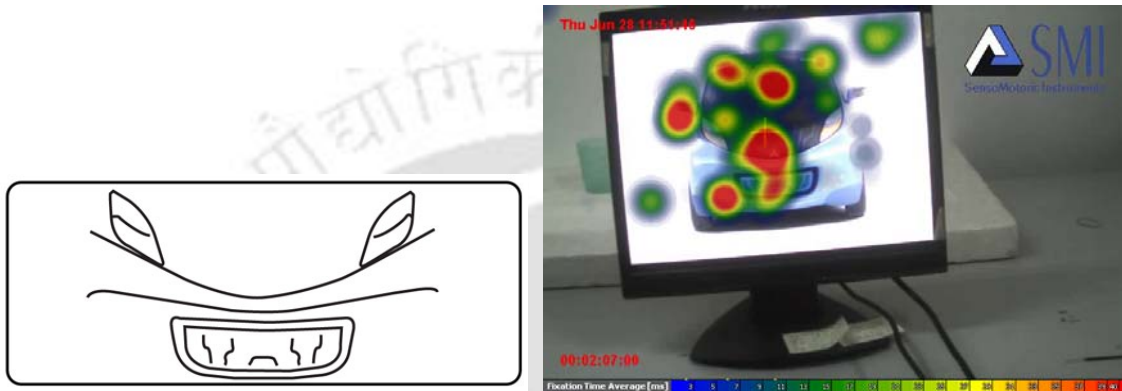
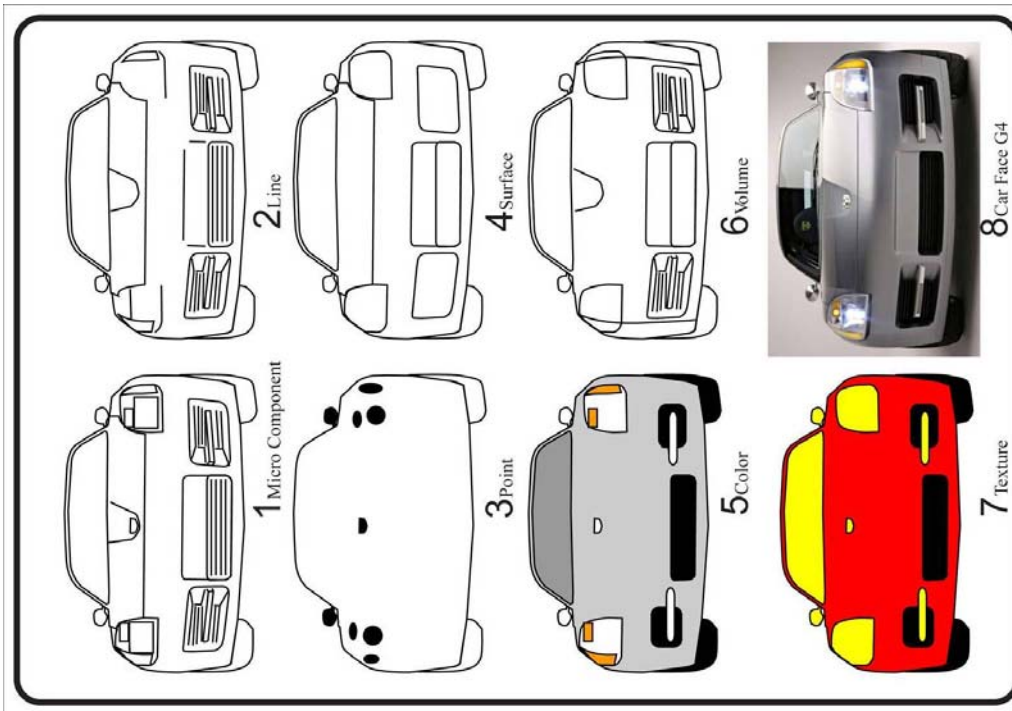
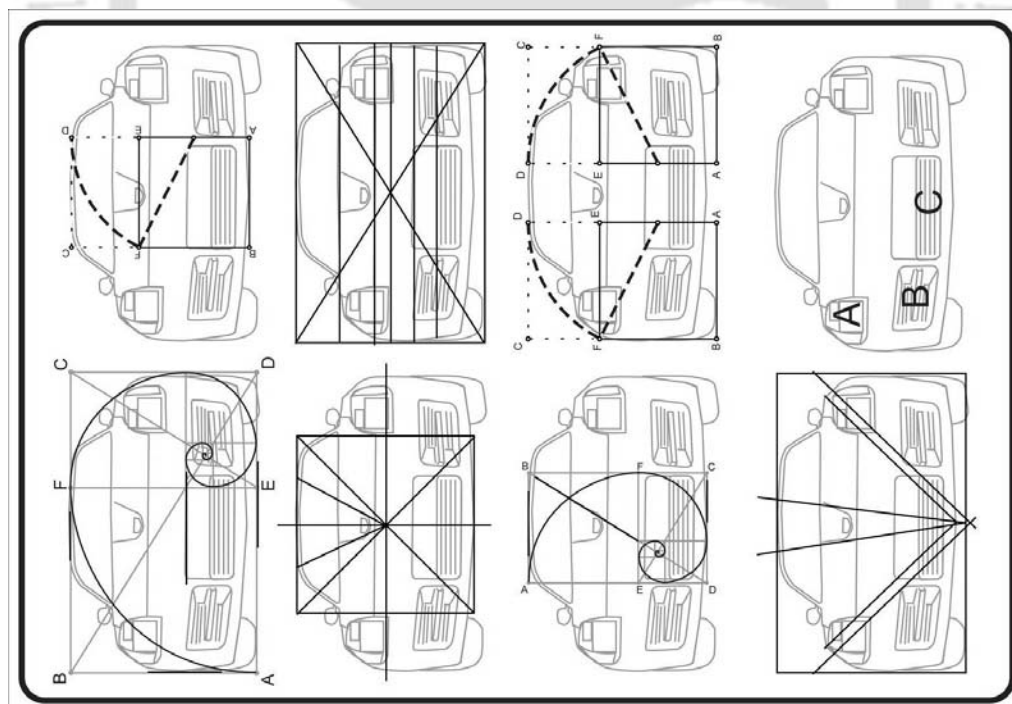


Figure 5.2a.26: Graphical key of G3 (Left), Eye tracking analysis of G3 (Right)

Proportion analysis reveals that the, G3 is powerful in terms of both geometric and golden ratio. The visual hierarchy analysis shows, that the eye first goes to the location of grille “A” because of the color and form. The eye then wanders slowly from the grille “A” to lights “B”, because of the color. It may hence be concluded that the grille “A” is a very attractive search icon within the peripheral field of vision. The result of machine eye tracking analysis shows the eye jump from grille “A” to logo and then to lights “B”. In terms of sequences it is 80% same with the result of self assessment eye movement analysis and in terms of importance of elements both result shows same locations but the result of eye tracking shows area of logo as another important location which is visible in the above figure.



← Figure 5.2a.27: Visual analysis for G4



← Figure 5.2a.28: Golden ratio and Visual Hierarchy analysis for G4

In G4, the fittings with special silver plating in part 7 (texture) and in part 6 (volume) along with the complex arcs expresses the element of sophistication and glory of the car. The plating on the small grille (in sides of grille), lights and logo also reinforces the expression of glory. The form of the hood has a symmetrical line and also has a good effect on aesthetic of design. The line starts from the hood (in front of windscreen), and then follow to the logo. Part 2 (line) reflects a calmer expression because of the horizontal lines, and parts 4 (surface) and 7 (texture) the expression finally reflects curiosity and attentiveness.

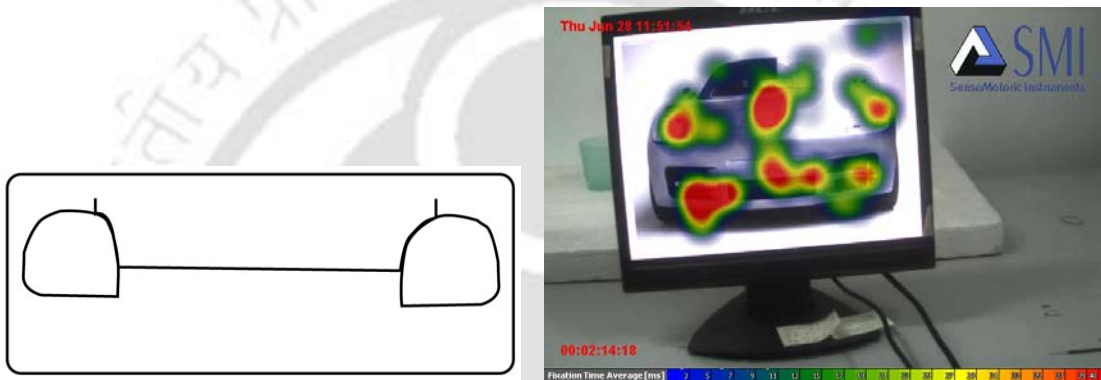
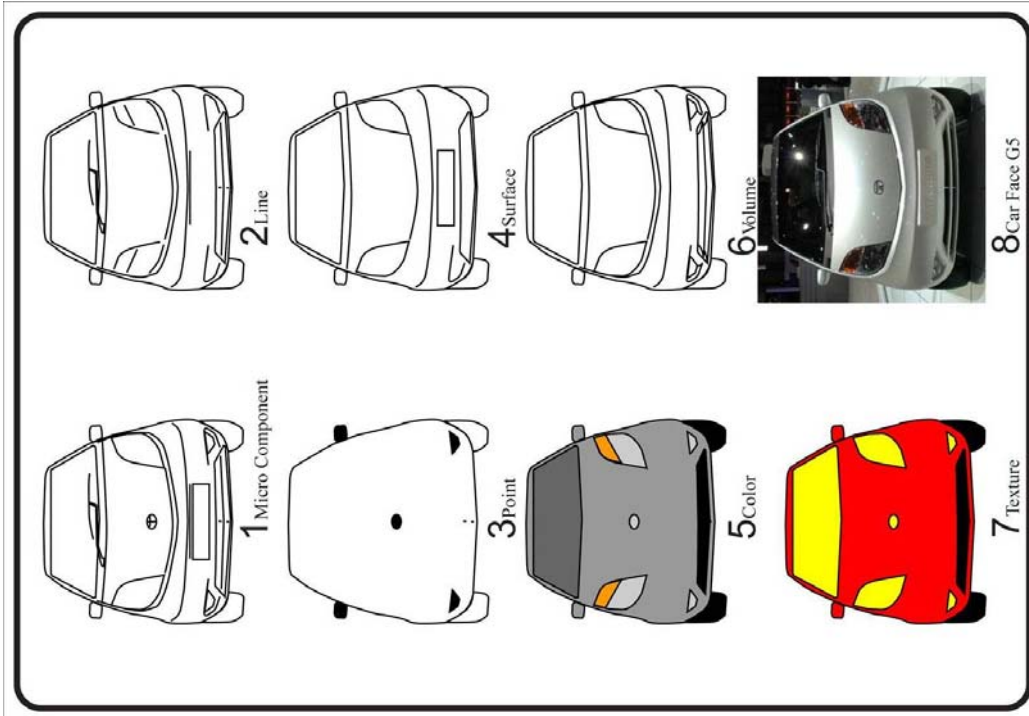
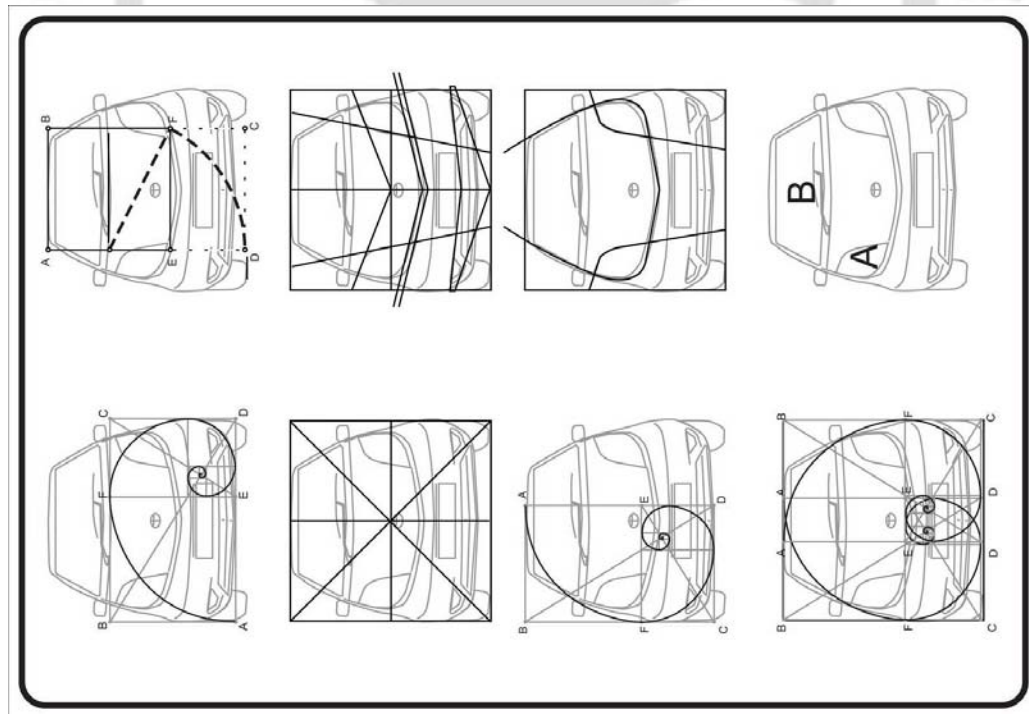


Figure 5.2a.29: Graphical key of G4 (Left), Eye tracking analysis of G4 (Right)

The proportion analysis reveals that, G4 is powerful in terms of both geometric and golden ratio. The visual hierarchy analysis shows, that the eye movement first goes to the location of lights “A” because of the existence of the golden ratio area and also because of the presence of contrast of size and color. The eye then wanders from lights “A” to lower grille “B” and grille “C” due to the diversity in color and form. Hence it maybe concluded that the lights “A” are a very attractive search icons within the peripheral field of vision. The result of machine eye tracking analysis shows the eye jump from grille “C” to lower grille “B”, then to logo and lights “A”. In terms of sequences it is 10% same with the result of self assessment eye movement analysis and in terms of importance of elements both result shows same locations and the result of eye tracking shows area of logo as another important location which is visible in the above figure.



← Figure 5.2a.30: Visual analysis for G5



← Figure 5.2a.31: Golden ratio and Visual Hierarchy analysis for G5

The vertical lines on the hood are symmetrical and have a good effect on the aesthetics of design. This line starts from the hood (in front of the windscreen), and then goes on to the logo, the guard and then the grille. It makes a good composition with the logo. This line brings about a sense of balance in the user's mind. The lower grille and the fog lights bring about a new style of car design in the modern era. The lower grille joins the fog lights and the sides together. In part 2 (line) the car appears to have a smiling expression, while in part 3 (point) it only has focus, in parts 4 (surface), 6 (volume) and 7 texture) the expression is that of curiosity and attentiveness mostly due to the size of the lights. Eventually it expresses happiness and curiosity. In part 5,(color) the expression evident is that of anger.

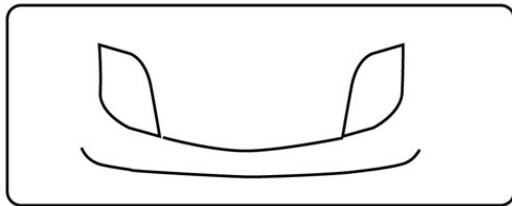
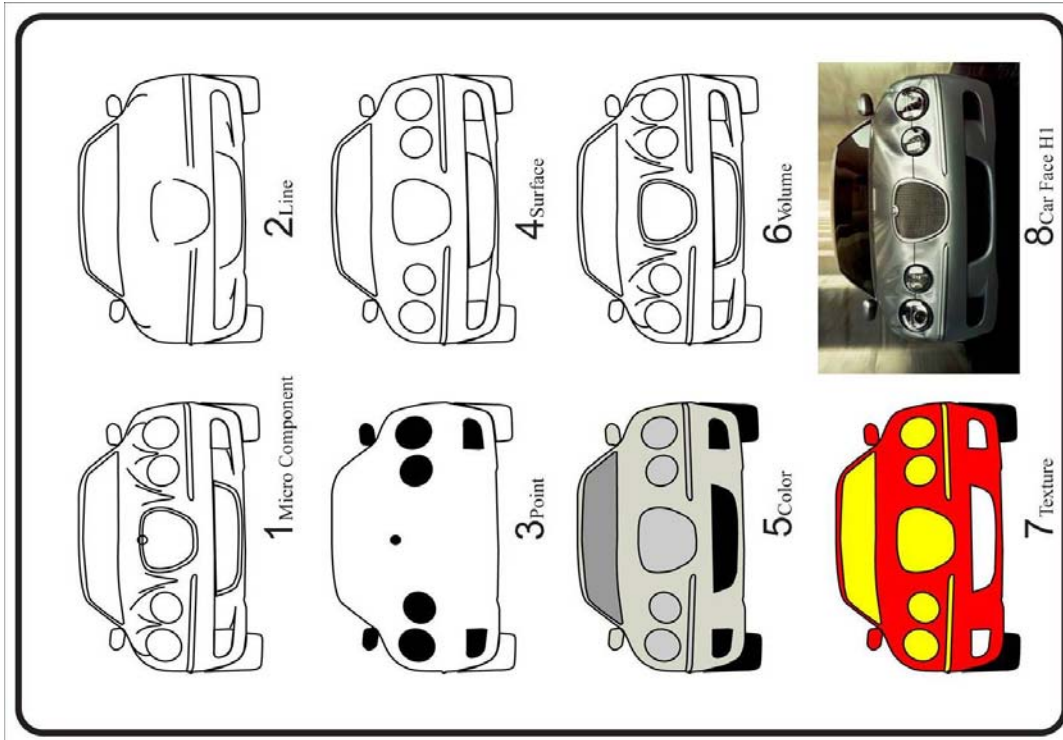
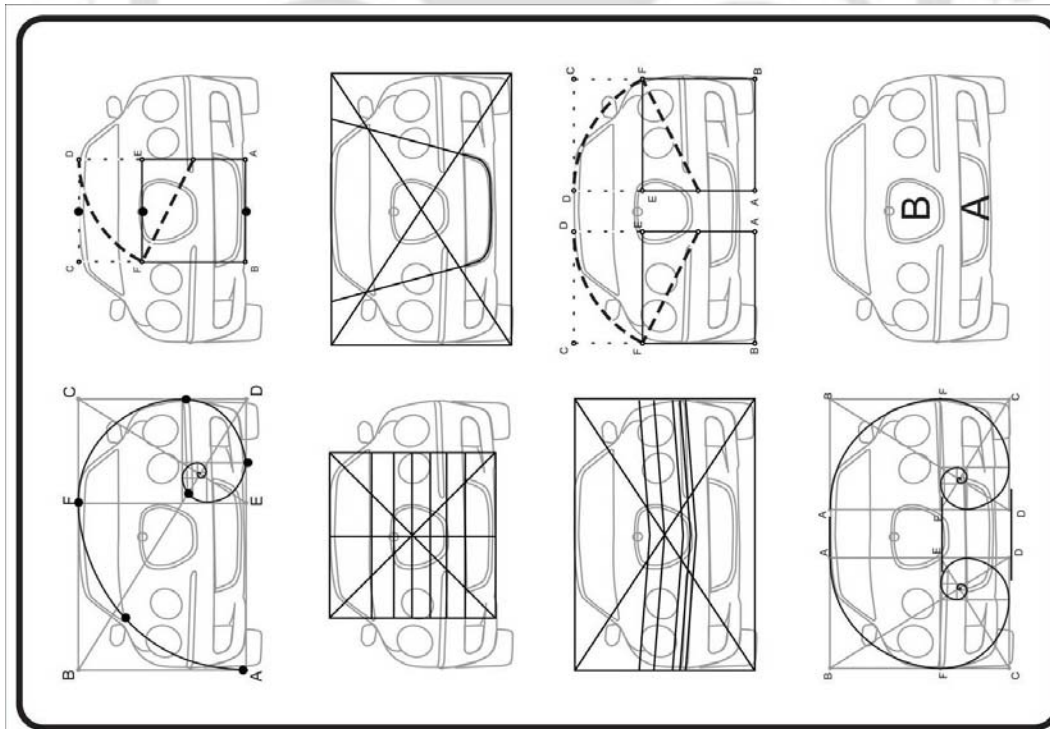


Figure 5.2a.32: Graphical key of G5 (Left), Eye tracking analysis of G5 (Right)

The proportion analysis reveals that the, G5 is powerful in terms of both the geometric and golden ratio. The visual hierarchy analysis shows, that the eye movement first goes towards the location of lights “A” due to the presence of contrast in color and size. Then the eye slowly wanders from the lights “A” to windscreen “B” because of the texture and color. It may hence be concluded that the icon lights “A” are very attractive search icons present within the peripheral field of vision. The result of machine eye tracking analysis shows the eye jump from lights “A” to logo. In terms of sequences it is 50% same with the result of self assessment eye movement analysis and in terms of importance of elements both result shows same locations which is visible in the above figure.



← Figure 5.2a.33: Visual analysis for H1



← Figure 5.2a.34: Golden ratio and Visual Hierarchy analysis for H1

In H1 the luxurious forms like fittings and polished finished delivers a kind of sophisticated and elegant expression. H1 creates a focus on the grille and lights because of the circular shape and this circle (lights) creates harmony with grille the because of the direction of lights and grille. Professional users can identify the car even with out the logo because of the distinctive design of the grille. This acts as a positive property.

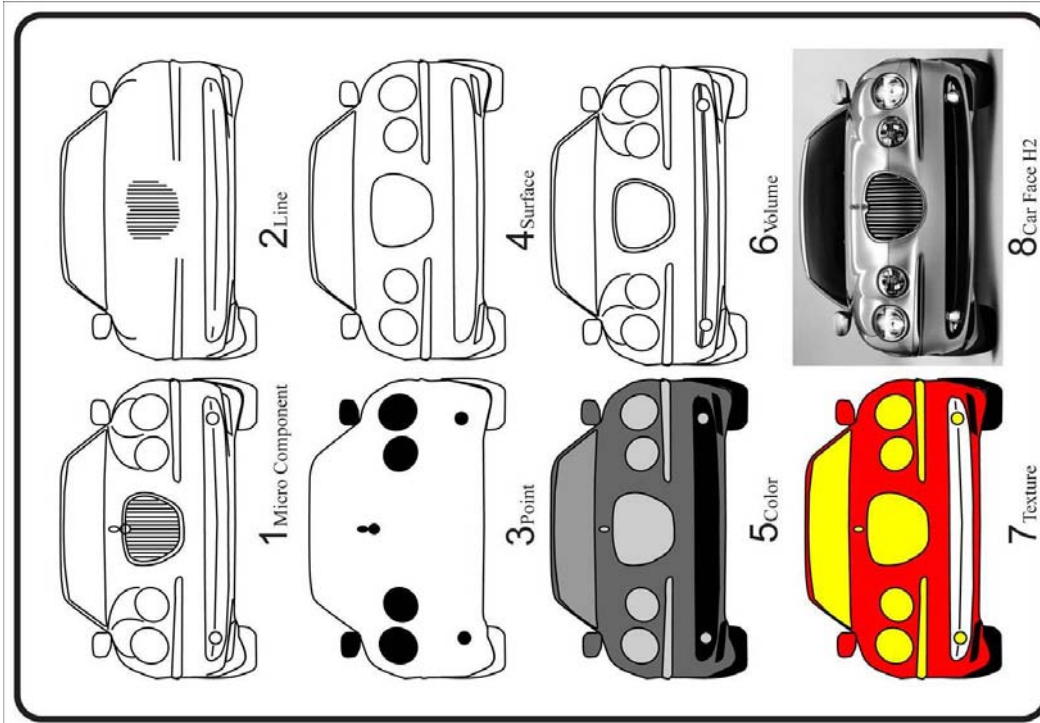
The analysis of parts 2 (line), 4 (surface), 5 (color) and 7 (texture) leads to a surprised expression apparently due to the size of lights and the shape of the grille. Part 6 (volume) however has a serious expression and part 3 (point) bears a curious and attentive expression owing to the shape and size.

In this case the contrast of space is best used. The three blank spaces make a good composition with grille and lights leading to a final expression of surprise.

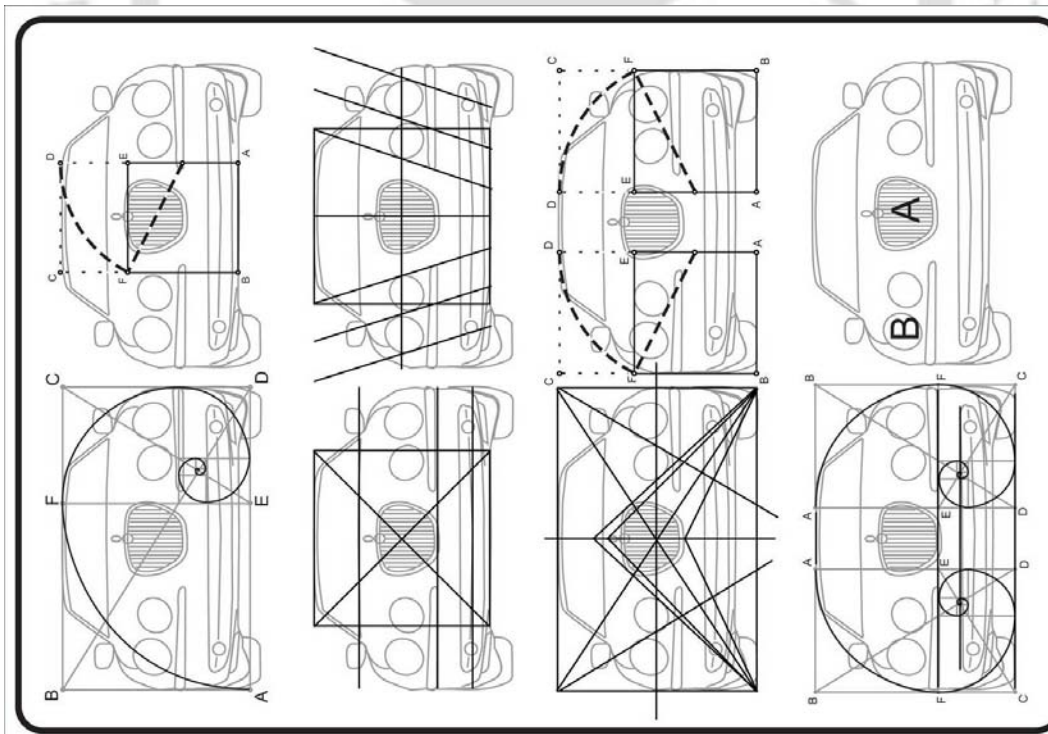


Figure 5.2a.35: Graphical key of H1(Left), Eye tracking analysis of H1(Right)

Proportion analysis reveals that, H1 is powerful in terms of both geometric and golden ratio. The visual hierarchy analysis shows, that the eye movement first drifts towards the location of lower grille “A” owing to the contrast of color and space. The eye then slowly wanders from lower grille “A” to grille “B” because of the shape and size. It may hence be concluded that the icon lower grille “A” is a very attractive search icon within the peripheral field of vision. The result of machine eye tracking analysis shows the eye jump from grille “B” to lights. In terms of sequences it is 10% same with the result of self assessment eye movement analysis and in terms of importance of elements both result shows same locations but the eye tracking did not show the location of lower grille “A” which is visible in the above figure.



← Figure 5.2a.36: Visual analysis for H2



← Figure 5.2a.37: Golden ratio and Visual Hierarchy analysis for H2

The presence of luxurious forms like fittings and polished metal finish on the grille frame and guard reflects sophistication and an expression of glory. In case of relation of forms, H2 creates focus on grille and lights. Here, the lights create harmony with the grille due to the similarity of shape. Professional users can identify the car even without the logo because of the distinctive design of the grille. This acts as a positive property. The presence of circular forms often draws the attention of the user and the eyes turn till it finds a gap. Here the grill is most likely to steal the attention of the user and then eventually drift towards the side lights. The Part 2 (line) expresses a kind of resistance and anger owing to the vertical lines on the grille. While Part 4 (surface), 5 (color) and 7 (texture) shows a surprised expression resulting from the size and shape of the grille and the lights. Here the part 6 (volume) reflects the expression of speed established with the lines present on the hood. Finally Part 3 (point) has a surprised expression.

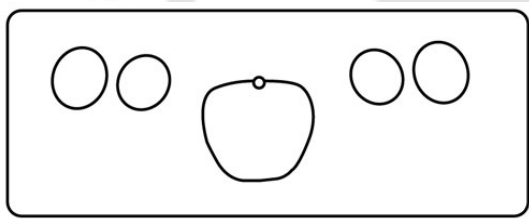
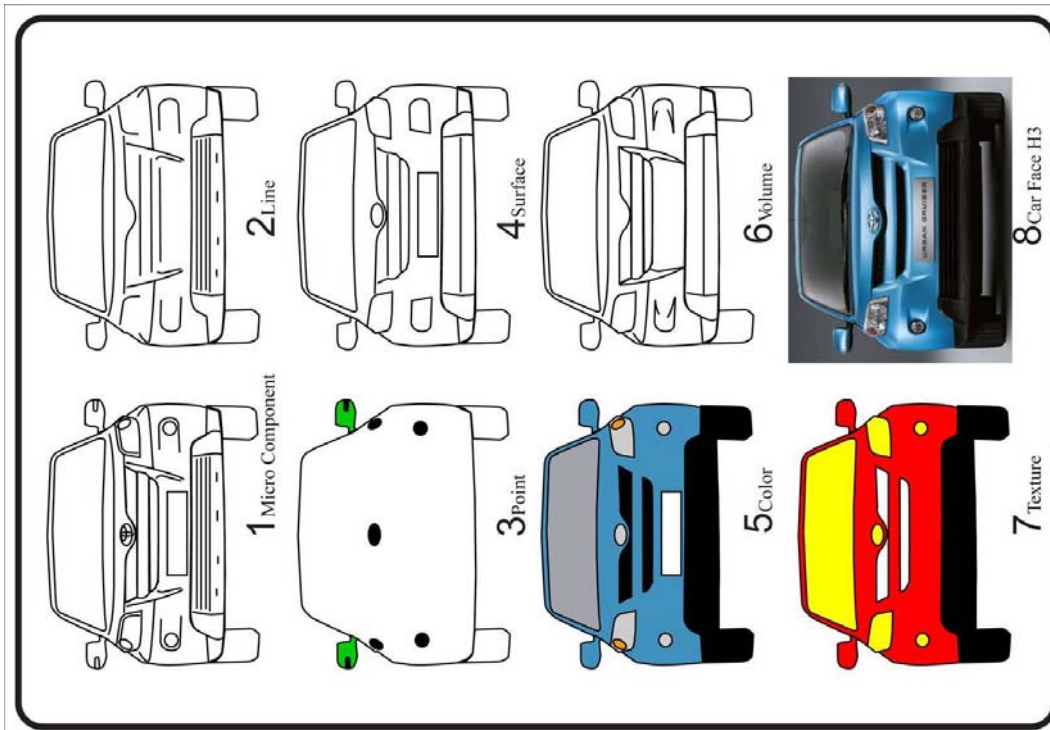
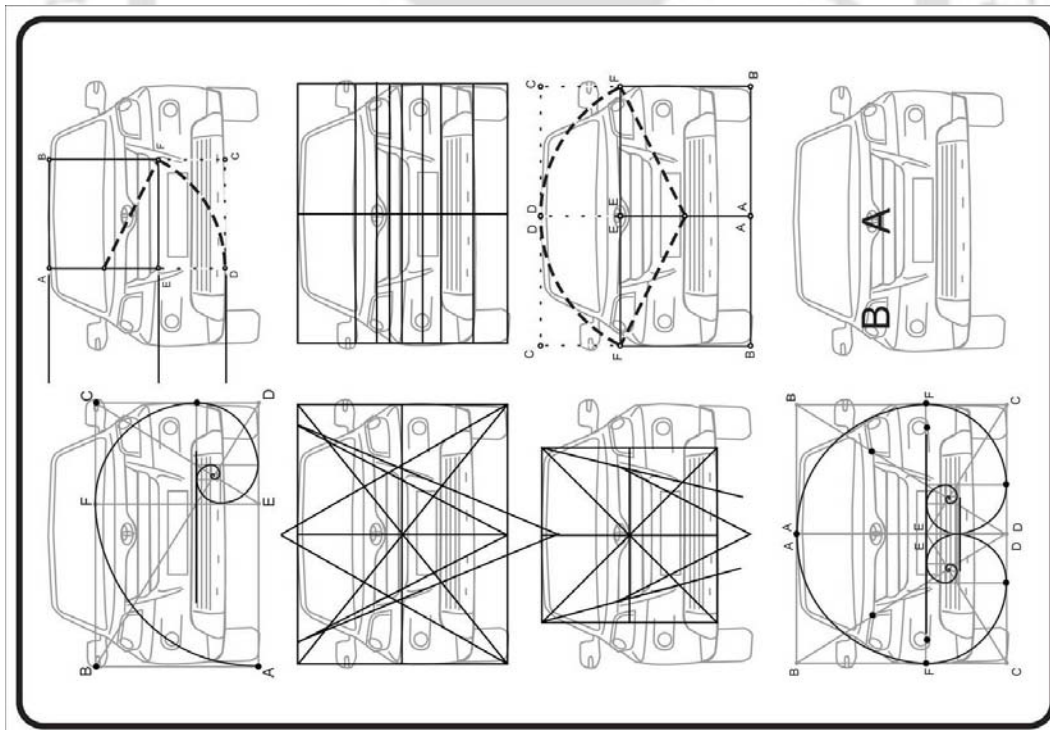


Figure 5.2a.38: Graphical key of H2 (Left), Eye tracking analysis of H2 (Right)

Proportion analysis reveals that the, H2 is powerful in terms of both geometric and golden ratio. The visual hierarchy analysis shows, that the eye first moves towards the location of grille “A” because of the shape and then drifts from grille “A” to lights “B” owing to the shape. It may hence be concluded that the icon grille “A” is a very attractive search icon within the peripheral field of vision. The result of machine eye tracking analysis shows the eye jump from grille “A” to lights “B”. In terms of sequences it is 100% same with the result of self assessment eye movement analysis and in terms of importance of elements both result shows same locations which is visible in the above figure.



← Figure 5.2a.39: Visual analysis for H3



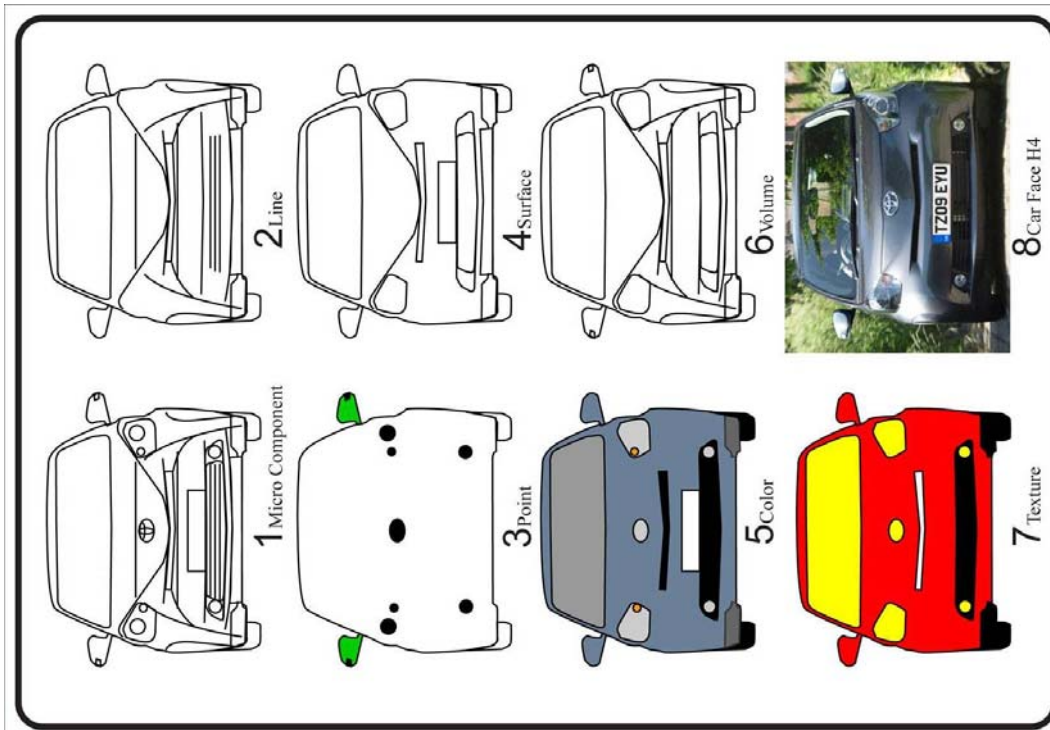
← Figure 5.2a.40: Golden ratio and Visual Hierarchy analysis for H3

Due to the relativity of forms, the designer puts the logo on the golden ratio area because of which H3 finds fixation on the grille. Overall the oval shape (logo) helps to attract the attention of the user towards the centre. This point is also symmetrically placed. Part 2 (line) has a calmer expression owing to the presence of horizontal lines on the grille. Part 3 (point) has the element of direction, which is also capable of drawing attention. Part 4 (surface) and 7 (texture) bears a serious expression attributing to the shapes of the lights. While in Part 5 (color) the position of the orange color leads to a stupid expression while blue has a relatively calmer expression. Part 6 (volume) appears dangerous and angry mostly due to the shape of the fog lights. Eventually the expression of the car is serious.

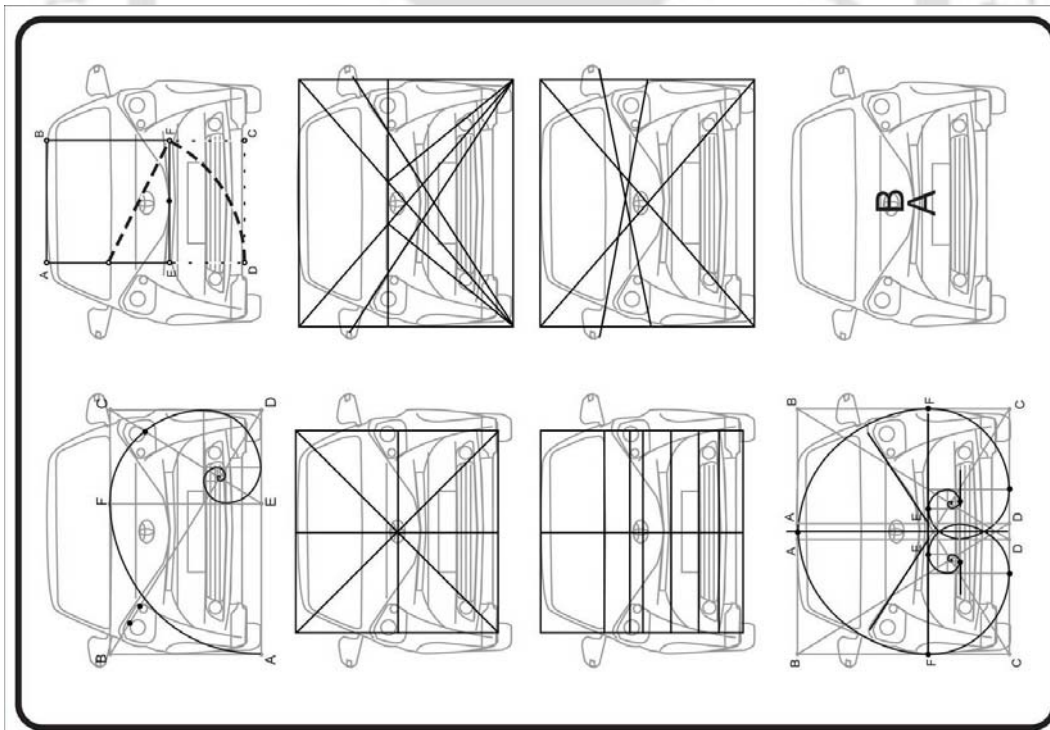


Figure 5.2a.41: Graphical key of H3 (Left), Eye tracking analysis of H3 (Right)

Proportion analysis reveals that the, H3 is powerful in terms of both geometric and golden ratio. The visual hierarchy analysis shows, that the eye movement first moves to the location of grille “A” due to the existence of the golden ratio area and also due to the presence of contrast of colors. The eye wanders from grille and logo “A” to lights “B” because of the color. It may hence be concluded that the icon grille “A” is a very attractive search icon within the peripheral field of vision. The result of machine eye tracking analysis shows the eye jump from grille and logo “A” to lights “B”. In terms of sequences it is 100% same with the result of self assessment eye movement analysis and in terms of importance of elements both result shows same locations which is visible in the above figure.



← Figure 5.2a.42: Visual analysis for H4



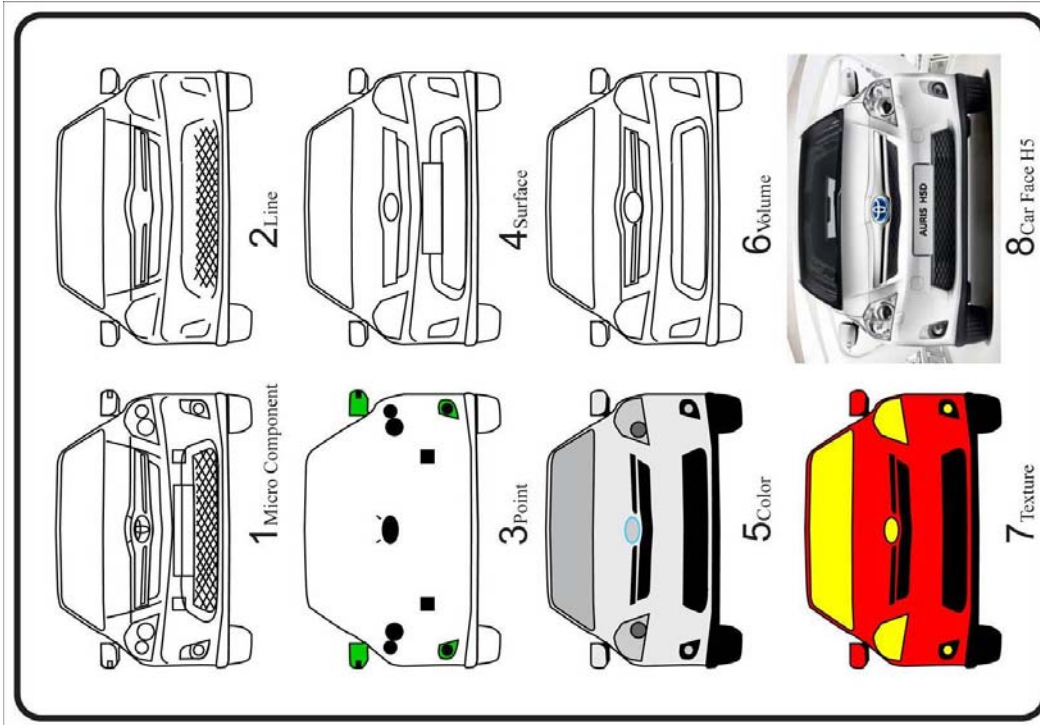
← Figure 5.2a.43: Golden ratio and Visual Hierarchy analysis for H4

Horizontal parallel lines on the lower grille with fog lights give a new look to the car design which makes for a good composition. Here H4 has a serious expression on part 2 (line). On the other hand, part 3 (point) reflects direction and draws people's attention, parts 4 (surface), 6 (volume) and 7 (texture) reflects serious expression owing to the lights. Part 5 (color) which is the red color accentuates the serious expression, specially the oval shape which draws the eyes towards the light area. The contrast of space eliminates the thick line from the grille finally leading to a serious expression.

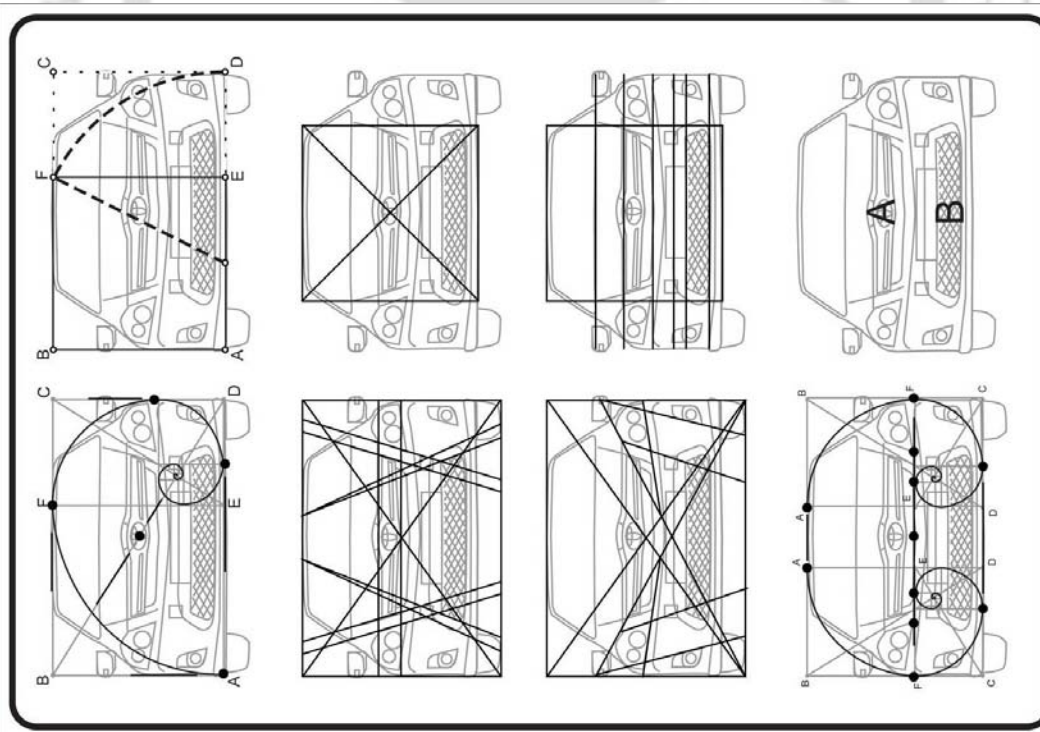


Figure 5.2a.44: Graphical key of H4 (Left), Eye tracking analysis of H4 (Right)

Proportion analysis reveals that the, H4 is not powerful in terms of both geometric and golden ratio. The visual hierarchy analysis shows, that eye first moves towards the location of grille "A" owing to the golden ratio area and also due to the presence of contrasting color and space. The eye shifts from grille "A" to logo "B" because of the texture and shape. It may hence be concluded that the icon grille "A" is a very attractive search icon within the peripheral field of vision. The result of machine eye tracking analysis shows the eye jump from grille "A" to lights and then to logo "B". In terms of sequences it is 80% same with the result of self assessment eye movement analysis and in terms of importance of elements both result shows same locations and eye tracking showed light as another important location which is visible in the above figure.



← Figure 5.2a.45: Visual analysis for H5



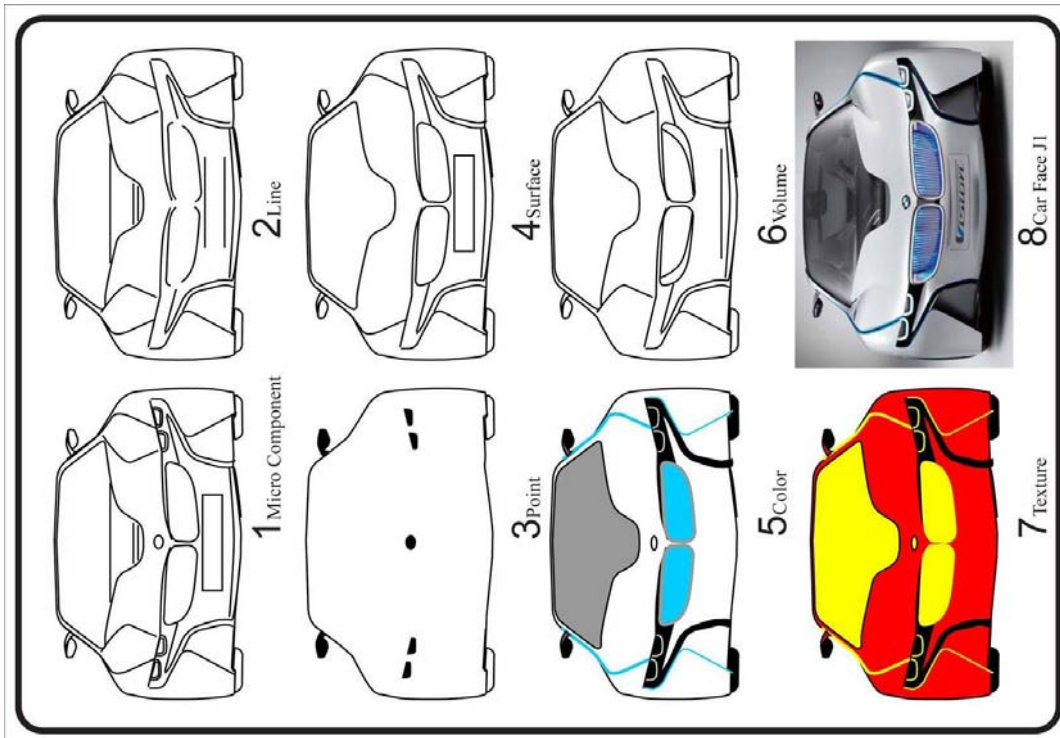
← Figure 5.2a.46: Golden ratio and Visual Hierarchy analysis for H5

H5 has the logo within the golden ratio area placed on a symmetrical line and hence steals the user's eye, we can thereby conform this point as the main point. Honeycombed net on the lower grille join the sides together creating a contrast of color with the body. In this analysis we see, that in part 2 (line) horizontal lines on the grille lead to a calmer look on the design. The top line of the guard creates the impression of a smile, part 3 (point) shows direction and draws attention, parts 4 (surface), 6 (volume) and 7 (texture) show a happy and smiling expression. Finally the expression is that of happiness.

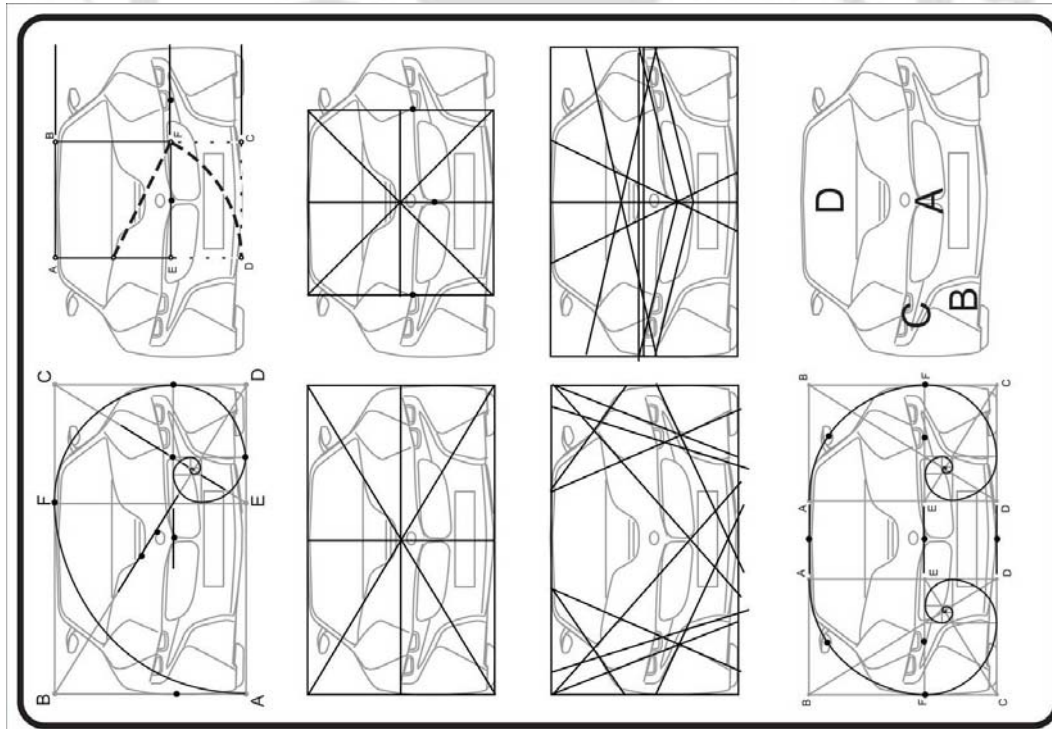


Figure 5.2a.47: Graphical key of H5 (Left), Eye tracking analysis of H5 (Right)

Proportion analysis reveals that the, H5 is powerful in terms of both geometric and golden ratio. The visual hierarchy analysis shows, that the eye movement first moves towards the location of logo “A” owing to the placement in the golden ratio area and also due to the presence of contrasting color and shape. The eye wanders from logo “A” to lower grille “B” because of the colors. It may hence be concluded that the icon logo “A” is a very attractive search icon within the peripheral field of vision. The result of machine eye tracking analysis shows the eye jump from grill and logo “A” to lights. In terms of sequences it is 50% same with the result of self assessment eye movement analysis and in terms of importance of elements both result shows same locations which is visible in the above figure.



← Figure 5.2a.48: Visual analysis for J1



← Figure 5.2a.49: Golden ratio and Visual Hierarchy analysis for J1

The Luxurious forms like fittings and complex forms and arcs express as sense of sophistication and elegance. In case of relation of forms, J1 creates a focus on grille owing to the golden ratio. Also the windscreen has a new form giving a different shape to the hood. This composition creates a sense of direction which draws attention towards the grille. Professional users can identify this car even with out the logo because of the distinctive design of the grille. This is therefore a positive factor. In part 3 (point) and 4 (surface), the point where the logo placed is the central point on the car face. This is mainly due to the direction of the hood. This makes the place as the central point of focus, and the evolution of the form J1 begins from this point. The contrast of space leads to a good composition with the lights as well as the blue lines. Owing to this, all parts finally reflect an angry expression.

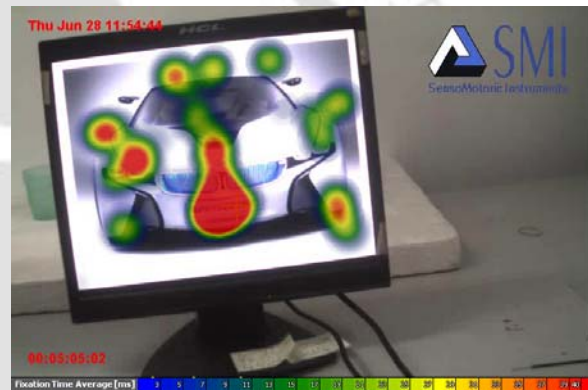
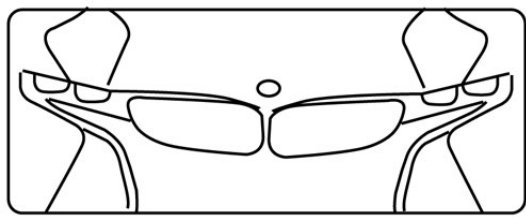
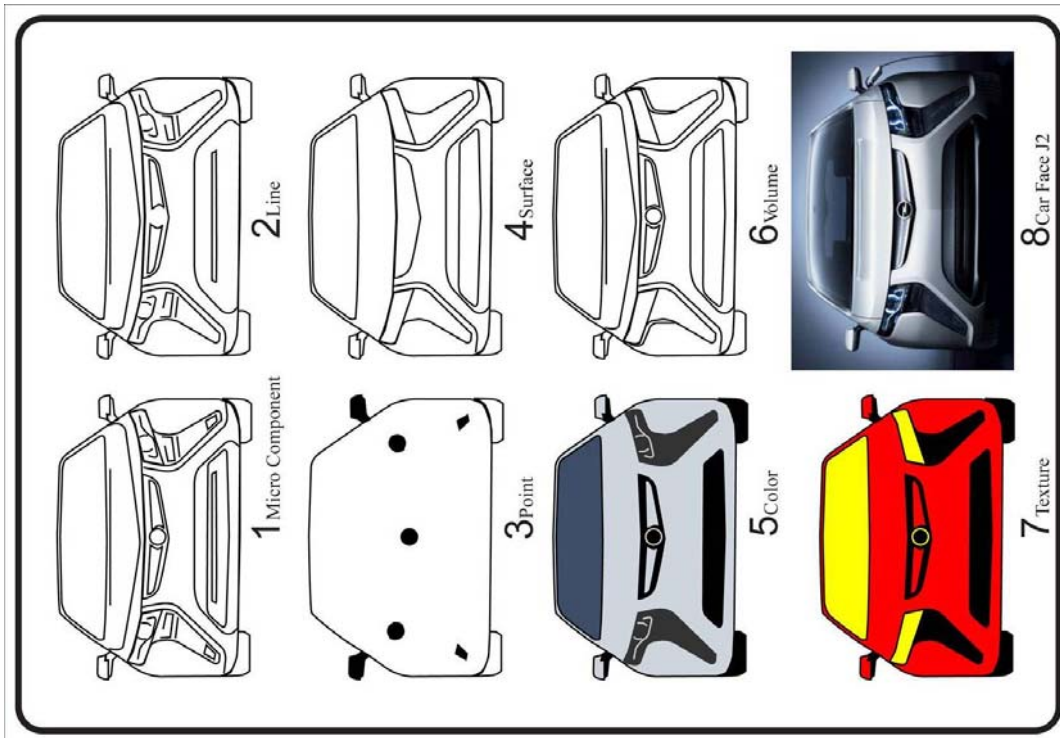
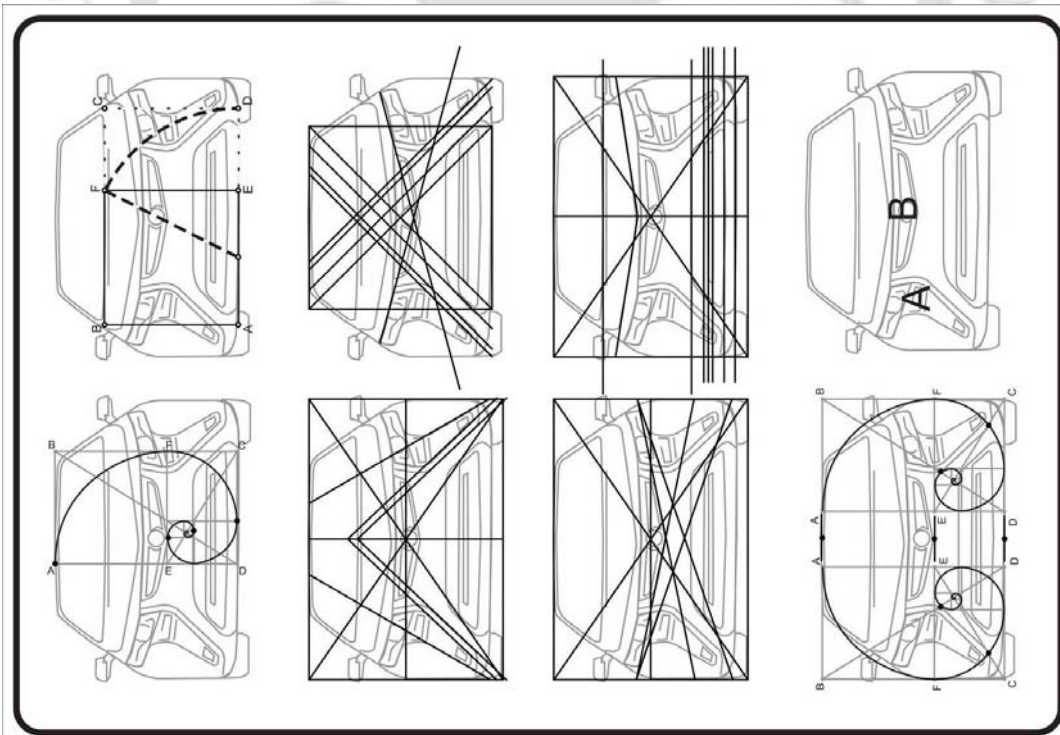


Figure 5.2a.50: Graphical key of J1(Left), Eye tracking analysis of J1(Right)

Proportion analysis reveals that the, J1 is powerful in terms of both geometric and golden ratio. The visual hierarchy analysis shows, that the eye first moves towards the location of the grille “A” owing to the direction of color and form as well as the existence of the golden ratio area. The eye tracks from grille “A” to form “B” and lights “C” and windscreen “D” due to the form and special color. It may hence be concluded that the icon grille “A” is a very attractive search icon within the peripheral field of vision. The result of machine eye tracking analysis shows the eye jump from grille “A” to lights “C” and windscreen “D”. In terms of sequences it is 80% same with the result of self assessment eye movement analysis and in terms of importance of elements both result shows same locations which is visible in the above figure.



← Figure 5.2a.51: Visual analysis for J2



← Figure 5.2a.52: Golden ratio and Visual Hierarchy analysis for J2

In J2, the Luxurious forms like fittings and complex forms and arcs express sophistication and elegance. In case of relation of forms, J2 places the focus on the logo. In part 3 (point) and 4 (surface), the point where the logo placed becomes the central point of the car face owing to the direction of grille lines. It shows this place as the central point from which the form J2 evolves. The oval shape of the logo steals the user's eyes as it is in the golden ratio area. The oval shape creates harmony with the grille especially due to its long form. Professional users can identify this car even with out the logo because of the distinctive design of the lights as well as the grille. This works as a positive factor. Here part 3 has a sense of direction and can draw the attention of the user. The parts 2 (line), 4 (surface), 5 (color), 6 (volume) and 7 (texture) show an angry expression. Finally we have an angry expression.

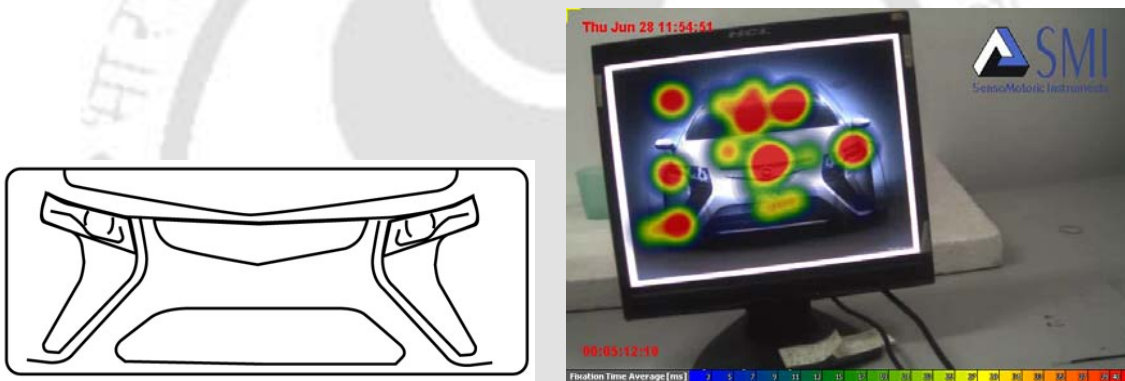
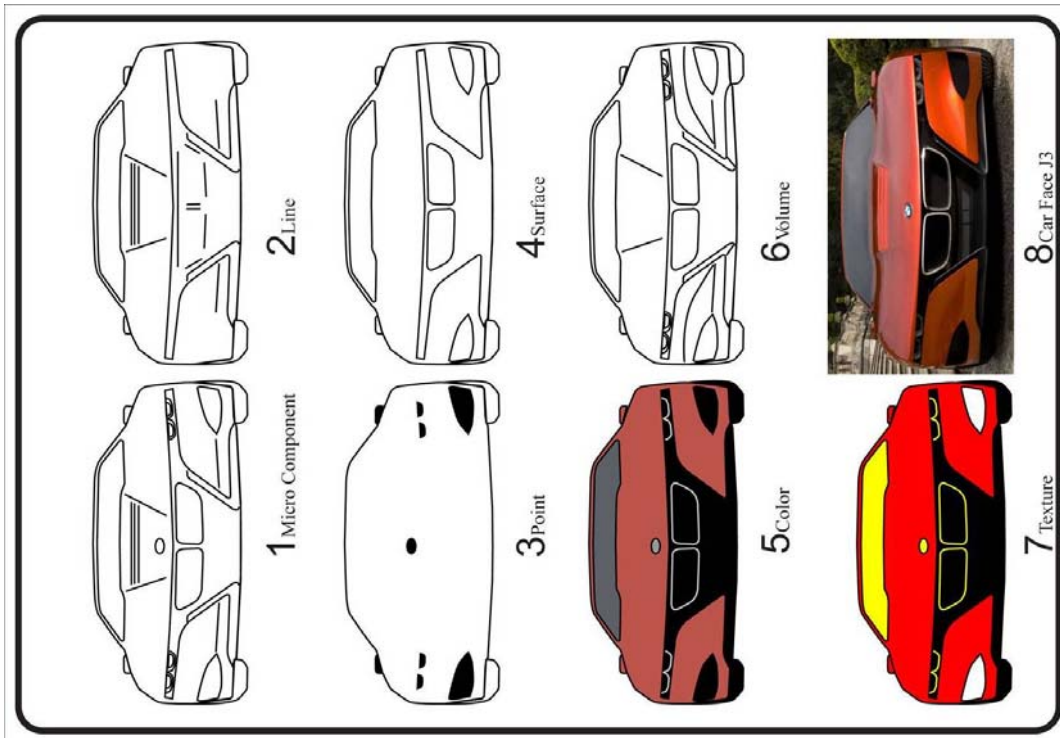
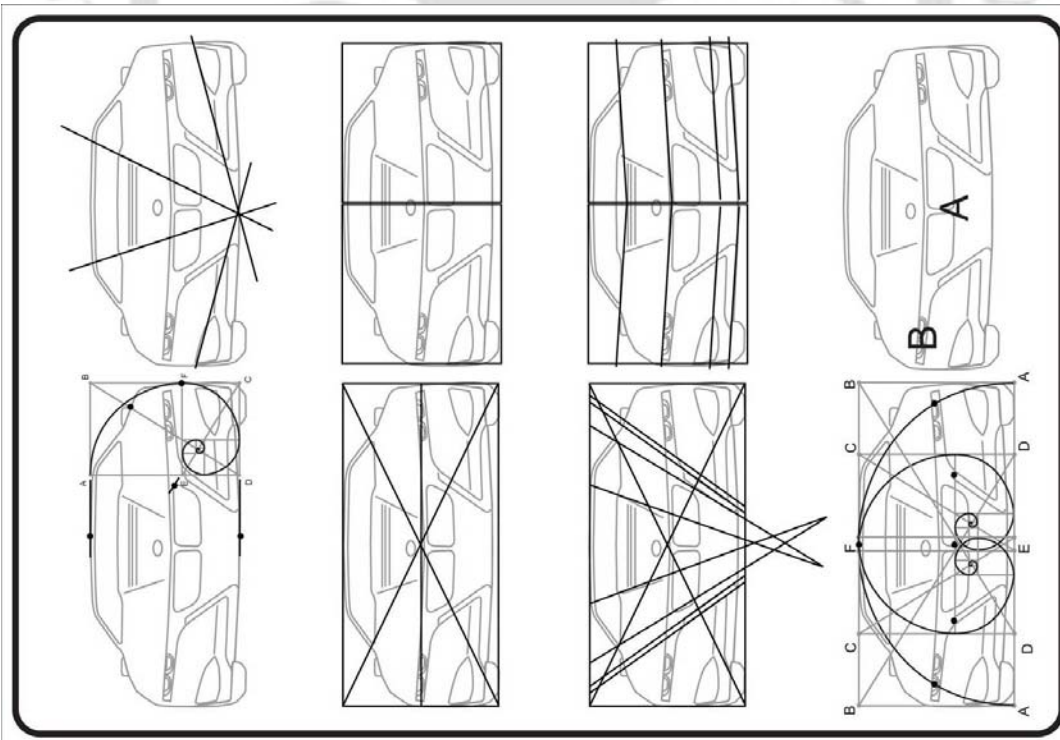


Figure 5.2a.53: Graphical key of J2 (Left), Eye tracking analysis of J2 (Right)

Proportion analysis reveals that the, J2 is powerful in terms of both geometric and golden ratio. The visual hierarchy analysis shows, that the eye first moves towards the location of form “A” owing to the color and form. The eye wanders from form “A” to logo “B” because of the form and shape. It may hence be concluded that the icon form “A” is a very attractive search icon within the peripheral field of vision. The result of machine eye tracking analysis shows the eye jump from form “A” to logo “B”. In terms of sequences it is 100% same with the result of self assessment eye movement analysis and in terms of importance of elements both result shows same locations which is visible in the above figure.



← Figure 5.2a.54: Visual analysis for J3



← Figure 5.2a.55: Golden ratio and Visual Hierarchy analysis for J3

The Grille frame along with the silver reflection expresses glory and elegance. In terms of relation of forms, J3 draws the focus on the grille. This primarily owes to the contrast of color as well as the location of the grille is in the golden ratio area. In part 1, the micro component and in part 3 (point) the point of logo forms the central point on the car face. Professional users can identify this car even with out the logo because of the distinctive design of the grille. This acts as positive factor. Part 4 (surface) has a smiling expression, whereas part 2 (line), 5 (color), 6 (volume) and 7 (texture) reflects a powerful angry expression/ Here, part 3 (point) has the sense of direction and draws the attention towards the logo. The final expression is therefore of anger.

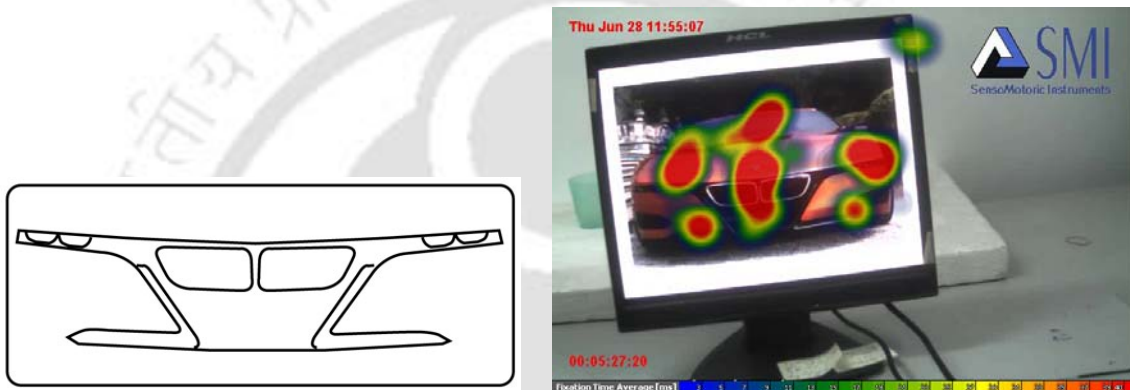
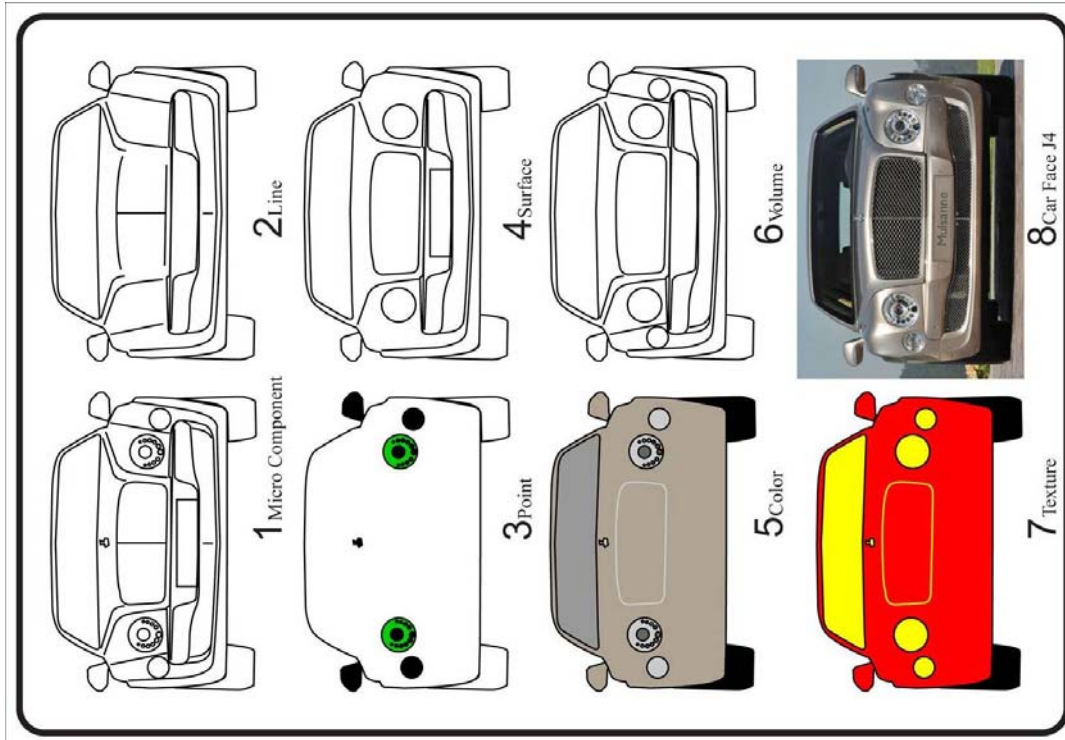
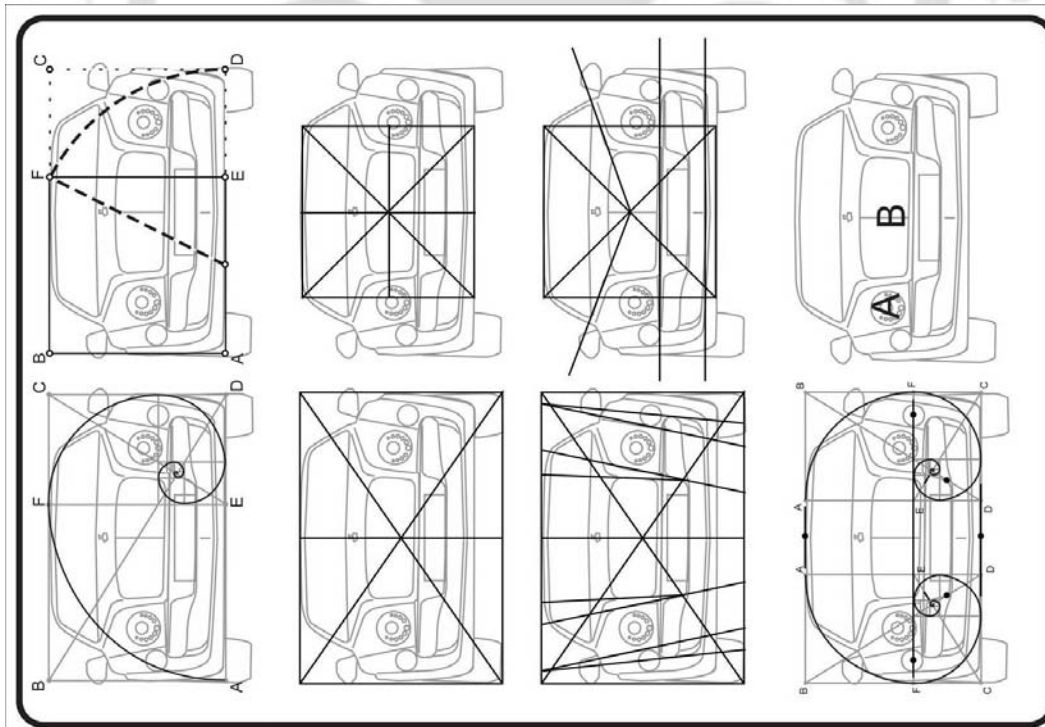


Figure 5.2a.56: Graphical key of J3(Left), Eye tracking analysis of J3 (Right)

Proportion analysis reveals that the, J3 is powerful in terms of both geometric and golden ratio. The visual hierarchy analysis shows, that the eye first moves towards the location of grille “A” owing to the color and form as well as the presence of the golden ratio area. The eye tracks from grille “A” to lights “B” because of the colors and direction of lines. It may hence be concluded that the icon grille “A” is a very attractive search icon within the peripheral field of vision. The result of machine eye tracking analysis shows the eye jump from grille “A” to lights “B”. In terms of sequences it is 100% same with the result of self assessment eye movement analysis and in terms of importance of elements both result shows same locations which is visible in the above figure.



← Figure 5.2a.57: Visual analysis for J4



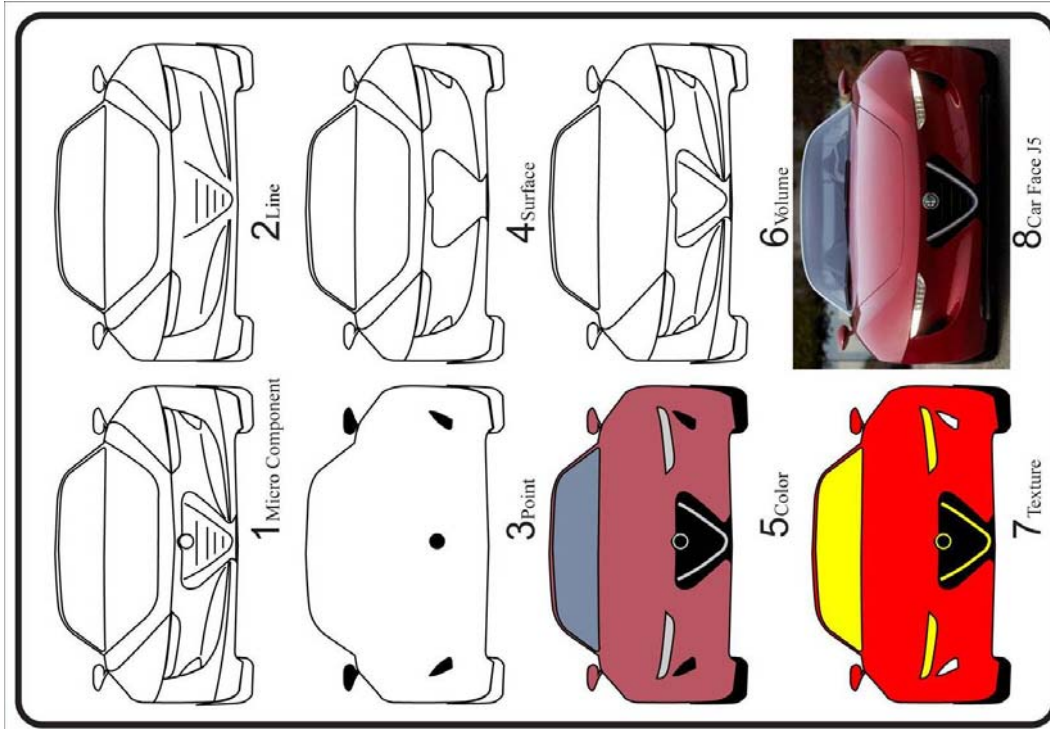
← Figure 5.2a.58: Golden ratio and Visual Hierarchy analysis for J4

The Car J4 expresses glory due to the presence of luxurious forms like the fittings and complex forms and arcs. In terms of relation of forms, J4 draws focus on the grille. In part 4 (surface) the area of grille becomes the central area of the car face. It shows this area as the main point from which the form J4 evolves. Professional users can identify this car even without logo owing to the distinctive design of the lights as well as the grille. This acts as a positive factor. In part 2 (line) we see an angry expression, part 3 (point) reveals an attentive and curious expression owing to the shape of the lights and grille. Part 5 (color), 7 (texture), 4 (surface) and 6 (volume), together express an attentive and surprised expression. Finally we have an angry expression.

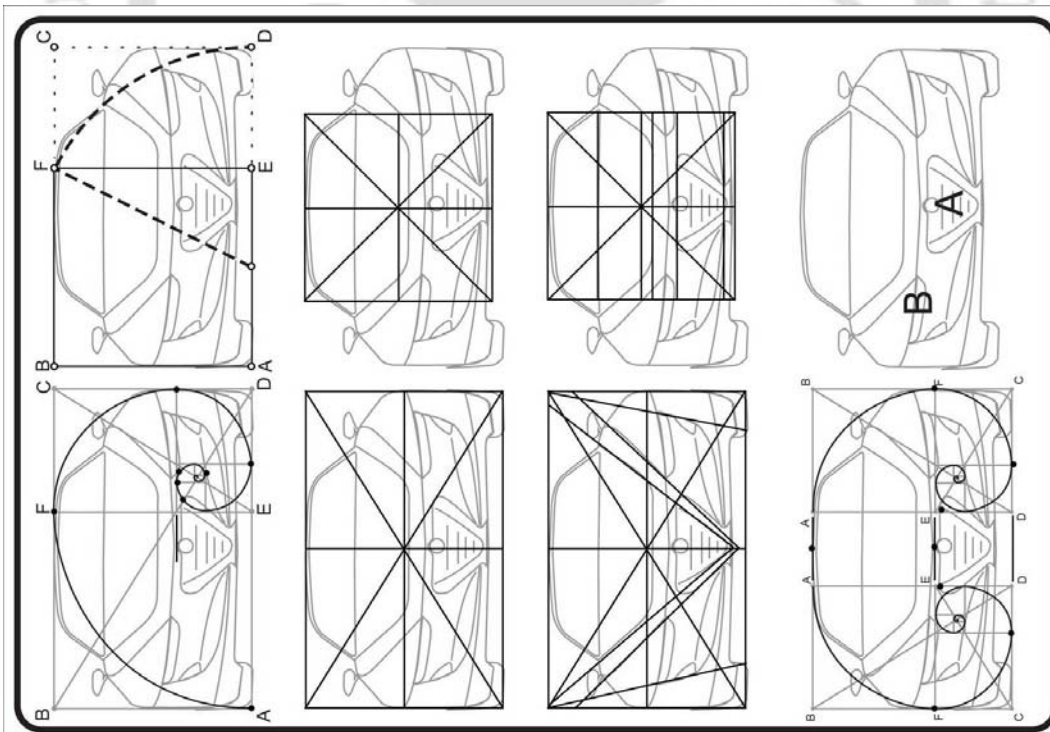


Figure 5.2a.59: Graphical key of J4 (Left), Eye tracking analysis of J4 (Right)

Proportion analysis reveals that the, J4 is powerful in terms of both geometric and golden ratio. The visual hierarchy analysis shows, that the eye movement first moves towards the location of lights “A” owing to the circular shape. The eye shifts from lights “A” to grille “B” due to the size and shape. It may hence be concluded that the icon lights “A” is a very attractive search icon within the peripheral field of vision. The result of machine eye tracking analysis shows the eye jump from lights “A” to grille “B”. In terms of sequences it is 100% same with the result of self assessment eye movement analysis and in terms of importance of elements both result shows same locations which is visible in the above figure.



← Figure 5.2a.60: Visual analysis for J5



← Figure 5.2a.61: Golden ratio and Visual Hierarchy analysis for J5

Here the silver reflection of the grille frame expresses sophistication and glory. In terms of relation of forms, J5 creates focus on the grille as well as the point where the logo is placed. In part 3 (point) and 4 (surface) the point where the logo placed becomes the central point of focus on the car face. This could be because the part 2 (line) lines lead to the direction of this point. It therefore establishes this place as the main point, from which the form J5 evolves. The circular shape specially has the ability to steal the user's eyes. Here, professional users can identify this car even with out the logo owing to the distinctive design of the grille. This acts as a positive factor. Part3 (point) directs attention towards the logo. Part 2 (line), 4 (surface), 5 (color), 6 (volume) and 7 (texture), together show a wild and angry expression. Designer used the element of contrast of space for placing the grille as well as the logo, as evident in part 5(color) and 7(texture). Finally it reveals an angry expression.

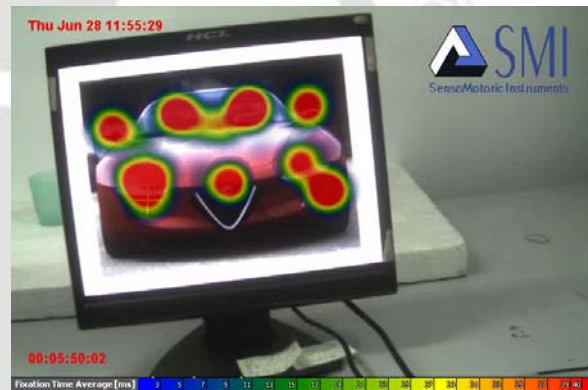
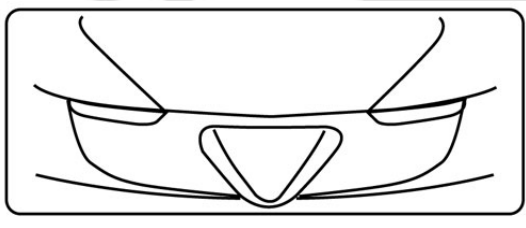
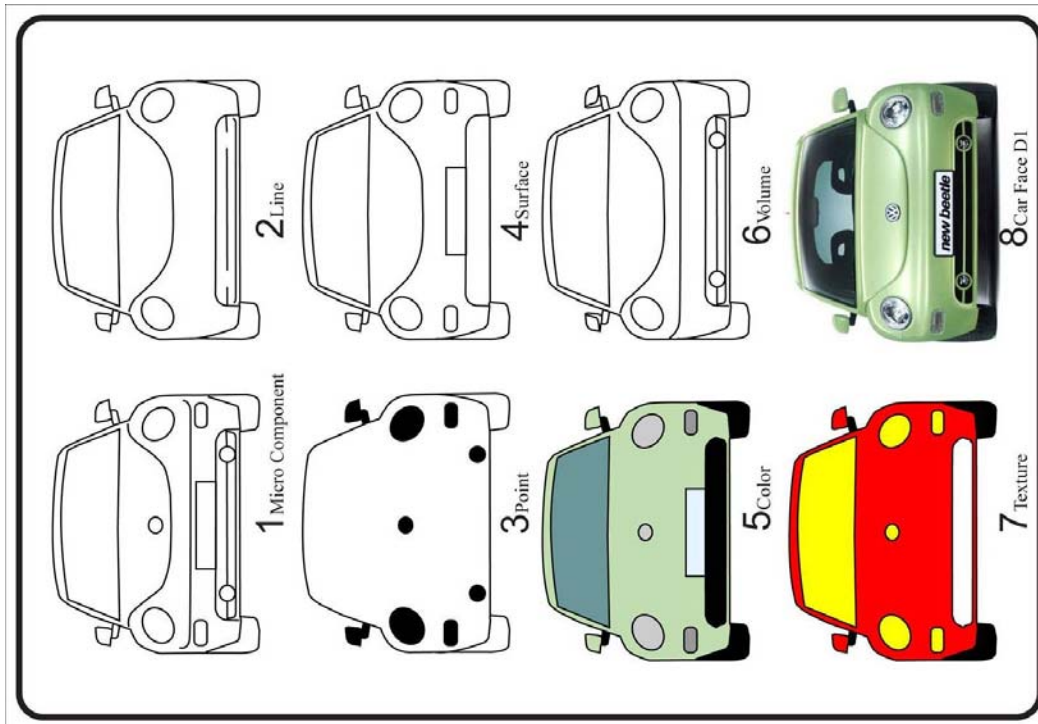
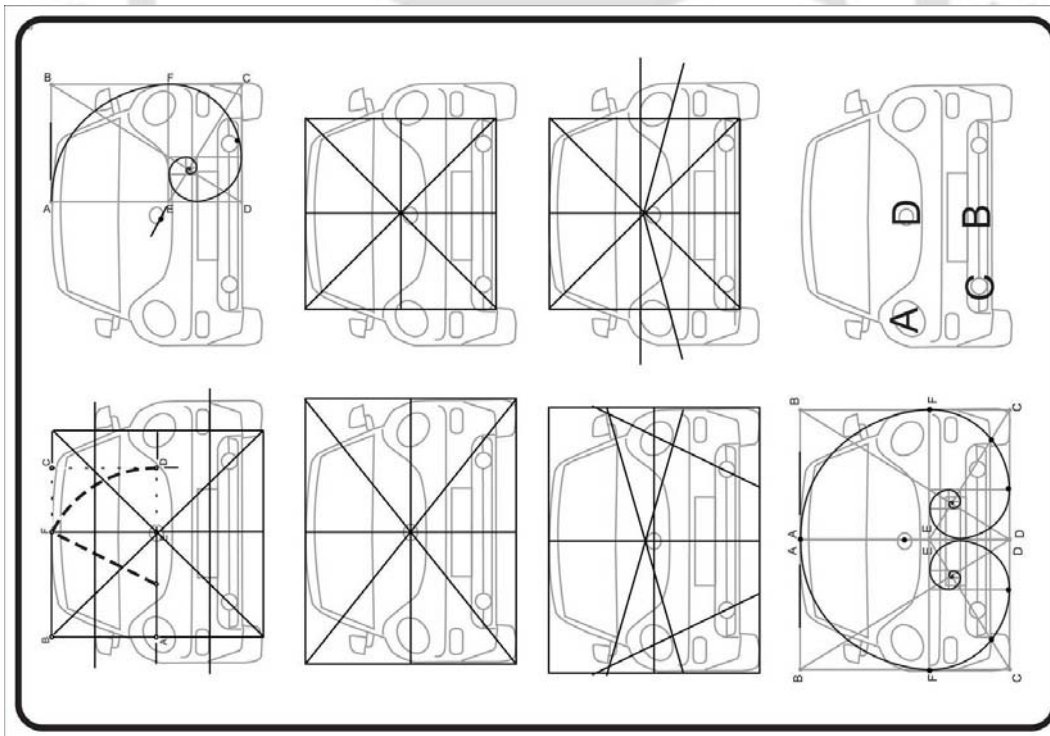


Figure 5.2a.62: Graphical key of J5 (Left), Eye tracking analysis of J5 (right)

Proportion analysis reveals that the, J5 is powerful in terms of both geometric and golden ratio. The visual hierarchy analysis shows, that the eye movement first moves towards the location of grille “A” due to the V shape along with the black color and form. The eye tracks from grille “A” to lights “B” owing to the colors. It may hence be concluded that the icon grille “A” is a very attractive search icon within the peripheral field of vision. The result of machine eye tracking analysis shows the eye jump from grille “A” to lights “B”. In terms of sequences it is 100% same with the result of self assessment eye movement analysis and in terms of importance of elements both result shows same locations which is visible in the above figure.



← Figure 5.2a.63: Visual analysis for D1



← Figure 5.2a.64: Golden ratio and Visual Hierarchy analysis for D1

In D1, the Lower grille makes a good composition with the fog lights leading to a new car design. Part 2 (line) has a serious expression; while part 3 (point) directs the attention towards the lights owing to the circular shape as well as the golden ratio. Part 4 (surface), 5 (color) and 7 (texture) portrays a cute expression and part 6 (volume) has a smiling expression.

Using the element of contrast of space, designers draw the focus towards the horizontal line and the both fog lights on the lower grille. The frontal portion of the car is almost square with symmetrical surfaces. The logo of this car is on the hood placed at the center of the square. Finally we have a happy expression.

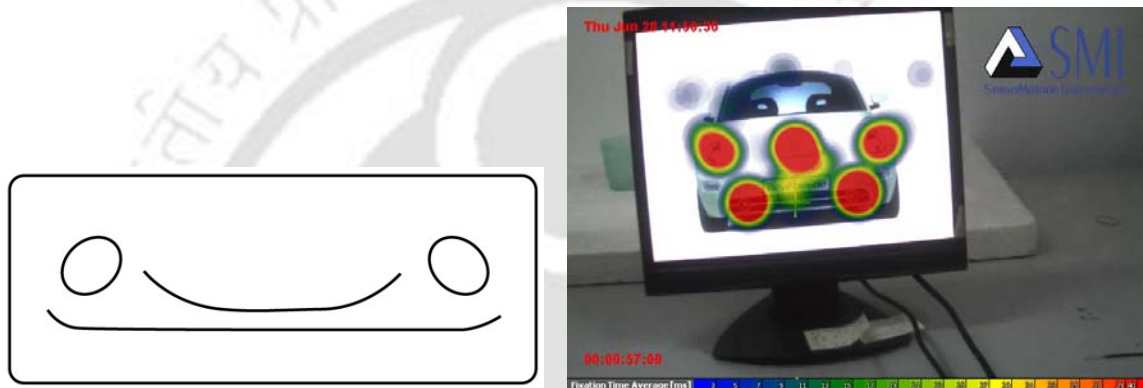
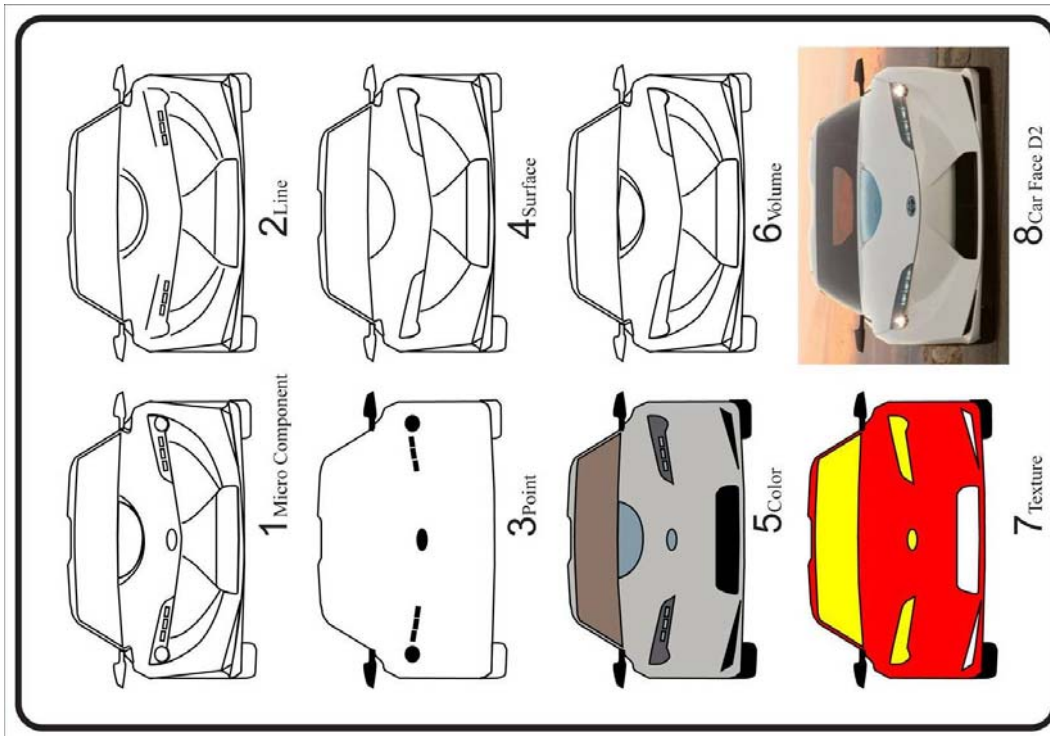
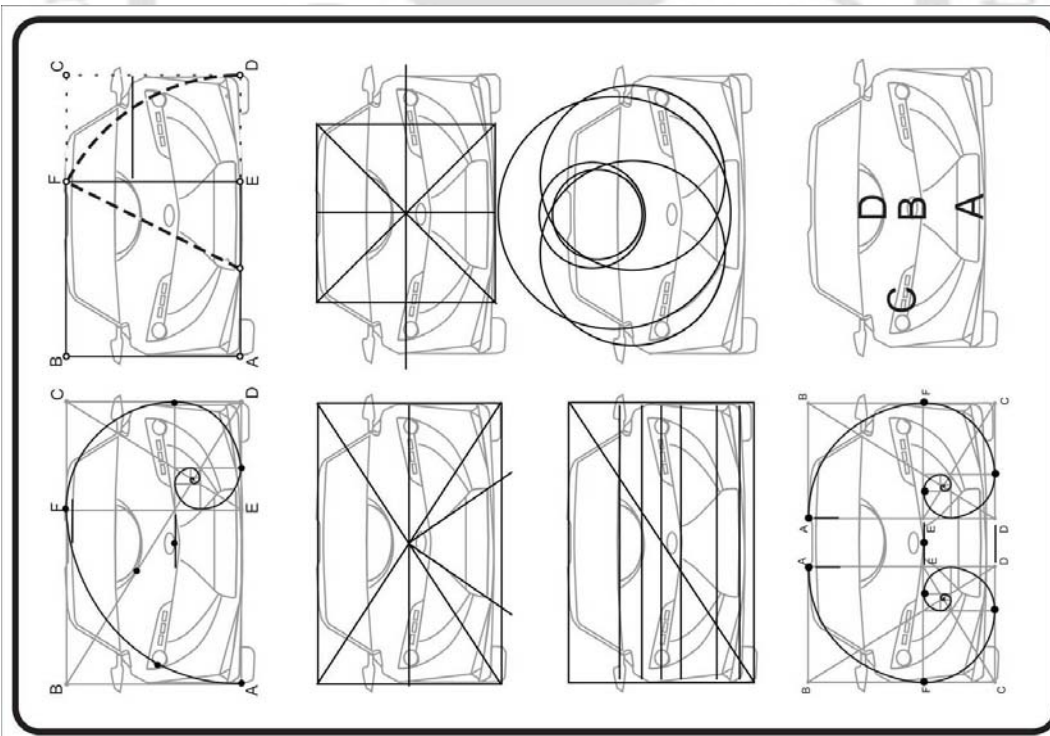


Figure 5.2a.65: Graphical key of D1 (Left), Eye tracking analysis of D1(Right)

Proportion analysis reveals that the, D1 is powerful in terms of both geometric and golden ratio. The visual hierarchy analysis shows, that the eye first moves towards the location of lights “A” owing to the circular shape and the existence of the golden ratio area. The eye tracks from lights “A” to form “B, C, and D due to the circular shape and color. It may hence be concluded that the icon lights “A” is a very attractive search icon within the peripheral field of vision. The result of machine eye tracking analysis shows the eye jump from logo “D” to lights “A” to form “B”. In terms of sequences it is 10% same with the result of self assessment eye movement analysis and in terms of importance of elements both result shows same locations which is visible in the above figure.



← Figure 5.2a.66: Visual analysis for D2



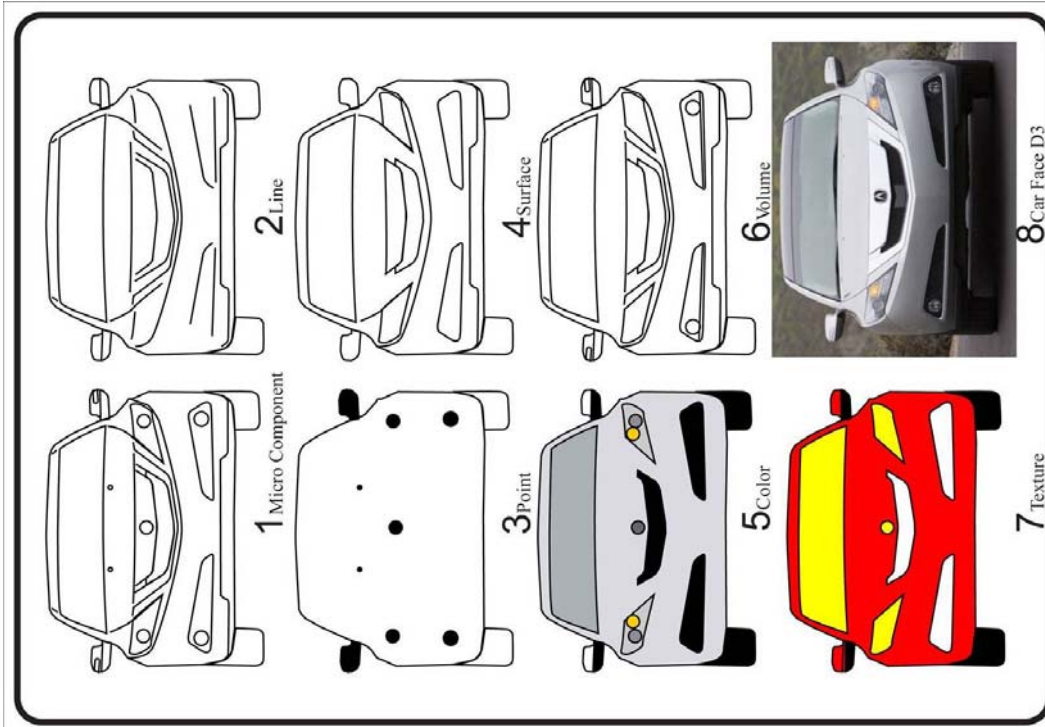
← Figure 5.2a.67: Golden ratio and Visual Hierarchy analysis for D2

In D2, complex forms are specified leading to an elegant and sophisticated expression. In terms of relation of forms, D2 places focus on the lower grille. In part 5 (color), a good contrast of color and space is visible. Owing to this contrast, designers can direct the attention towards the logo. Part 3 (point) also directs the attention of the user towards the logo. Part 2 (line), 4 (surface), 5 (color), 6 (volume) and 7 (texture) reflect a smiling expression. Finally the expression is that of happiness.

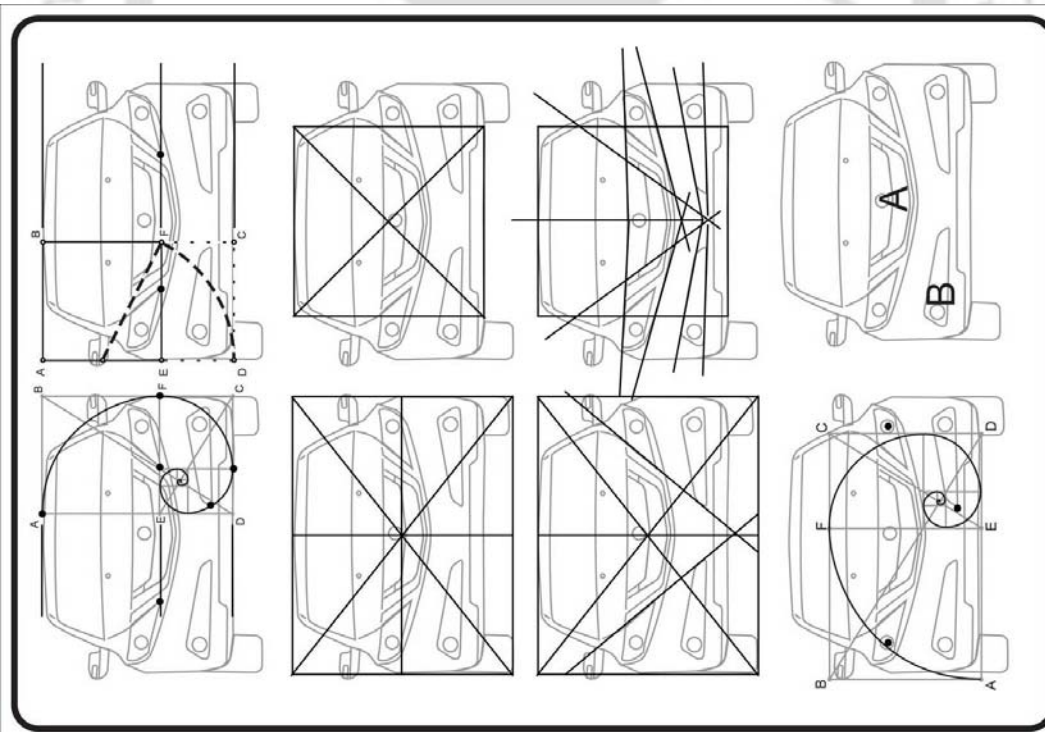


Figure 5.2a.68: Graphical key of D2 (Left), Eye tracking analysis of D2 (Right)

Proportion analysis reveals that the, D2 is powerful in terms of both geometric and golden ratio. The visual hierarchy analysis shows, that the eye movement first goes towards the location of grille “A” owing to the contrast of space and color. The eye tracks from grille “A” to Logo “B” and lights “C” and form “D” due to directions as well as its presence in the golden ratio area. It may hence be concluded that the icon grille “A” is a very attractive search icon within the peripheral field of vision. The result of machine eye tracking analysis shows the eye jump from grille “A” to Logo “B” and lights “C” and form “D”. In terms of sequences it is 100% same with the result of self assessment eye movement analysis and in terms of importance of elements both result shows same locations which is visible in the above figure.



← Figure 5.2a.69: Visual analysis for D3



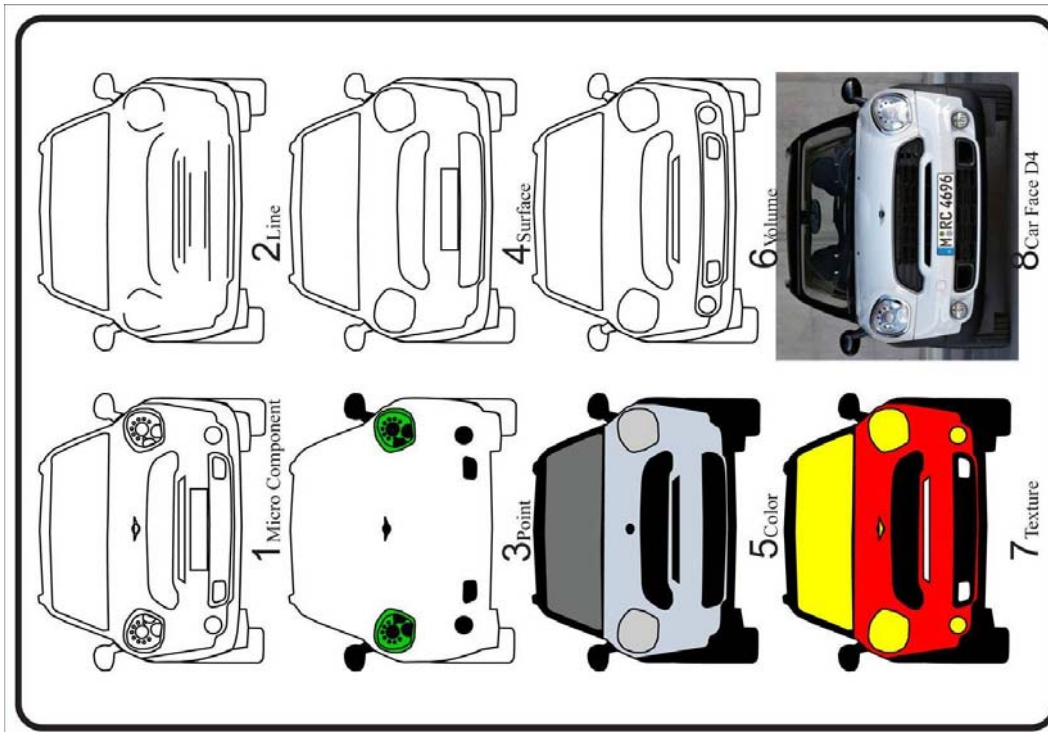
← Figure 5.2a.70: Golden ratio and Visual Hierarchy analysis for D3

D3 has a vertical line on the hood which is placed in a symmetrical manner on the car face. This is an important factor in car designing. This line starts from the hood (in front of windscreen) and goes down to the end of grille. Part 3 (point) draws the direction and attention towards the logo while part 2 (line), 4 (surface), 5 (color), 6 (volume) and 7 (texture) show an extremely happy expression. Here, the contrast of color and space in grille also leads to a good direction. Finally it has an expression of happiness.

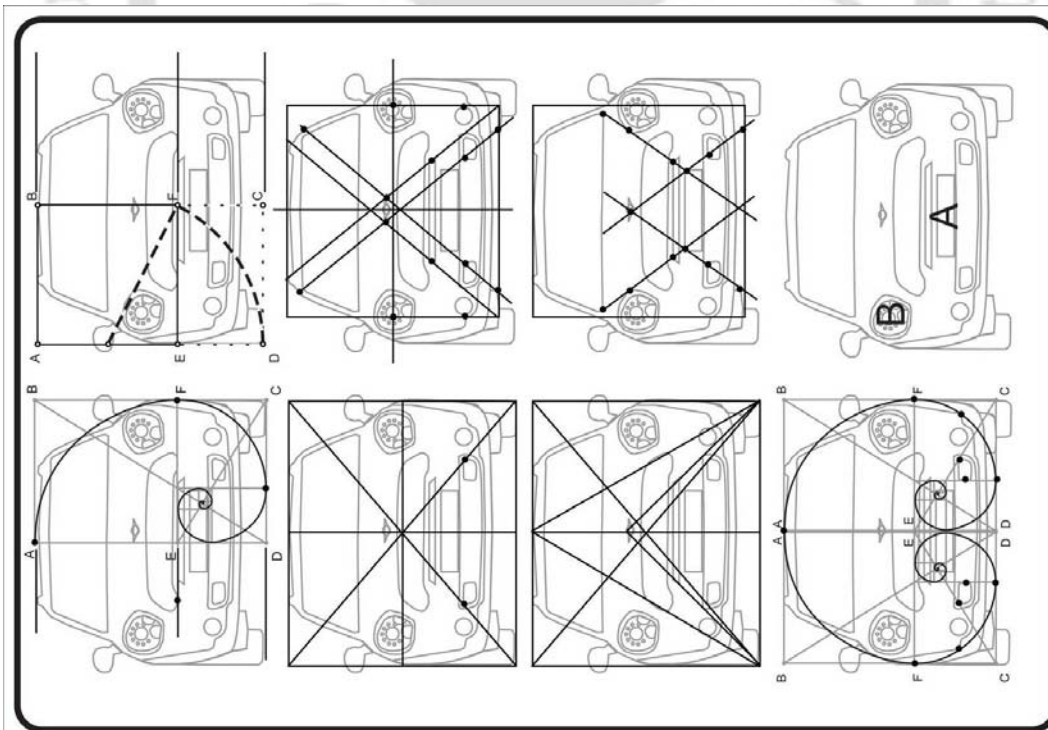


Figure 5.2a.71: Graphical key of D3 (Left), Eye tracking analysis of D3 (Right)

Proportion analysis reveals that the, D3 is powerful in terms of both geometric and golden ratio. The visual hierarchy analysis shows, that the eye movement first goes towards the location of grille “A” owing to the color and form and also due to the existence of the golden ratio area. The eye tracks from grille “A” to lower grille “B” attributing to the colors. It may hence be concluded that the icon grille “A” is a very attractive search icon within the peripheral field of vision. The result of machine eye tracking analysis shows the eye jump from grille “A” to light and then to lower grille “B”. In terms of sequences it is 80% same with the result of self assessment eye movement analysis and in terms of importance of elements both result shows same locations which is visible in the above figure.



← Figure 5.2a.72: Visual analysis for D4



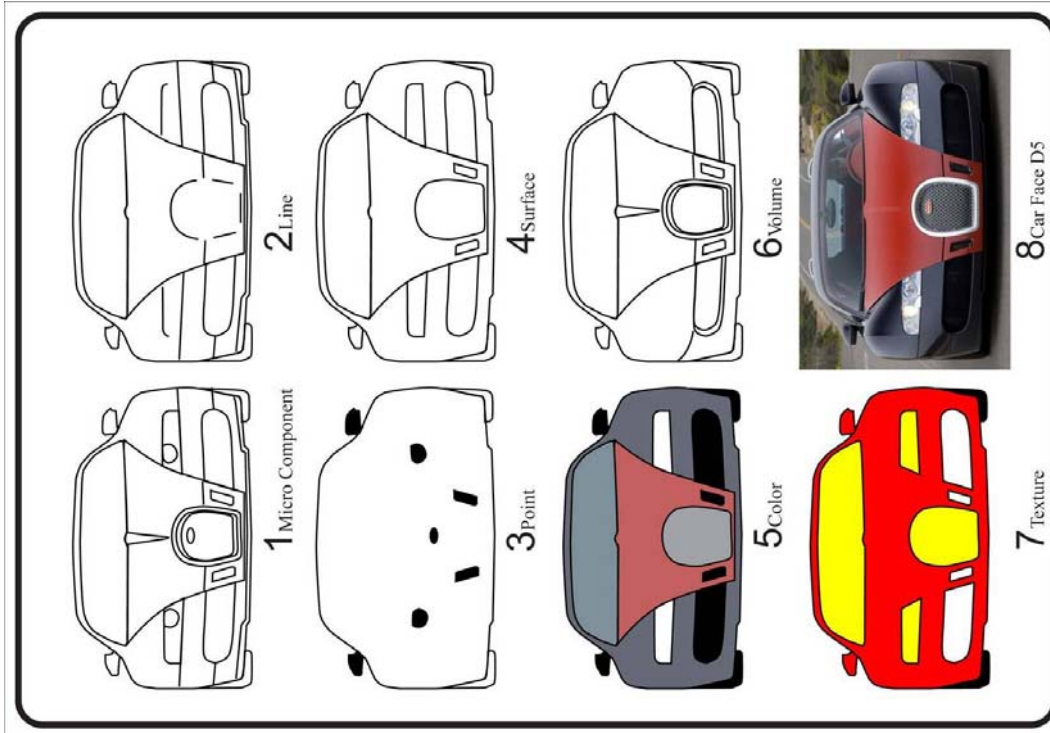
← Figure 5.2a.73: Golden ratio and Visual Hierarchy analysis for D4

The area between the grille and lower grille is the central point of car face. It has a sense of direction due to the contrast of color as well as the presence of the golden ratio. This form joints all the lights together, in gestalt. Part 2 (line), 3 (point), 4 (surface), 5 (color), 6 (volume) and 7 (texture) show a deeply saddened expression. The final expression is therefore sad.

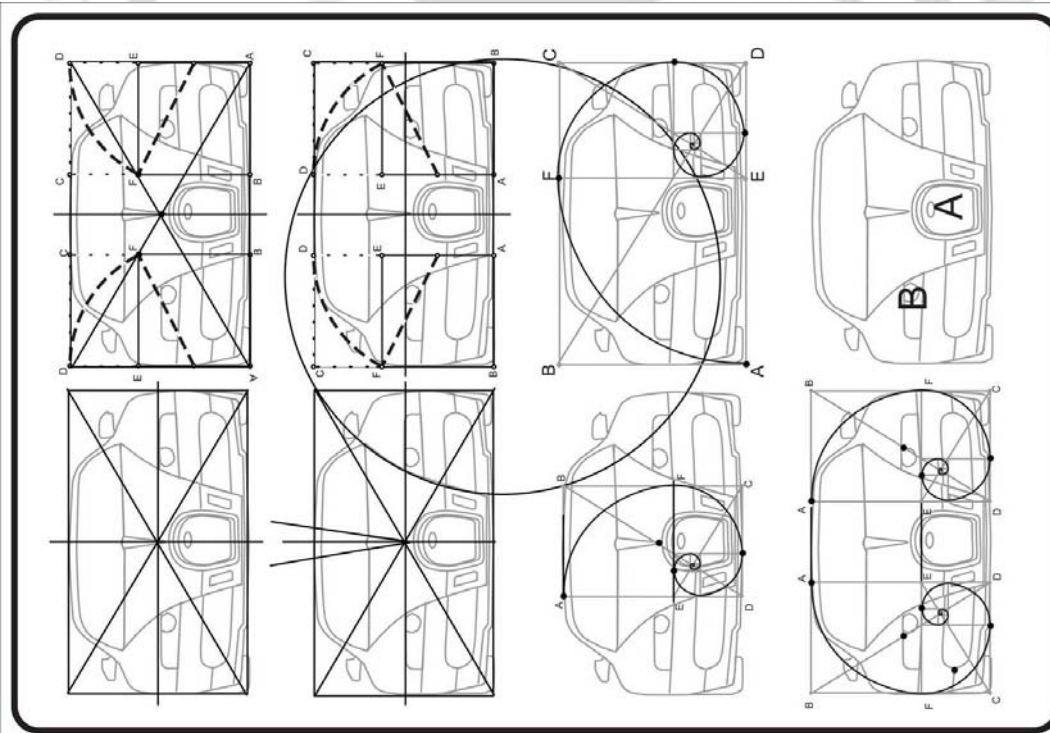


Figure 5.2a.74: Graphical key of D4 (Left), Eye tracking analysis of D4 (Right)

Proportion analysis reveals that the, D4 is powerful in terms of both geometric and golden ratio. The visual hierarchy analysis shows, that the eye first moves towards the part between the grille and lower grille “A” owing to the color and form and the existence of the golden ratio area. The eye tracks from location “A” to lights “B” due to the shape. It may hence be concluded that the location “A” is a very attractive search icon within the peripheral field of vision. The result of machine eye tracking analysis shows the eye jump from location “A” to lights “B”. In terms of sequences it is 100% same with the result of self assessment eye movement analysis and in terms of importance of elements both result shows same locations which is visible in the above figure.



← Figure 5.2a.75: Visual analysis for D5



← Figure 5.2a.76: Golden ratio and Visual Hierarchy analysis for D5

In D5, luxurious forms like the fittings and complex forms and arcs express richness and a sense of pride. In terms of relation of forms, D5 focuses on the grille and the point where the logo is placed. In part 3 (point) and 4 (surface) the point where the logo is placed forms the central point of car face as in part 2 (line) all arcs lead to the direction of the grille. It focuses this place as the central point from which the form D5 evolves. The special rounded shape of the grille can easily steal the attention of the user. Professional users can identify this car even with out logo because of the distinctive design of the lights form and the grille. This acts as a positive factor. The vertical line on the car face has a symmetry which works well for the design. This line starts from the hood (in front of the windscreen). In Visual analysis, parts 2 (line), 3 (point), 4 (surface), 5 (color), 6 (volume) and 7 (texture) reveals a deeply saddened expression. Finally the expression is that of sadness.

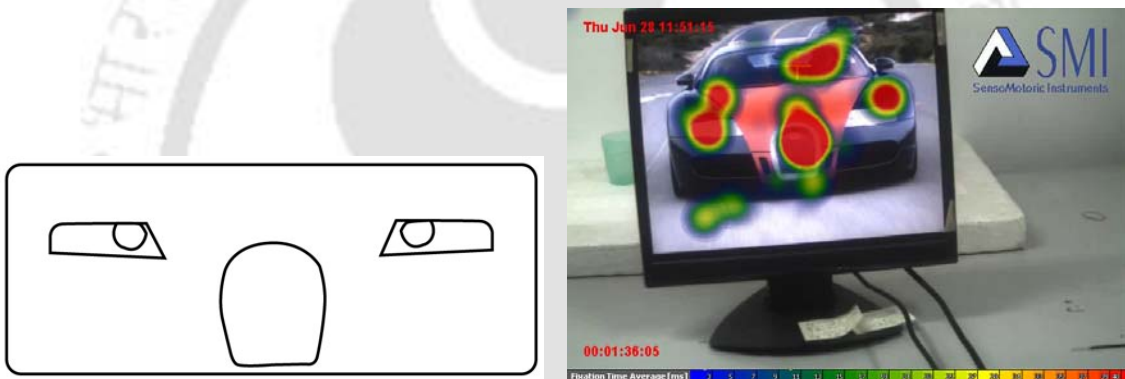
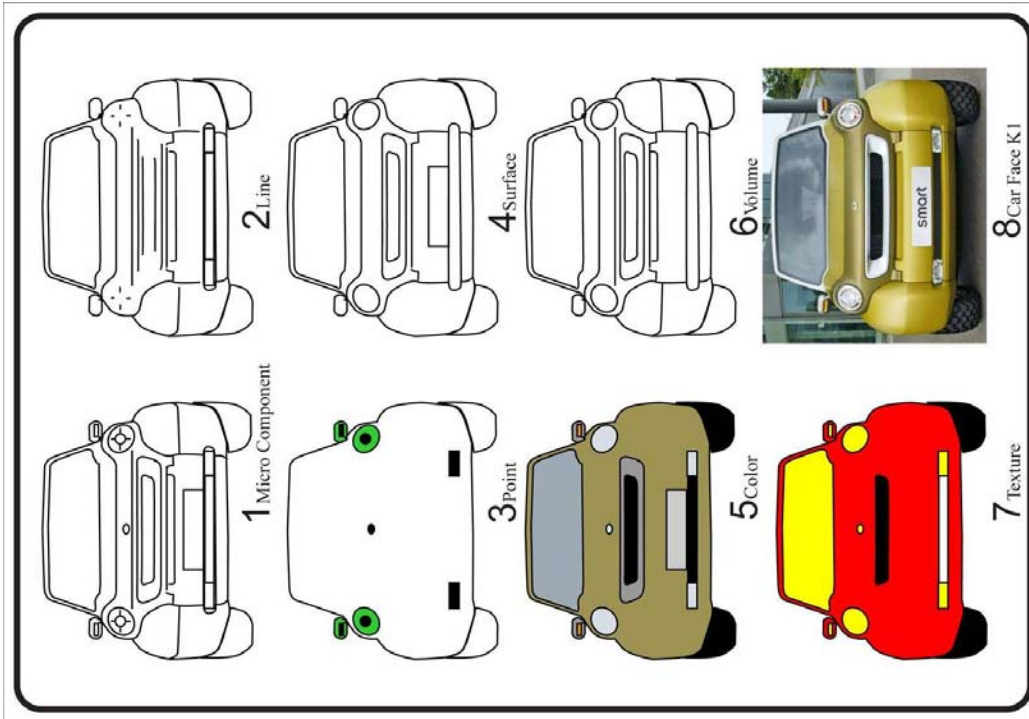
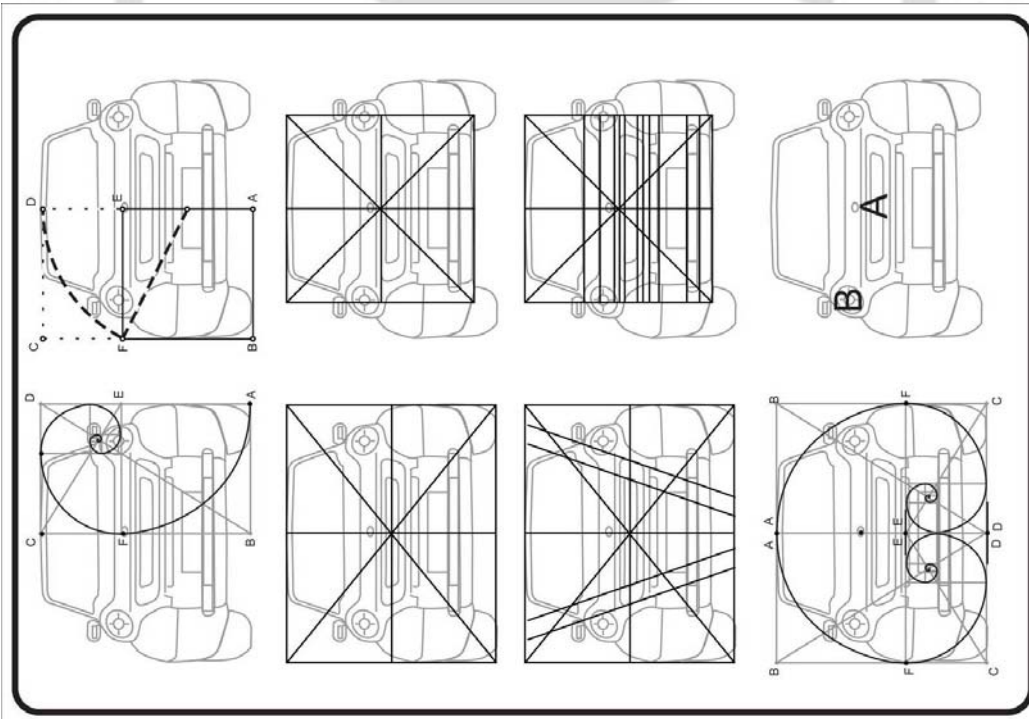


Figure 5.2a.77: Graphical key of D5 (Left), Eye tracking analysis of D5 (Right)

Proportion analysis reveals that the, D5 is powerful in terms of both geometrical and golden ratio. The visual hierarchy analysis shows, that the eye movement first moves towards the location of grille “A” owing to the shape and the existence of the golden ratio area. The eye tracks from grille “A” to lights “B” because of the colors. It may hence be concluded that the icon grille “A” is a very attractive search icon within the peripheral field of vision. The result of machine eye tracking analysis shows the eye jump from grille “A” to lights “B”. In terms of sequences it is 100% same with the result of self assessment eye movement analysis and in terms of importance of elements both result shows same locations which is visible in the above figure.



← Figure 5.2a.78: Visual analysis for K1



← Figure 5.2a.79: Golden ratio and Visual Hierarchy analysis for K1

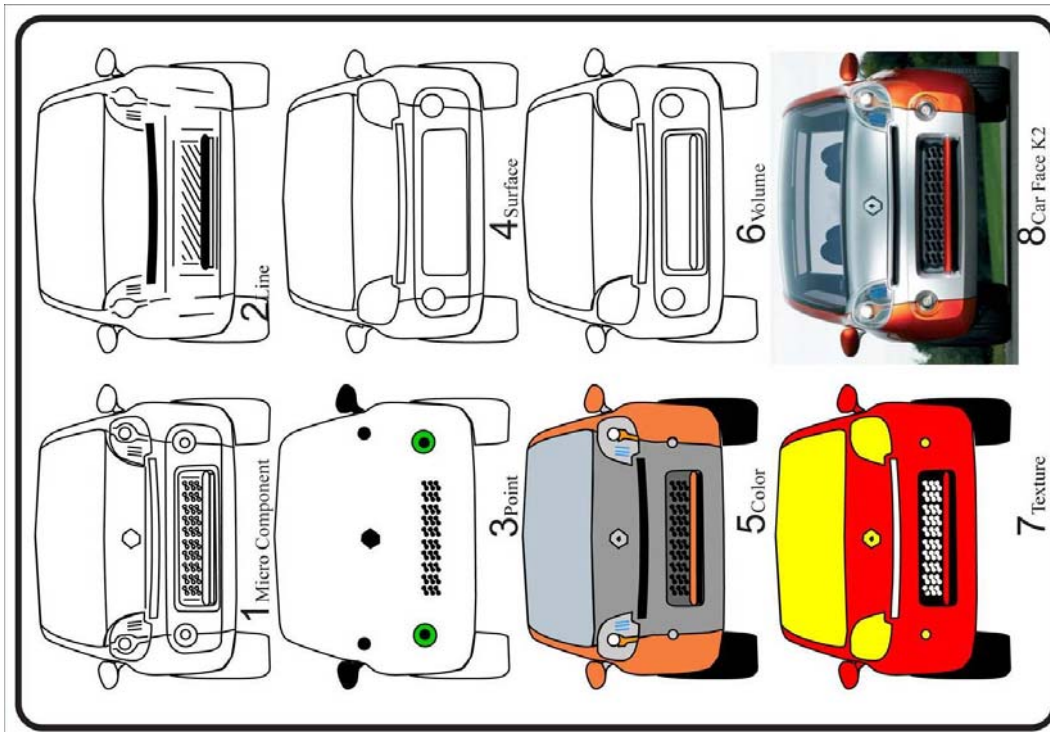
K1 has a complex form because of which the grille becomes the centre geometrically and owing to the contrast of colors the attention stays at the grille.

Here car designers use the element of contrast of color and space on the grille for developing a good composition with grille frame. In Visual analysis, 3 (point), 4 (surface), 5 (color), 6 (volume) and 7 (texture) portrays an extremely funny and comic expression. Finally the expression of the car remains comical.

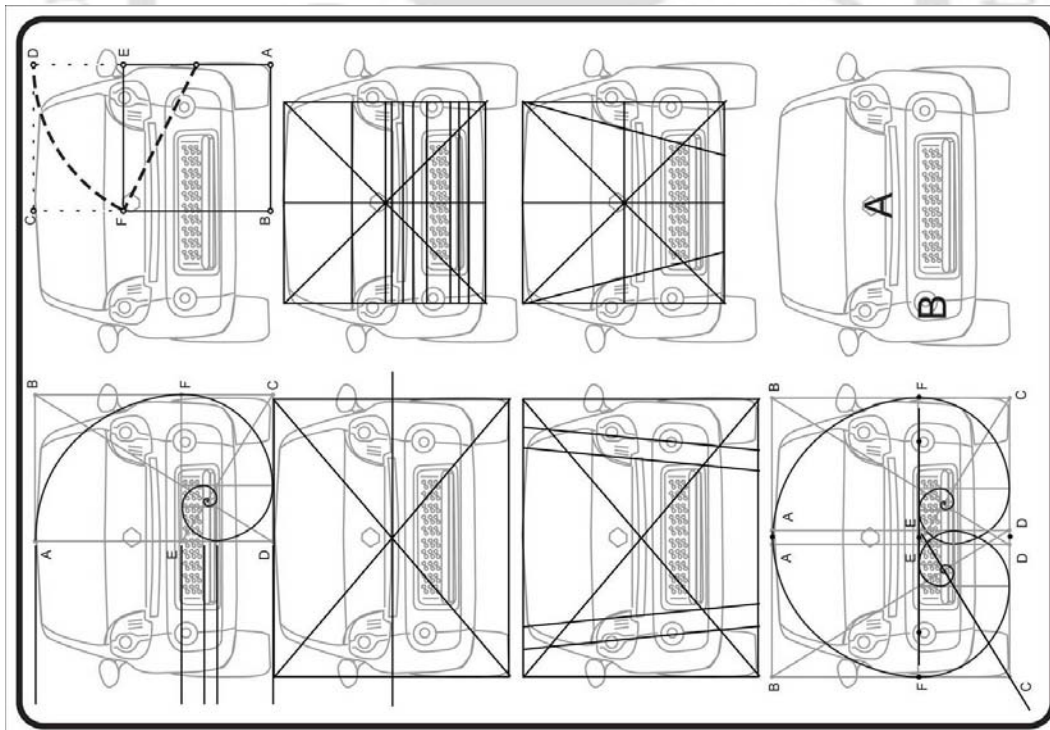


Figure 5.2a.80: Graphical key of K1 (Left), Eye tracking analysis of K1 (Right)

Proportion analysis reveals that the, K1 is powerful in terms of both geometrical and golden ratio. The visual hierarchy analysis shows, that the eye first moves towards the location of the grille “A” owing to the color and form as well as the existence of the golden ratio area. The eye shifts from grille “A” to lights “B” because of the circular shape. It may hence be concluded that the icon grille “A” is a very attractive search icon within the peripheral field of vision. The result of machine eye tracking analysis shows the eye jump from grille “A” to lights “B”. In terms of sequences it is 100% same with the result of self assessment eye movement analysis and in terms of importance of elements both result shows same locations which is visible in the above figure.



← Figure 5.2a.81: Visual analysis for K2



← Figure 5.2a.82: Golden ratio and Visual Hierarchy analysis for K2

In this car face, the lower grille and the grille are located in the golden ratio area. Here the car designers use the contrast of space in the grille which leads to a visible smiling expression. The logo of K2 is an abstract of diamond. This logo has the element of direction which leads to a good composition with the grille. In other analysis, part 2 (line) has a shaky expression as the lines slant towards the right side. However the contrast of space in the grille bears a happy smiling expression. Part 3 (point) will show comic and funny expression, parts 4 (surface), 6 (volume) and 7 (texture) will show smile and happy expression, part 5 (color) has comic expression. Finally the expression is comical

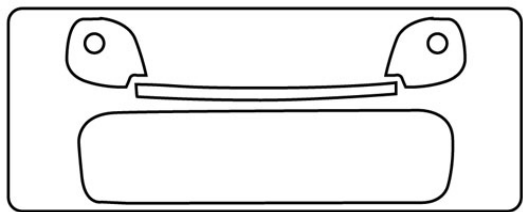
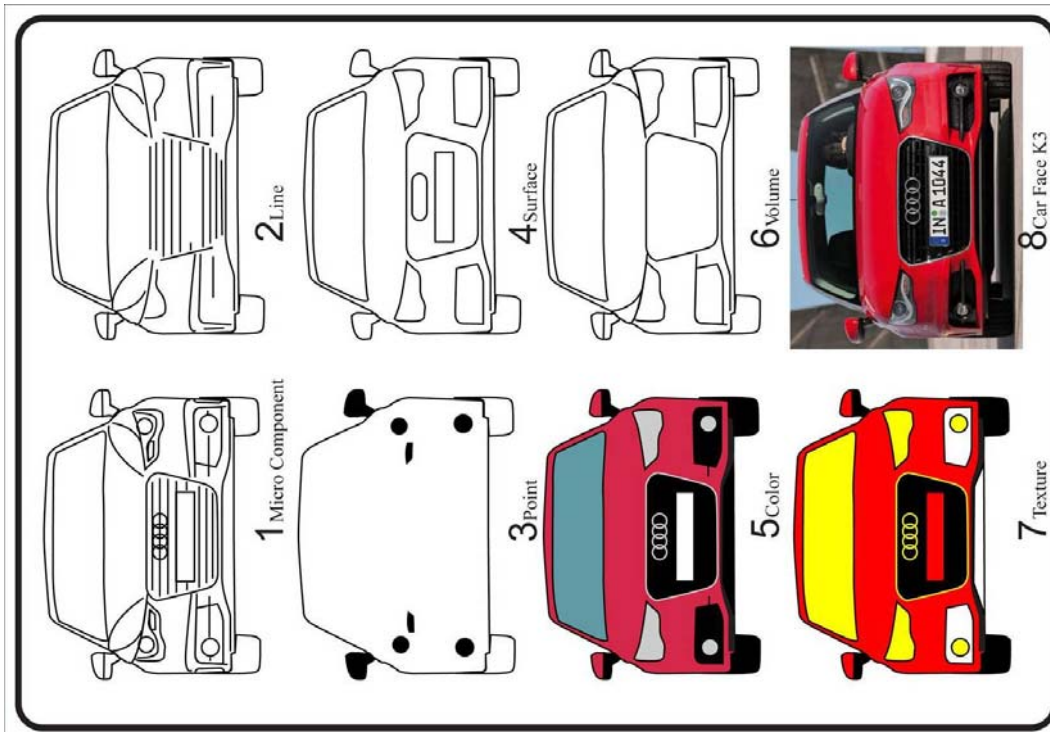
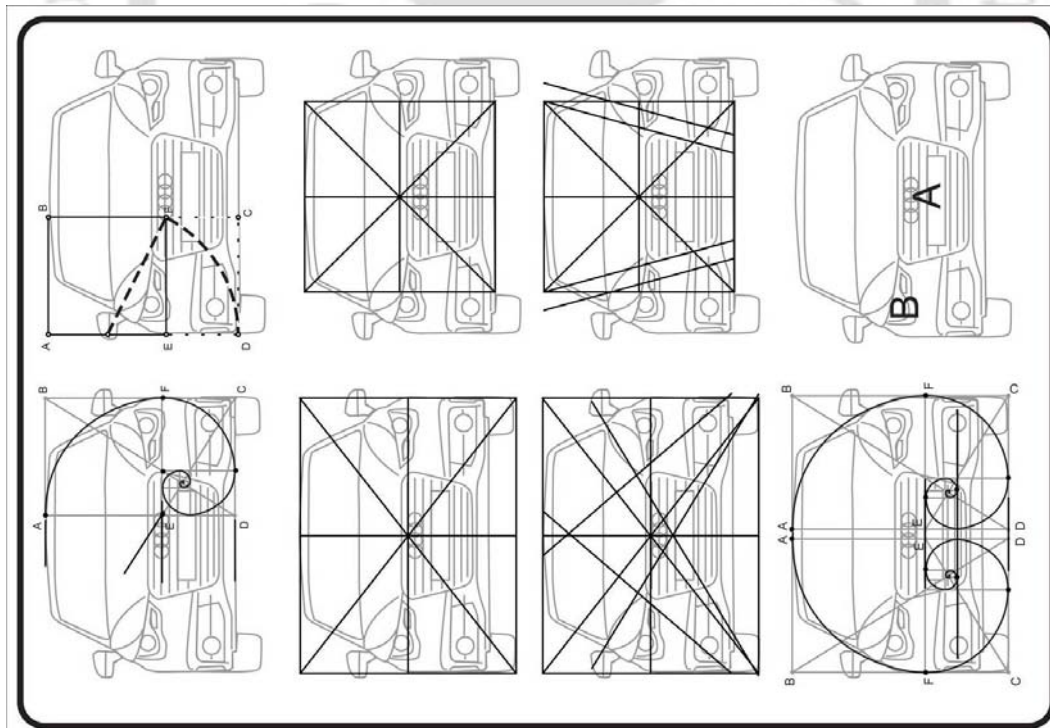


Figure 5.2a.83: Graphical key of K2 (Left), Eye tracking analysis of K2 (Right)

Proportion analysis reveals that the, K2 is powerful in terms of both geometric and golden ratio. The visual hierarchy analysis shows, that the eye movement first goes towards the location of logo “A” owing to the color and line. The eye shifts from logo “A” to lights “B” because of the colors. It may hence be concluded that the icon logo “A” is a very attractive search icon within the peripheral field of vision. The result of machine eye tracking analysis shows the eye jump from grille to logo “A” to lights. In terms of sequences it is 50% same with the result of self assessment eye movement analysis and in terms of importance of elements both result shows same locations which is visible in the above figure.



← Figure 5.2a.84: Visual analysis for K3



← Figure 5.2a.85: Golden ratio and Visual Hierarchy analysis for K3

Luxurious forms like the fittings and complex forms and arcs express richness and elegance. In terms of relation of forms, K3 places the focus on the grille as well as the logo. In part 3 (point) and 4 (surface), the point of logo becomes the central point of focus on the car face. This is primarily due to part 2 (line) where all lines direct towards the same point. It shows this place as the primal point of focus from which the form K3 evolves. The shape of the logo has the capacity to draw the attention of the user towards it. Professional users can identify this car even without the logo owing to the distinctive design of the lights as well as the grille. This acts as a positive factor. As we further analyze we see that part 2 (line) has an angry expression, while part 3 (point) directs towards the point where the logo is placed and part 4 (surface), 5 (color), 6 (volume) and 7 (texture) reflect an extremely serious expression. Designers often use contrasting colors in the grille for highlighting the logo. Finally the car face expression is very serious.

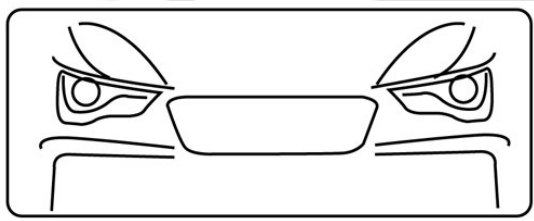
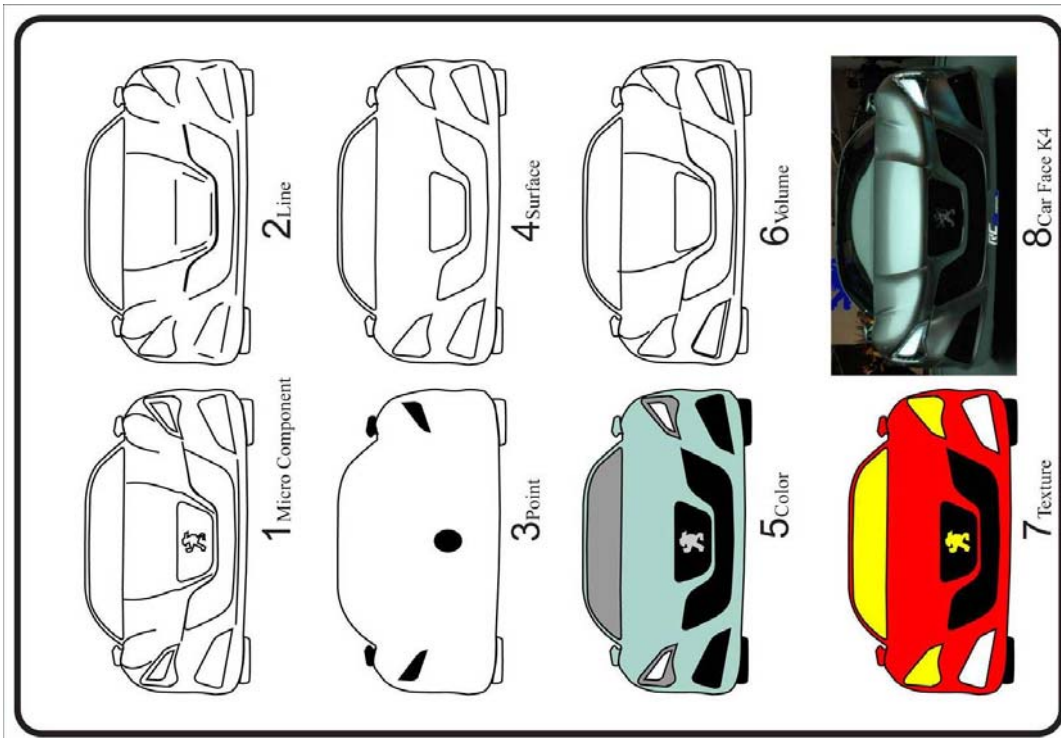
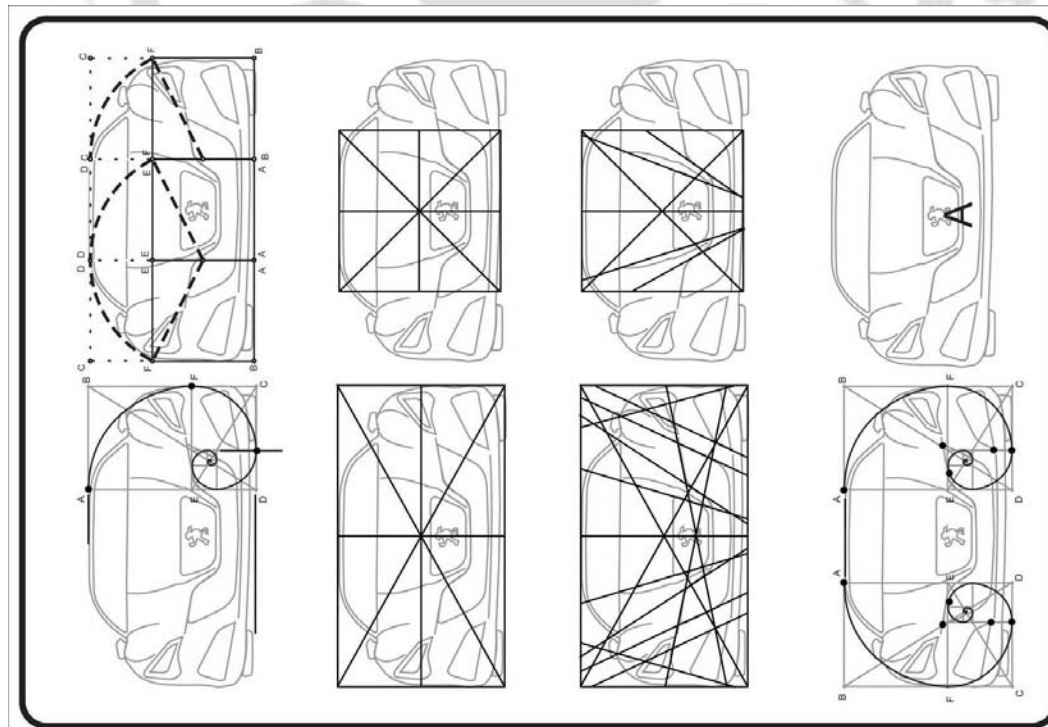


Figure 5.2a.86: Graphical key of K3 (Left), Eye tracking analysis of K3 (Right)

Proportion analysis reveals that the, K3 is powerful in terms of both geometric and golden ratio. The visual hierarchy analysis shows, that the eye movement first moves towards the location of the logo “A” owing to the color and form as well as the existence of the golden ratio area. The eye tracks from logo “A” to lights “B” because of the form. It may hence be concluded that the icon logo “A” is a very attractive search icon within the peripheral field of vision. The result of machine eye tracking analysis shows the eye jump from logo “A” to lights “B”. In terms of sequences it is 100% same with the result of self assessment eye movement analysis and in terms of importance of elements both result shows same locations which is visible in the above figure.



← Figure 5.2a.87: Visual analysis for K4



← Figure 5.2a.88: Golden ratio and Visual Hierarchy analysis for K4

In K4, luxurious forms like the fittings and complex forms and arcs express richness and elegance. In terms of relation of forms, K4 places the focus on the grille as well as the logo. In part 3 (point) and 4 (surface) the point where the logo is placed becomes the central point of focus on the car face primarily due to the fact that in part 2 (line) all arcs direct towards the point. It shows this place as the main place from which the form K4 evolves. Professional users can identify the car even without the logo because of the distinctive design of the grille. This acts as a positive factor. Here part 2 (line) has an expression of speed, while part 3 (point) has a serious expression. Part 2 (line), 4 (surface), 5 (color), 6 (volume) and 7 (texture) have a serious angry expression. Designers use the contrast of space in the grille due to the shine present in the logo. The final expression is therefore serious.

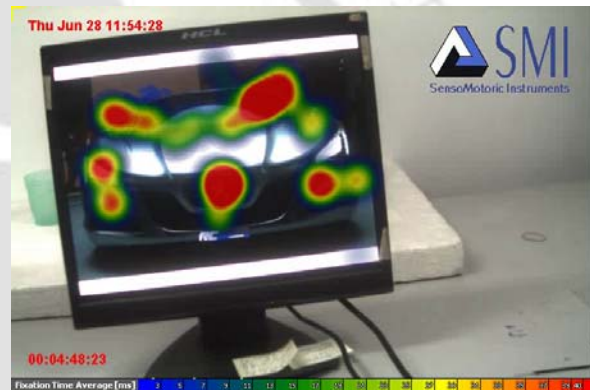
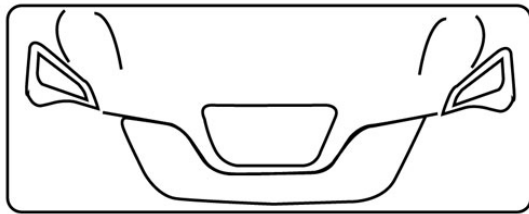
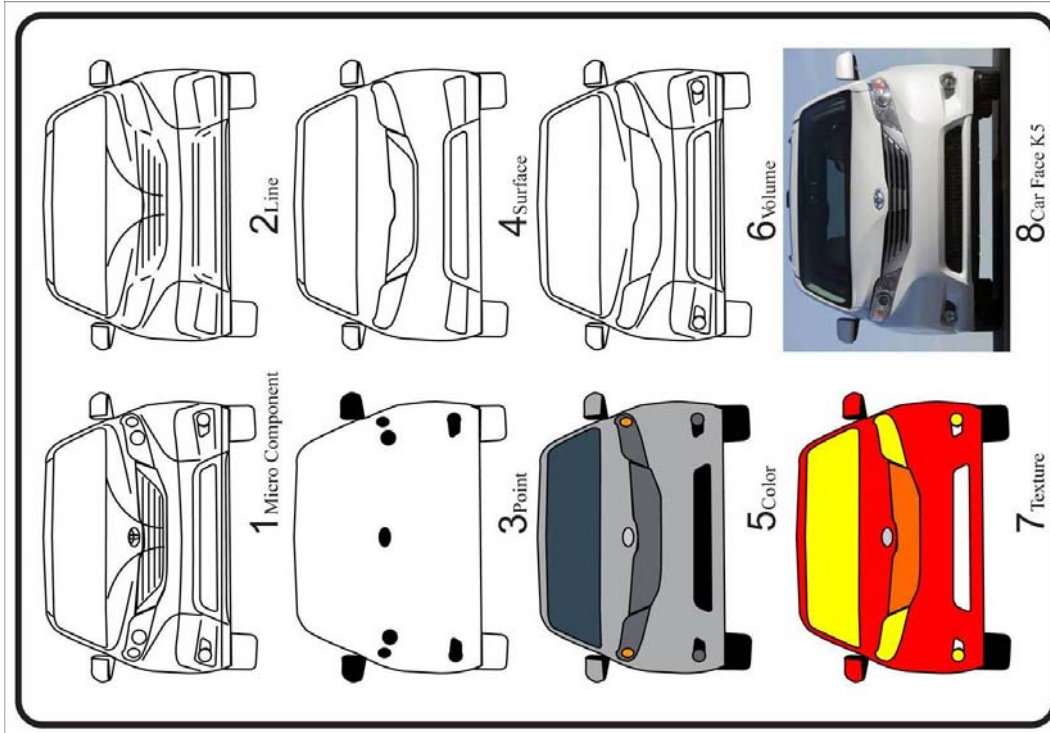
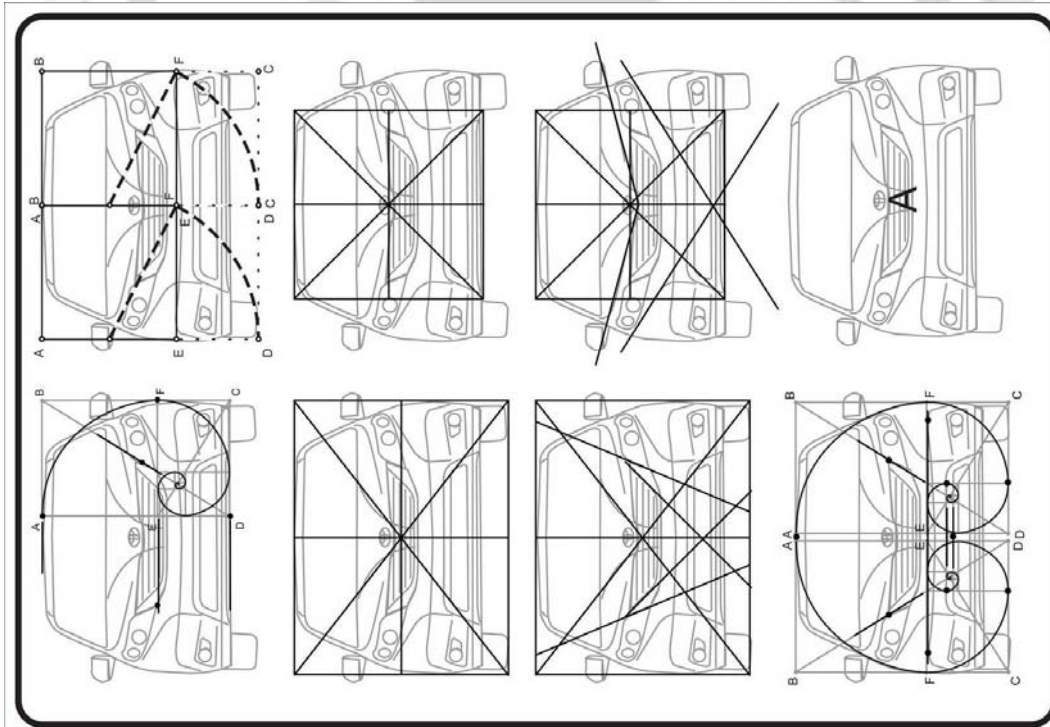


Figure 5.2a.89: Graphical key of K4 (Left), Eye tracking analysis of K4 (Right)

Proportion analysis reveals that the, K4 is powerful terms of both geometrical and golden ratio. The visual hierarchy analysis shows, that the eye movement first moves towards the location of the grille “A” owing to the color and form as well as the existence of the golden ratio area. The eye tracks from grille “A” to lights due to the colors. It may hence be concluded that the icon grille “A” is a very attractive search icon within the peripheral field of vision. The result of machine eye tracking analysis shows the eye jump from grille “A” to lights. In terms of sequences it is 100% same with the result of self assessment eye movement analysis and in terms of importance of elements both result shows same locations which is visible in the above figure.



← Figure 5.2a.90: Visual analysis for K5



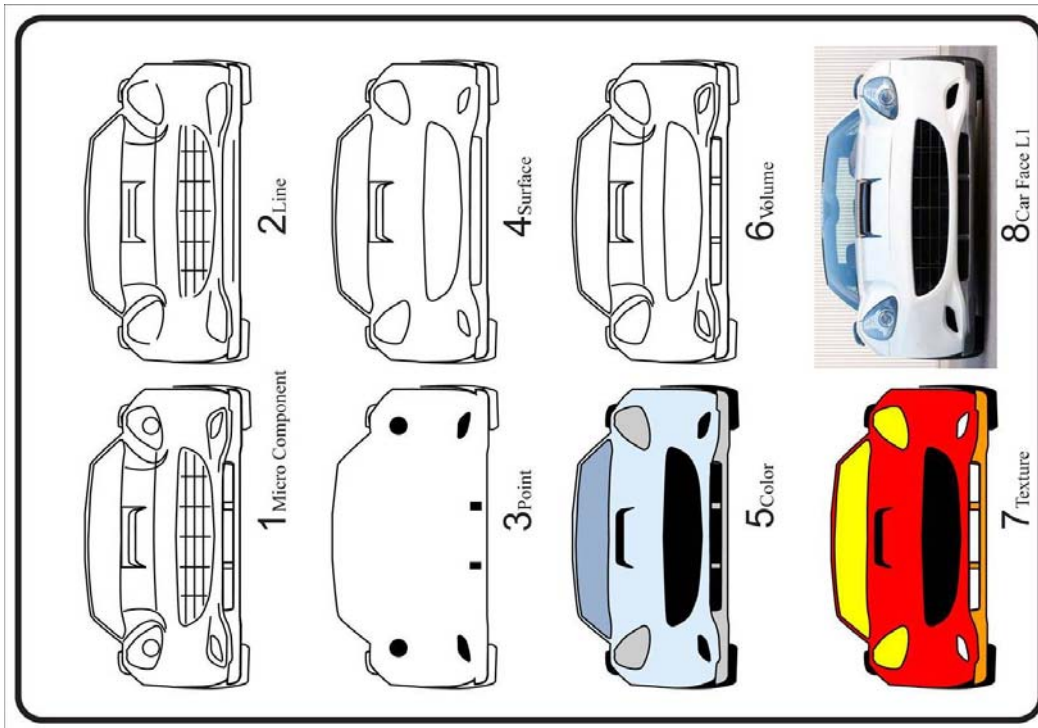
← Figure 5.2a.91: Golden ratio and Visual Hierarchy analysis for K5

The logo and grille reflect the light well. Geometrically they are in the center of the car face and the grille appears to join the lights and thereby leads to a good composition. The Designer with the use of contrast of space joins the two small lights and the lower grille together. Part 2 (line) conveys an angry expression while part 3 (point) has the sense of direction. Part 4 (surface), 5 (color), 6 (volume) and 7 (texture), in Visual analysis, bear a serious expression. Finally the expression of the car face is serious.

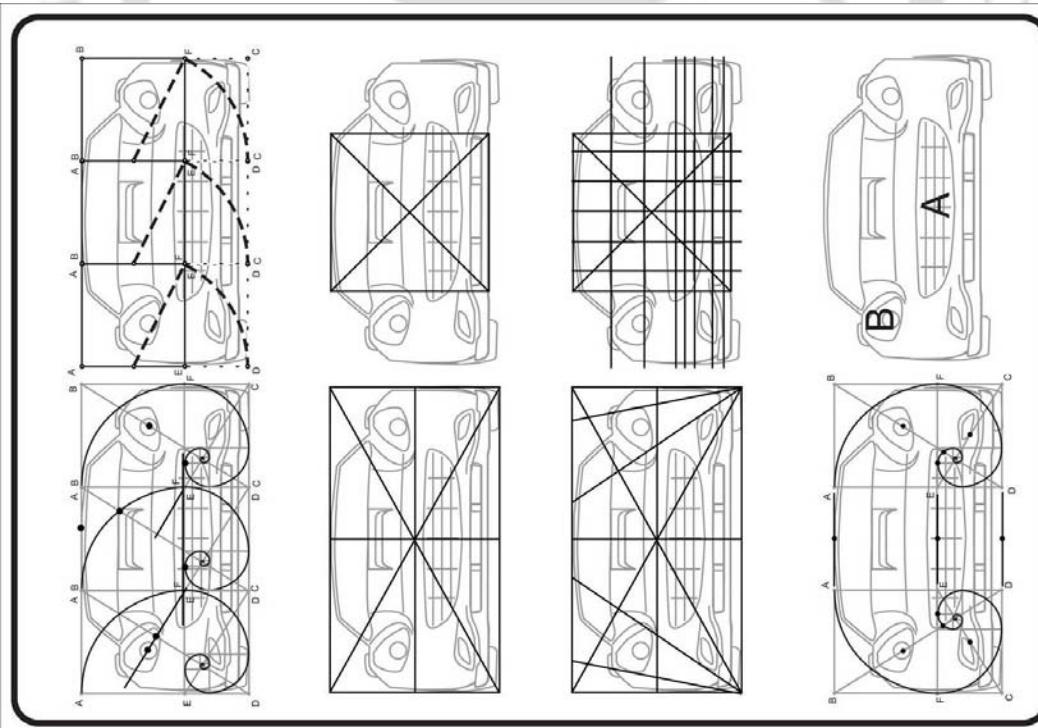


Figure 5.2a.92: Graphical key of K5 (Left), Eye tracking analysis of K5(Right)

Proportion analysis reveals that the, K5 is powerful in terms of both geometric and golden ratio. The visual hierarchy analysis shows, that the eye first moves from the location of grille “A” owing to the direction of the lines as well as the existence of the golden ratio area. The eye shifts from grille “A” to lower grille owing to the colors. It may hence be concluded that the icon grille “A” is a very attractive search icon within the peripheral field of vision. The result of machine eye tracking analysis shows the eye jump from grille “A” to lights. In terms of sequences it is 80% same with the result of self assessment eye movement analysis and in terms of importance of elements both result shows same locations which is visible in the above figure.



← Figure 5.2a.93: Visual analysis for L1



← Figure 5.2a.94: Golden ratio and Visual Hierarchy analysis for L1

The presence of complex forms in design expresses elegance and sophistication. The Grille and lights are in the area of golden ratio. Part 1 (micro component) shows a wild and dangerous expression while part 3 (point) directs the eyesight. Part 2 (line) has dangerous expression owing to the vertical and horizontal line that appear to look like the gritting teeth of an angry person. Part 4 (surface), 5 (color), 6 (volume) and 7 (texture) reflect seriousness due to the existence of the lights as well as the grill. The presence of contrast of colors in the grille leads to a visible expression of the car face. Finally the car face has an expression of danger.

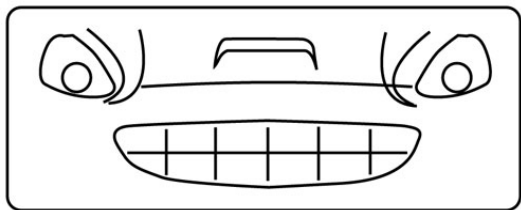
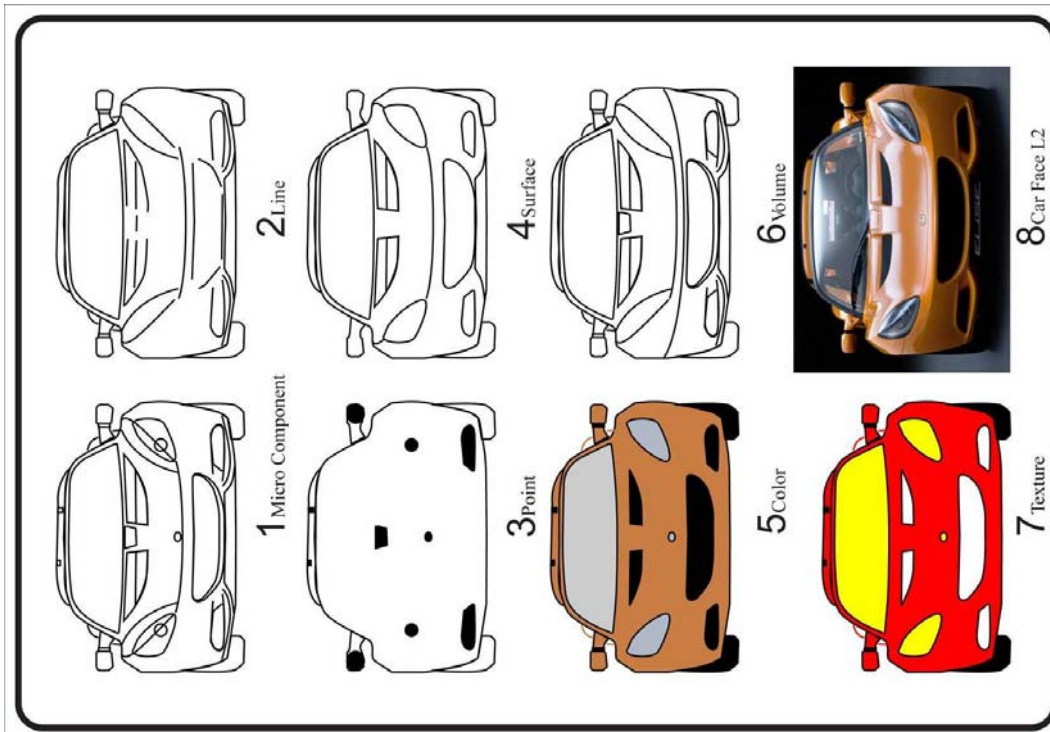
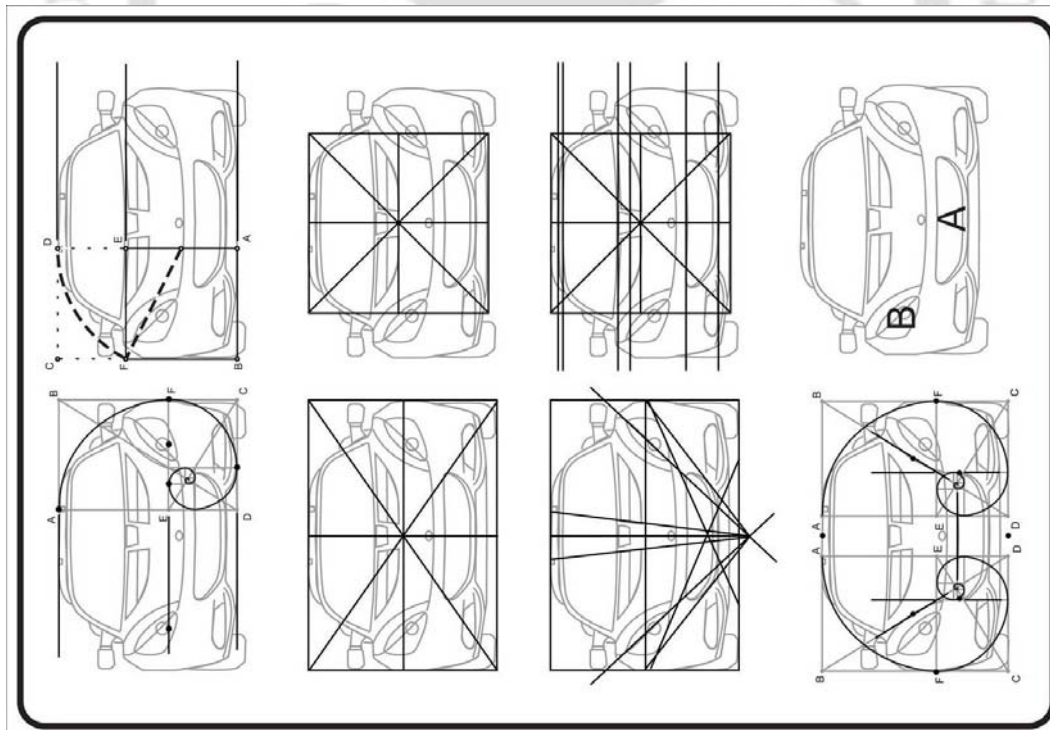


Figure 5.2a.95: Graphical key of L1(Left), Eye tracking analysis of L1 (Right)

Proportion analysis reveals that the, L1 is powerful in terms of both geometric and golden ratio. The visual hierarchy analysis shows, that the eye first moves from the location of grille “A” owing to the color and lines as well as the existence of the golden ratio area. The eye tracks from grille “A” to lights “B” because of the form. It may hence be concluded that the icon grille “A” is a very attractive search icon within the peripheral field of vision. The result of machine eye tracking analysis shows the eye jump from grille “A” to lights “B”. In terms of sequences it is 100% same with the result of self assessment eye movement analysis and in terms of importance of elements both result shows same locations which is visible in the above figure.



← Figure 5.2a.96: Visual analysis for L2



← Figure 5.2a.97: Golden ratio and Visual Hierarchy analysis for L2

The presence of luxurious forms makes the car appear special and glorious. In part 1 (micro component) the car face bears a wild, dangerous and anger expression, part 3 (point) has the element of direction whereas part 2 (line), 4 (surface), 5 (color), 6 (volume) and 7 (texture) have a serious and dangerous expression. This is primarily due to the presence of Contrast of colors in the grille that makes for a good expression of the mouth. The final expression is eventually of that of danger.

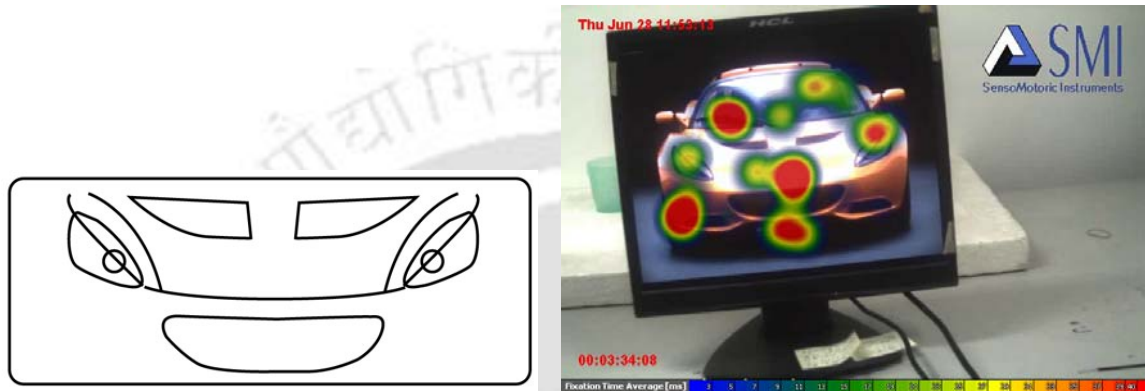
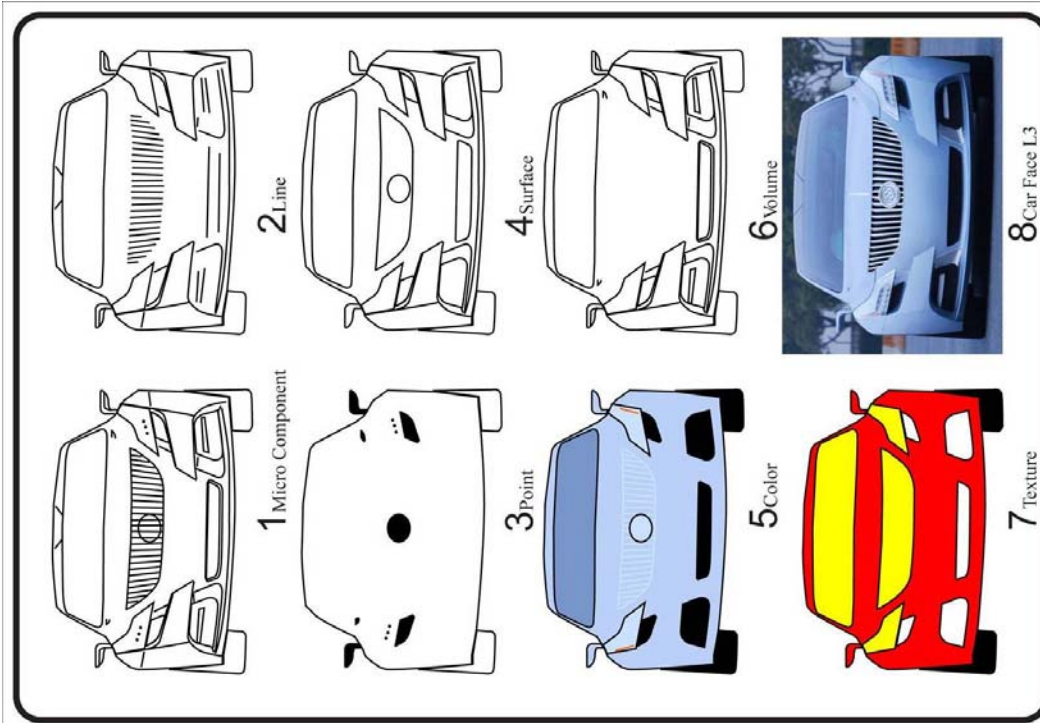
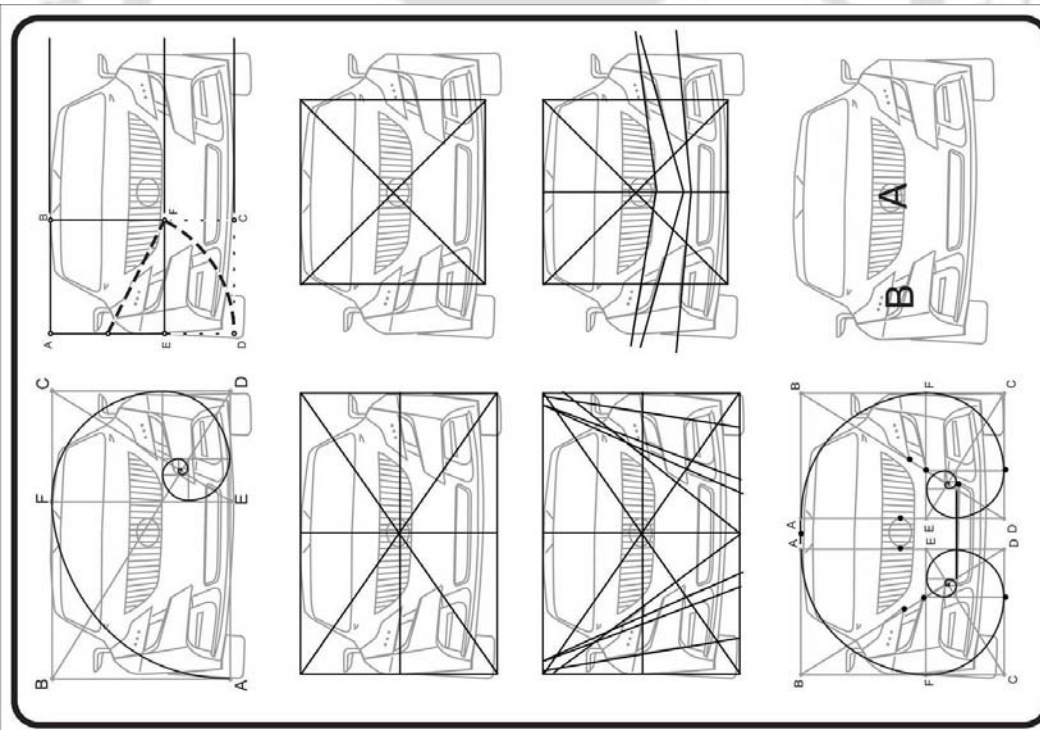


Figure 5.2a.98: Graphical key of L2 (Left), Eye tracking analysis of L2 (Right)

Proportion analysis reveals that the, L2 is powerful in terms of both geometric and golden ratio. The visual hierarchy analysis shows, that the eye first moves towards the location of grille “A” because of the color and form. The eye shifts from grille “A” to lights “B” owing to the form. It may hence be concluded that the icon grille “A” is a very attractive search icon within the peripheral field of vision. The result of machine eye tracking analysis shows the eye jump from grille “A” to lights “B”. In terms of sequences it is 100% same with the result of self assessment eye movement analysis and in terms of importance of elements both result shows same locations which is visible in the above figure.



← Figure 5.2a.99: Visual analysis for L3



← Figure 5.2a.100: Golden ratio and Visual Hierarchy analysis for L3

The presence of luxurious forms like the fittings and complex forms and arcs express richness and elegance. Due to the contrast of space in this car there is the presence of a scary expression behind the visible face. In terms of relation of forms, L3 places the focus on the grille and the point where the logo is placed. In part 3 (point) and 2 (line), the point of the logo, appears as the central point of the car face. It demonstrates this place as the main point from which the form F1 evolves. The oval shape at the centre steals the user's vision. Part 2 (line) has an angry and dangerous connotation while, part 3 (point) leads to the direction of the logo. Part 4 (surface) and 6 (volume) have a dangerous expression as it appears to look like a dangerous insect with sharp legs or even looks like a helmet of a soldier. Part 5 (color) and 7 (texture) have a serious and angry expression leading to a final expression of danger.

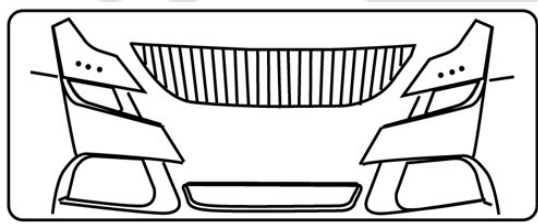
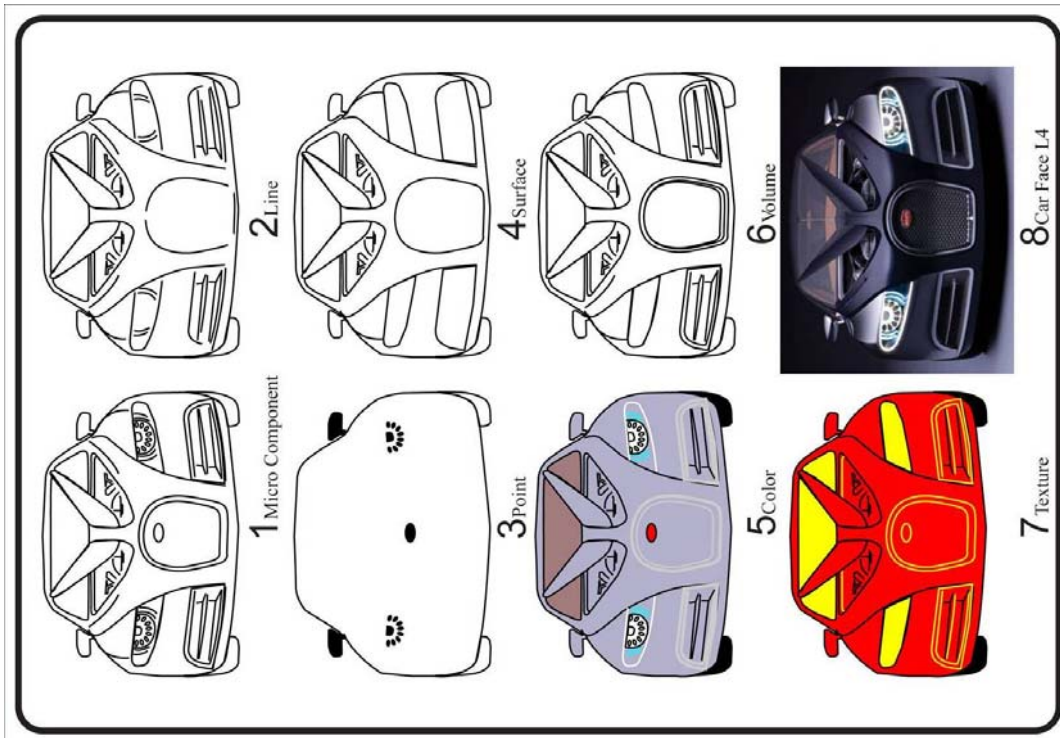
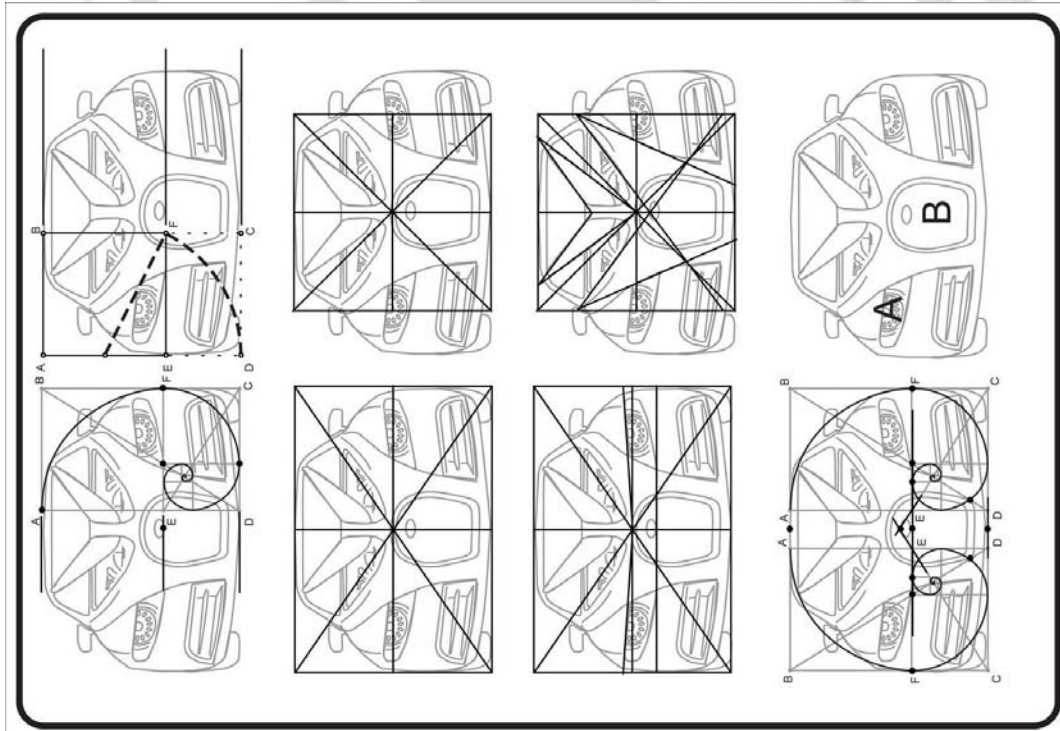


Figure 5.2a.101: Graphical key of L3 (Left), Eye tracking analysis of L3 (Right)

Proportion analysis reveals that the, L3 is powerful in terms of both geometric and golden ratio. The visual hierarchy analysis shows, that the eye first moves towards the location of grille “A” owing to the color and vertical lines as well as the existence of the golden ratio. The eye shifts from grille “A” to form “B” because of the colors. It may hence be concluded that the icon grille “A” is a very attractive search icon within the peripheral field of vision. The result of machine eye tracking analysis shows the eye jump from grille “A” to lights “B”. In terms of sequences it is 100% same with the result of self assessment eye movement analysis and in terms of importance of elements both result shows same locations which is visible in the above figure.



← Figure 5.2a.102: Visual analysis for L4



← Figure 5.2a.103: Golden ratio and Visual Hierarchy analysis for L4

The presence of luxurious forms like fittings and complex forms and arcs express richness and elegance due to the relation of forms. Professional users can identify this car even with out the logo because of the distinct design of the lights form and grille. This acts as a positive factor. Part 3 (point) has direction and part 2 (line) and 5 (color) bears the expression of dangerous animals. Part 4 (surface), 6 (volume) and 7 (texture) have the look of a wild animal with open mouth which leads to a final expression of danger.

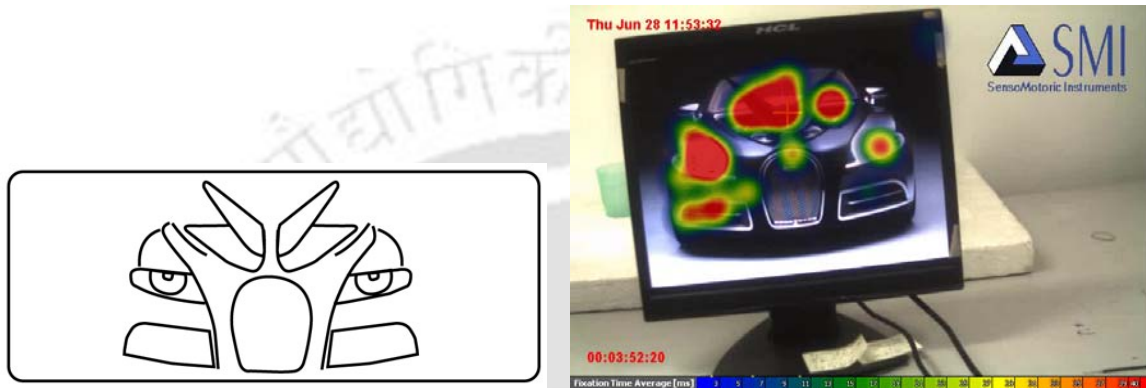
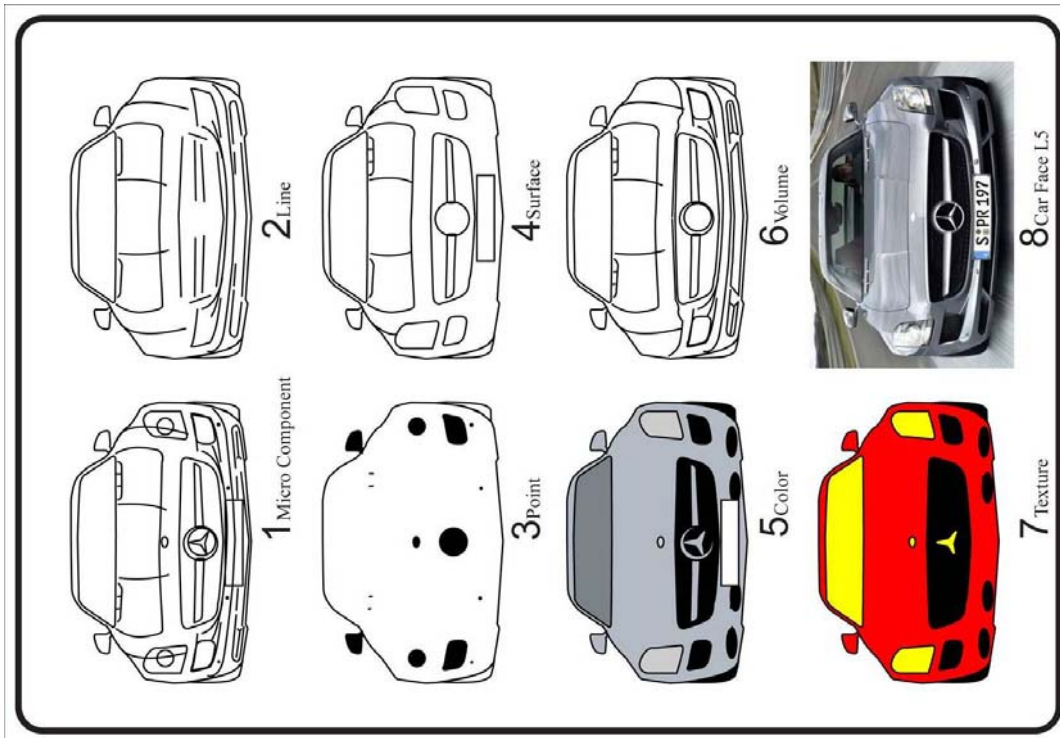
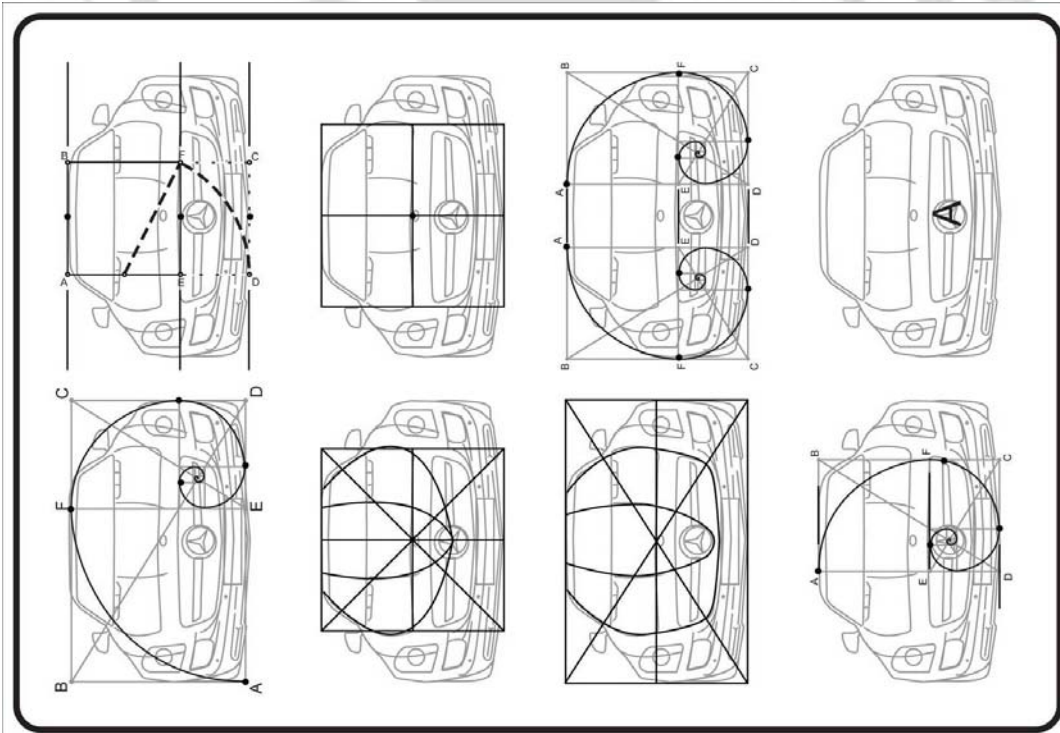


Figure 5.2a.104: Graphical key of L4 (Left), Eye tracking analysis of L4 (Right)

Proportion analysis reveals that the, L4 is powerful in terms of both geometric and golden ratio. The visual hierarchy analysis shows, that the eye first moves towards the direction of the lights “A” owing to the color and form. The eye shifts from lights “A” to grille “B” because of the direction of lights and also as it is present in the golden ratio area. It may hence be concluded that the icon lights “A” is a very attractive search icon within the peripheral field of vision. The result of machine eye tracking analysis shows the eye jump from lights “B” to grille “A”. In terms of sequences it is 0% same with the result of self assessment eye movement analysis and in terms of importance of elements both result shows same locations which is visible in the above figure.



← Figure 5.2a.105: Visual analysis for L5



← Figure 5.2a.106: Golden ratio and Visual Hierarchy analysis for L5

The presence of luxurious forms like fittings and complex forms and arcs express richness and elegance. In terms of relation of forms, L5 places the focus on the grille as well as the logo. In part 3 (point) and 2 (line), the point where the logo is placed becomes the central point of car face. Also, in part 2 (line) all arcs direct towards this point. It establishes the point as the place from which the form L5 evolves. The circular shape draws the attention of the user. Part 1 (micro component) has a wild, dangerous and angry expression while part 3 (point) has the element of direction being located in the golden ratio area. Part 2 (line), 4 (surface), 5 (color), 6 (volume) and 7 texture as per gestalt have a serious, angry and dangerous expression. This is mainly because the grille looks similar to wild animal keeping its mouth open. The presence of contrast of space in the grille leads to this expression. Finally the car face has a dangerous expression.

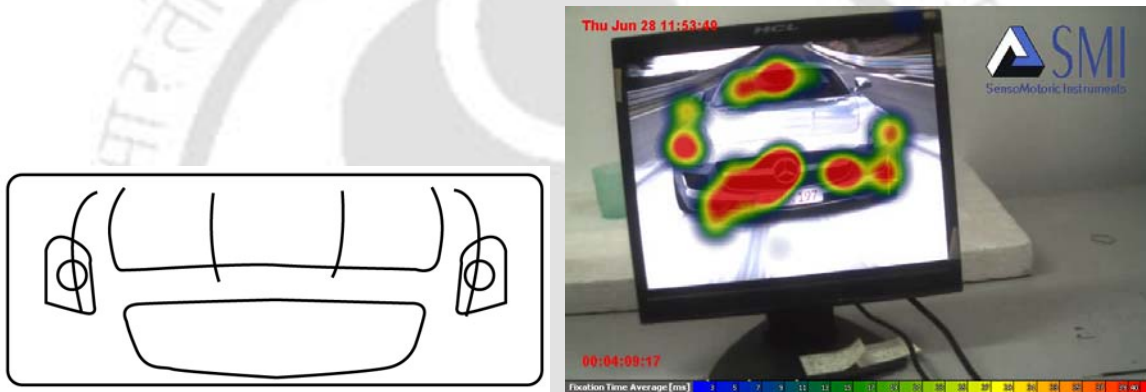


Figure 5.2a.107: Graphical key of L5 (Left), Eye tracking analysis of L5 (Right)

Proportion analysis reveals that the, L5 is powerful in terms of both geometric and golden ratio. The visual hierarchy analysis shows, that the eye first moves towards the location of the grille “A” owing to the color and form as well as the existence of the golden ratio area. It may hence be concluded that the icon logo and grille “A” are a very attractive search icon within the peripheral field of vision. The result of machine eye tracking analysis shows the eye jump from grille “A” to lights. In terms of sequences it is 100% same with the result of self assessment eye movement analysis and in terms of importance of elements both result shows same locations which is visible in the above figure.

Appendix 8

List of publications:

- Jaafarnia, M. and Bass, A. (2011) 'Design Semantics: Even hybrid Motorcycles need to make noise', Proceedings of the *IMProVe International conference on Innovative Methods in Product Design, Italy*.
- Jaafarnia, M. and Bass, A. (2011) 'Tracing the Evolution of Automobile Design: Factors influencing the development of aesthetics in automobiles from 1885 to the present', Proceedings of the *IMProVe International conference on Innovative Methods in Product Design, Italy*.
- Jaafarnia, M. and Mokashi Punekar, R. (2011) 'Automobile Design: A co-relation technique to assessment of human emotion, visual expression and product form', Proceedings of *DPPI 11 - The 5th Conference on Designing Pleasurable Products and Interfaces, Italy* (In press).





Automobile design: A co-relation technique to assessment of human emotion, visual expression and product form

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ABSTRACT

Today, body designs of vehicles such as personal cars differ from brand to brand. The challenges of globalization have led to situations wherein manufacturers are prone to introduce an already existing model into new markets, especially emerging ones in developing countries. When such new markets get crowded with competition, manufacturers start customizing the designs developed elsewhere, to suit local preferences.

Designers involved in conceptualizing car forms are increasingly being inspired by a close study of human emotions including facial expression in the generation of product form. In this paper an attempt has been made to assess users response to automobile design based on drawing a co-relation between human emotion vis-a-vis the product expression and visual form of the front fascia of the car. Respondents were involved in assessing the front fascia of a set of 35 cars of reputed global car brands vis-a-vis two selected human bi-polar emotions chosen from amongst a set of 14 human facial expressions to state if they felt the product expression was 'in correspondence with'; 'in contrast with' or 'nether of the above' against a set expression. The responses were summarized and the results matched between respondents from India with those of the Iranian respondents. This resulted in drawing a cross cultural comparison of results of form expression and emotion associations for the two cultures.

The paper reports the findings from the above study. The results give leading directions to designers in mapping 'glocal' preference patterns of responses from two diverse cultures one Indian and the other Iranian.

Keywords

Emotion, semantics, automobile form, Co relation technique.

1. INTRODUCTION

Successful business models over a period of time have evolved a fairly sophisticated approach to product planning and Design. It is seen that leading design agencies such as Design Continuum, Frogdesign, and IDEO have opened their own branches in Asia in

order to cooperate more directly with clients there by having staff on the spot.

European corporations, particularly in the electronics and automotive industries, have opened offices abroad (especially in California) in order to follow current lifestyle trends more closely and to integrate the results of foreign studies more quickly into product development at home. The Audi TT is reported to be a good example. While the concept was born on the drawing boards of a Californian agency it has enjoyed equally spectacular success in America and Europe.



Figure 1. Audi TT

Köhler (2002), refers to another form of globalization that involves utilizing differences in manufacturing conditions. Design is conducted centrally, while production is decentralized. For example, Braun, based in the German town of Kronberg, has some of its electric shavers assembled in Shanghai. The motors are actually Chinese, while the rechargeable batteries come from Japan, and the heads for the high-quality blades are from Germany'

For more details please see the
Experiment 2b



Tracing the Evolution of Automobile design: Factors influencing the development of aesthetics in automobiles from 1885 to the present.

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Article Information

Keywords:

Emotion, evolution, automobile form, aesthetics, transportation, car, semantic frame, history of the car

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Abstract

Using selected well-known automakers, the influence of new technology, lifestyle and culture of automobile design has been mapped, starting from 1885 through present day. We have identified seven eras to date. The study of history often yields clues to the future. Influences such as fashion, makeup and missiles have shaped automobile design since manufacturing began. The evolution of the car has been driven by the desire to create a semantic frame for speed. Over time, changes in lifestyle and culture have changed the semantic meaning of the frame. This time line will help automobile designers understand the markers that influenced the evolution of the automobile, and act as a tool to predict the future of car design.

Introduction

Using selected well-known automakers, we've mapped the influence of new technology, lifestyle and culture on automobile design starting from 1885 through present day. These influences have shaped automobile design since manufacturing began. This timeline will help automobile designers understand the markers that influenced the evolution of the automobile, and act as a tool to predict the future of car design.

We have identified seven eras to date. Beginning with the horseless carriage, automobile design has been driven by the attempt to create a semantic frame for speed. The apex of this arc was reached with the missile designs of the 1950's. Changes in lifestyle and culture have changed the semantic meaning of the frame over time. History has brought us full circle today as designers assign the semantic frame of animals to bio-designing techniques.

In the beginning, all vehicles looked basically the same. In 1885, the new motorized vehicles did not have a body or shell. The first car was essentially an engine, three wheels and a frame. All of the mechanics were exposed for easy access. Inventors were more concerned about function rather than form. Getting the machine to work properly was the first priority. Design aesthetics came later. The first typewriters, electric shavers, sewing machines and airplanes had no outer shell. Figure 1 compares the original forms of these early

machines with later versions. Products like cameras and submarines did have a shell. But then again, a submarine without a hull is simply missing the point of deep sea diving.

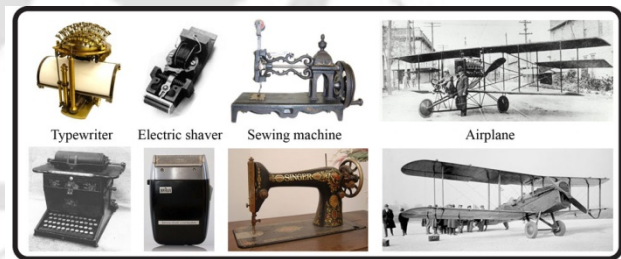


Fig.1 Early product development [10]

Evolution of the Automobile

The seven eras in chronological order are: Invention era, Innovation era, Manufacturing era, Capsule era, Classic era, Integration era and Modern era.

For more details please see the
Experiment 1a



Design Semantics: Even hybrid Motorcycles need to make noise.

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Introduction

Our everyday actions are linked to emotions [1]. We put on warm clothes when we feel a chill even if it's not really cold outside. Sometimes, we imagine the feeling of cold more than the reality of the actual temperature. What are the factors that make us think we are cold when we are not? Undoubtedly some signs of cold are being transmitted. [2] Products like refrigerators and cold drink packages are specifically designed to convey the feeling of cold. Designers use semantics to interpret signs and symbols and assign meaning to actions and objects within particular circumstances and contexts [3]. The study of semantics enables designers to find the right combination of color, shape and image to communicate a consistent semantic frame for a product and produce appropriate responses to it. Those who understand semantics are able to design products that fit consumers' physiological requirements and also take into account the emotional decisions that influence customer satisfaction [4].

Each of the five senses: (sight, hearing, smell, taste, touch) is a human receiver. The information from each of the five senses contains unique meanings that form the four parts of a product's semantic frame (aesthetic, physiologic, technical, economic). Understanding how each of the senses function helps designers create more satisfying products for consumers.

Product features play an important part in transmitting meaning. The audience for a particular product changes dramatically depending on specific features and design details. The consumer may or may not connect with a product

for a variety of reasons. It may be the look, feel or sound of a product. Consumer beliefs and attitudes create an emotional base for decision-making [5]. Using the information from only one sense does not give the consumer the whole picture. When consumers try to hear, smell, taste or touch with their eyes they can only imagine, because each sense is unique. It is not always possible to tell by looking at a piece of cake, how it will taste. We can imagine how good it will taste or smell, but visual inspection alone will not replace the other senses in determining if the cake is tasty.

The Semantic Frame

Every product has a special identity bound in a semantic frame. This frame contains four functions (aesthetic, physiologic, technical, economic) making a quadrangle (Figure 1).

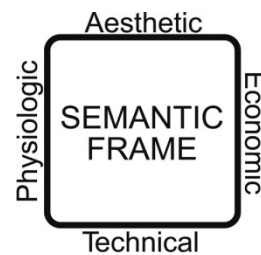


Figure 1. quadrangle of semantics

Every side of the square has a relationship to the other sides. A small alteration in one of the sides has a positive or negative effect on the others [6]. Changing one or more of the sides results in a new emotional frame. A product's semantic frame has numerous emotional expressions, but some are very weak. Others are very strong [7].

In Figure 2, both car #1's have the same design and model number (C63 Class) but the designer has changed the emotional expressions for each car. The original material for the body was painted steel, but the redesign was gold-plated. We can see the effect on the four sides of the semantic frame as follows:



Figure 2. Car #1 : Maroon Painted steel [8] (top and right), Gold plated steel.[9]

Aesthetic: Changing the material from painted steel to gold-plated steel had a positive effect on the aesthetic of the car. The look of the car was enhanced by the gold material. The lustrous quality and greater reflectivity of the precious metal expressed the feeling of speed better than the painted steel. Some modifications were made to the frame to accommodate the precious metal.

Technical: Changing the coating had negative effects on the technical side. In production, gold-plating requires special methods not ordinarily used in conventional body production.

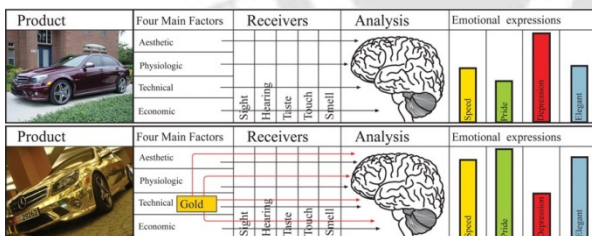


Figure 3. Speed emotion in Car #1: Emotional expressions of body with painted steel (top) Emotional expressions of body with gold plated steel (bottom).

Physiologic: The gold's reflectivity had a positive effect on the safety. The gold car worked as a mirror at night. The gold surface reflected other cars' lights and was easily visible in traffic or on the road.

Economic: The economic side weakened because of the gold's value. Due to the cost of the gold, the final price was much higher.

Changing the coating on the car affected all the sides of the semantic frame. We changed the visual aesthetic of the car and it had an effect on the physiologic, technical, and economic sides of the frame. The new frame created totally

new emotional expressions for the consumer (Figure 3). In this case, we enhanced a visual element. What would happen if we omitted something? What would happen if we produced an electric motorcycle with no sound? Will the omission of an expected sound have a negative effect on the consumer's emotional reaction to that product?

Products do not usually impart meanings from only one side of the semantic frame [10]. Consumers receive input from all five senses. The designer gives meaning to a product through manipulating all or some of the sides of the semantic frame. This meaning is interpreted by the consumer and enters into the decision-making process. The decision is often an emotional one, based on aesthetic or physiologic desires rather than only technical or economic needs.

Figure 4, demonstrates an analysis of the power of expression:



Figure 4. Power emotion in motorcycle No2

- **Sight** appreciates motorcycle's form and color. (aesthetic)
- **Touch** tests the size of the power handgrip and seat size, (physiologic)
- **Sight** inspects the number of accessories, engine size and others technical details. (technical)
- **Hearing** appreciates the powerful sound made by the engine. (technical)
- **Smell** breathes the smoke due to burning gasoline in the engine. (technical)
- **Sight** appraises the quality of the materials (economic).

Decision-making is often influenced by personal beliefs and attitudes, old information and personal memories. Is it possible to really know a product simply by looking at it in a store? Is visual reference powerful enough to replace all the other senses? After taking a product home, do consumers experience the same good feeling they had the day they left the showroom?

Experiment

How important is sound in high tech products like cars and motorcycles? If a motorcycle is soundless, is it confusing for the consumer? Experiments were conducted to see if the average consumer would have a negative reaction to the omission of sound in high tech products. Subjects were asked to make a relationship between two groups of sounds and three different motorcycles and to state their reasons for making individual choices. We began with an experiment to see if only one sense (sight) gives enough information to a consumer to know a product. The responses were recorded on a printed questionnaire.

Method

Prepared questionnaires were used both in the interview and to observe and collect experimental data. Data was collected in two stages. In the first stage, out of a total of 490 subjects involved, 257 were men (age 20-50) and 233 were women (age 18-46). All were inhabitants of Guwahati city. The experiment was conducted in coffee shops using four samples (two cakes Figure 9 and two scissors Figure 12). The samples were chosen by consensus and discussions with two professional designers, based on the emotional expression of the objects. Samples included: 1- fake cake made from wood, plastic foam and red silicon gel, 2- real cake with cream and real pineapple jelly, 3- scissors with handles out of the package, and 4- scissors completely inside the package.

The questions were sequentially asked to people at coffee shops. For question 1, the fake and real cakes were shown to them. For the second question, both packages of scissors were shown.

Questions were as follows:

- 1) Which cake is more delicious and tasty? (For Figure 9)
- 2) Which scissors is more comfortable for working? (For Figure 12)

The second stage of the experiment involved 69 people and explored further details of the observations made during the first stage. Based on observations from the cake and scissors experiment, subjects' reactions to motorcycles and sound were studied. We wanted to know which sound had the most influence over product selection. We postulated three hypotheses. 1_omission of sound can change the emotional expression of a product 2_artificial sound can produce positive emotions in users of new products 3_users relationships to sounds were predictable. (Table 1)

Motorcycle	Sounds	Sound Came from
Control	A	Electromotor
No 1	B	Chainsaw
No 2	C	Scooter
No 3	D	Harley Davidson

Table 1. Hypothesized relationships

We hypothesized that sound is an important factor in product design. Technologically, sound omission in new products is the norm. We can produce soundless motorcycles and cars, but will consumers enjoy these new products as much as the old noisemakers? Will the noise be integral to their personal satisfaction? To test this theory, we conducted another experiment using four sounds with the following properties; *A: Electromotor*: monotonous, very light and low, *B: Chainsaw engine*: very sharp and high, *C: Scooter*: low bass sound, *D: Harley Davidson*: deeper bass voice, very stated loud. We also showed three motorcycles with properties; *Motorcycle No.1*: specialized frame, very sharp aerodynamic lines (Figure 5). *Motorcycle No.2*: very powerful form and warm color (Figure 6), *Scooter No.3*: soft curves and a very light, green color. (Figure 7)

Total subjects involved in the second stage were 69, out of which 14 were women (ages 20-40) and 55 men (ages 18-51). All were inhabitants of the Indian Institute of Technology, Guwahati campus. The experiment was conducted on

campus. Figure 8, depicts the data collection methods used in the second stage of the experiment.



Figure 5. Motorcycle No1 [11]



Figure 6. Motorcycle No2 [12]



Figure 7. Scooter No3 [13]



Figure 8. Data collection

During the second stage, the following questions were sequentially asked:

1) Which sound is right for each motorcycle? (For Figure 14)

2) If you bought a motorcycle, and after using it, you realized that this bike did not make a sound like "B" or "C" or "D", but made a sound like "A", how would you feel about that? Please check all relevant emotions the "A" sound brings up for you. (Emotions: I do not have any negative emotion, Cheated, Undesirable, Unsuitable, Deficient, Unable to work, Lost) (For Figure 15)

Preliminary Analyses- Results

Selected results have been statistically compiled from the collected data and are presented below. No attempt has been made to validate the results using statistical tests. The sample size was limited to a total of 490 subjects in the first stage and 69 in the second. The percentage distribution of the responses to each of the question is shown in Figure 8.

First Experiment

In this stage we questioned whether, based on sight alone, a consumer could fully know a product. Would the information from the other senses change the consumer satisfaction level? We showed two cakes (a fake cake made out of wood, plastic foam and red silicon jelly and a real cake with cream and real pineapple jelly), (Figure 9) to 490 subjects found using randomized methods. We asked them which cake was more delicious and tasty?



Figure 9. Diagram of the real and fake cake: Cakes (Left) statistic of selection (Right).

464 people (95%) selected the fake cake as being more delicious. When asked why, most of them said the strawberry jelly made the cake look more delicious. Subjects reacted positively to the quantity of jelly and its red color.

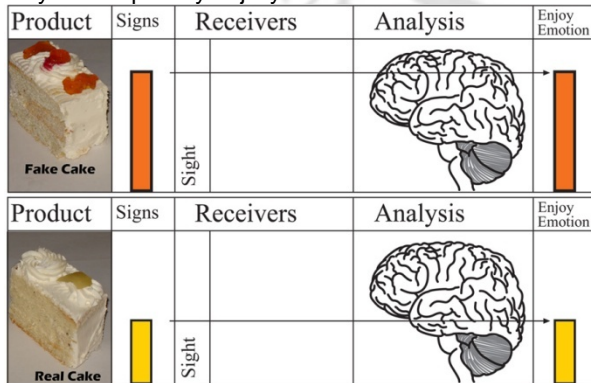


Figure 10. Expression of enjoyment for real and fake cake: Schematic diagram for fake cake (top) schematic diagram for real cake (bottom).

When they were allowed to touch the cakes, they were surprised and shocked to find that the fake cake was very hard and much lighter in weight than the real one.

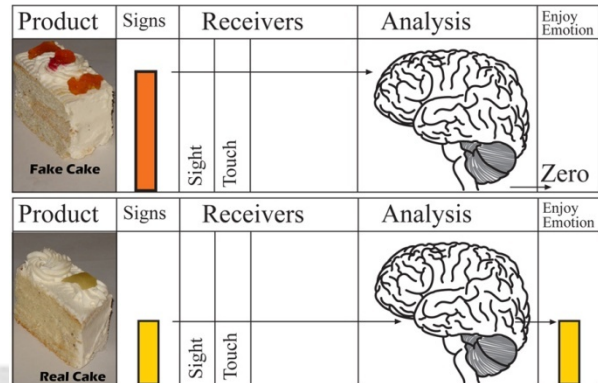


Figure 11. User's opinion after touch: schematic diagram for fake cake (top) schematic diagram for real cake (bottom).

They also realized that the jelly was made of rubber. All subjects changed their vote. (Figure 11)

Personal signs and symbols guide consumer's emotions. Using a knowledge of semantics, designers insert artificial signs and symbols in products to create consistent emotional expression. But designers are rarely concerned with semantic generalizations [14] because few understand the methods of practical design semantics.

The cake experiment demonstrates that consumers need a direct connection to a product to really know it. Consumer satisfaction levels rose proportionally with the number of external senses (receivers) used in the initial selection. The more customers interact, see, touch and smell a product, the better the emotional experience will be before and after purchase. Otherwise they may feel confused and disconnected from it.



Figure 12. Diagram of the scissors: scissors (Left) statistic of selection (Right).

In this stage we asked how many of the same people would try to explore a new product with their other senses (receivers) besides sight. We showed two packages of scissors to the last 490 subjects and asked which scissors would be more comfortable? Even though both the scissors were visible in the package and had the same design, all of the 490 samples reached out for model B and touched it.

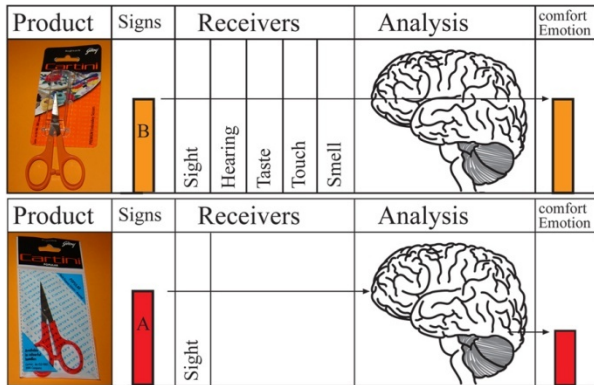


Figure 13. Easily expression for scissors: schematic diagram for model B (top) schematic diagram for model A (bottom).

456 people (93%) of subjects chose model B as more comfortable. When asked why, they explained that they could try it with their hand to make sure the scissors in model B was comfortable. They also said they did not want to make another mistake in selection. Subjects did not want to suffer the same negative emotions they experienced in their earlier choices.

Second Experiment

In the second stage we asked the following questions:

- 1) Which sound is the right one for each motorcycle?
- 2) How would you feel if, after purchasing, you realized your motorcycle did not have any sound?

We wanted to know how many of our subjects recognized and paired the sound they heard with the correct motorcycle.

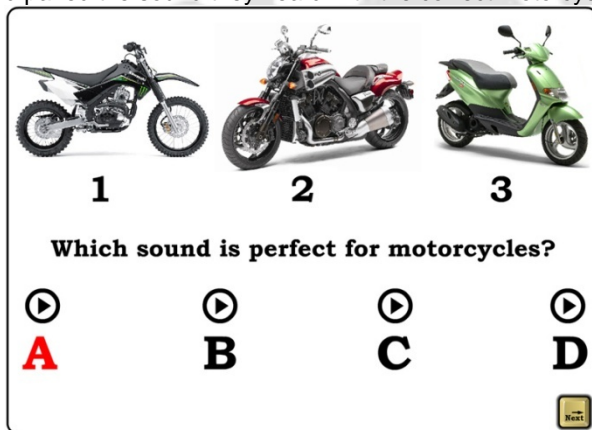


Figure 14. Which sound is perfect for motorcycles?

If you bought them and after using you understood these bikes does not have any sound like " B or C or D " and they have sound like " A " then What is your feeling and emotion? Please tick all relevant emotions the "A" sound has in these bikes, in your judgment.

	1	2	3
1- I do not have any negative emotion	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2- Cheated	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3- Undesirable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4- Unsuitable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5- Deficient	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6- Unable to work	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7- Lost	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

A
B
C
D

Figure 15. What is your feeling and emotion?

Because of the high percentage of correct pairings, we confirmed that consumers like to hear the sound that is consistent with a particular motorcycle. Sixty-two people (91%) matched sound "B" to Motorcycle (No.1). Sixty-three people (91%) matched sound "C" to the Scooter (No.3) and Sixty-one people (89%) matched sound "D" to Motorcycle (No 2). A small number of subjects did not miss hearing a sound. We deduced this because they paired sound "A" (the control) to motorcycle (No.1.) False selection of the control occurred when one person selected sound "A" for Motorcycle (No 1). Two people selected sound "A" for Motorcycle (No 2) and four people selected sound "A" for Scooter (No 3). Accordingly, we questioned their feelings about the missing sound. The results are listed in Figure 16.

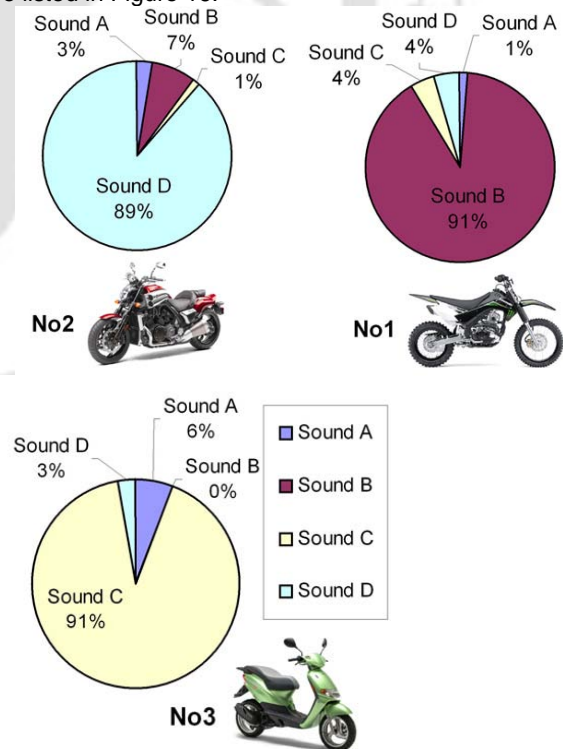


Figure 16. Percentage of selection sounds for motorcycles: motorcycle No2 , motorcycle No1 , scooter No3 .

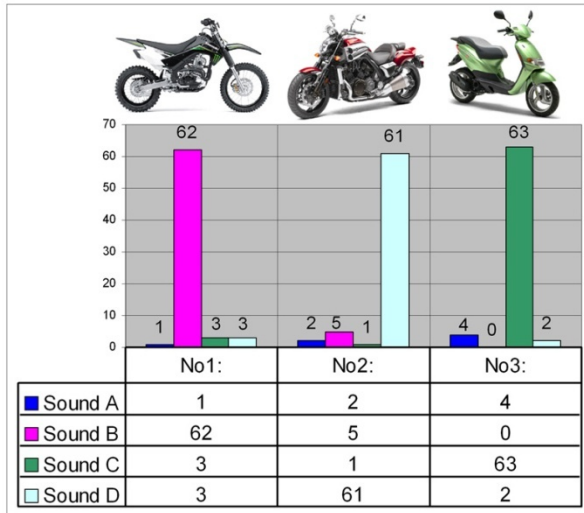


Figure 17. Number of people that selected sounds for motorcycles

When asked how they would feel if, upon getting home they realized their vehicle had no sound, there were a higher number of subjects had negative emotional reactions to the motorcycle sounds. (No 1) and (No 2). (Cheated, Undesirable, Unsuitable, Deficient, Unable to work and Lost). The Scooter (No 3) which had a gentler, rounded form produced opposite results. Eighty four percent of subjects had a negative emotional reaction to sound "A" for Motorcycle (No.1) Figure 18, (Cheated 22%+ Undesirable 16%+ Unsuitable 27%+ Deficient 5%+ Unable to work 7%+ Lost 7%= 84%) and Motorcycle (No 2) Figure 19, (Cheated 20%+ Undesirable 19%+ Unsuitable 22%+ Deficient 11%+ Unable to work 6%+ Lost 6%= 84%). They stated that the sound was unacceptable. Sixteen percent had no problem with the missing sound. (Figure 18, 19) They experienced no negative emotions. Scooter (No.3) produced the opposite results. When compared, subjects were satisfied that sound "A" fit the Scooter (No 3). In this case, 73 percent of subjects did not have a negative emotional reaction (Figure 20)

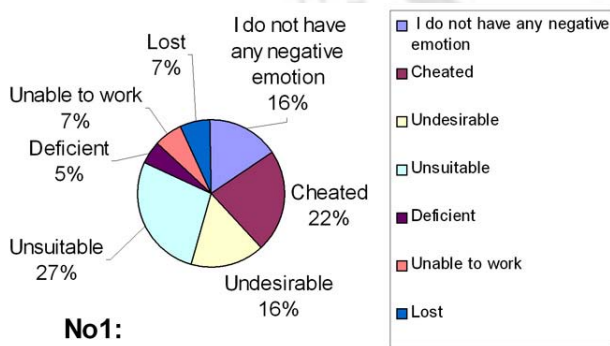


Figure 18. Emotions for motorcycle No1 with sound "A"

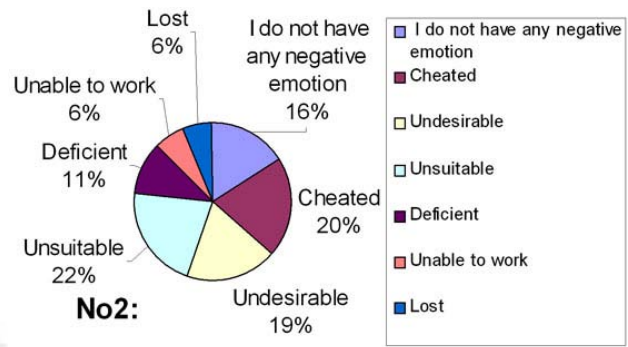


Figure 19. Emotions for motorcycle No 2 with sound "A"

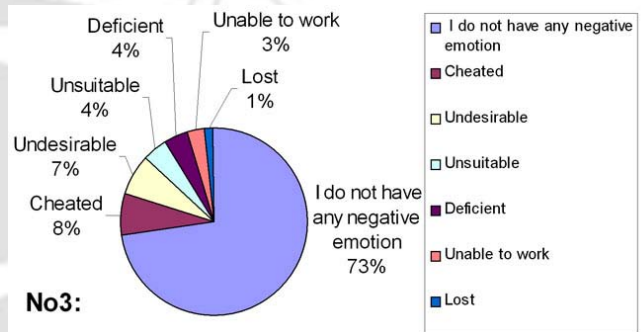


Figure 20. Emotions for scooter No3 with sound "A"

Discussion

Interpreting the meaning of a product with limited senses often leads to mistakes in decision making due to a lack of information. In phase 1, we learned that one sense (receiver) is not enough to know the meaning of a product. The selection of the wrong cake demonstrated that vision alone is not a good replacement for the other senses. When subjects were able to touch the cake, they realized they had been fooled. Their primary experience caused them to choose more carefully the second time, reaching out to touch the scissors.

In the second stage, subjects listened to different motorcycle sounds and paired them to motorcycle forms. (Figure 17) A majority of subjects correctly identified and paired the sounds to the appropriate forms, indicating that consumers experience associations to sounds. The results were compiled for comparison. (Figure 18, 19 & 20)

Conclusions

Most consumers have the ability to correctly identify and match sounds with their respective motorbikes. (scooters vs. motorcycles). When sound is omitted in high tech products, it changes the meanings of the semantic frame and has a negative effect on the emotional expression of the product. The absence of expected sound can alter other semantic meanings that have powerful expressions on the other side of the frame. (Figure 4) Consumers have definite judgments about sound. The correct sound can be very satisfying, but the wrong sound can be disturbing. In the first experiment, when

subjects reacted negatively to finding out the cake was a fake, they used the halo effect to make a new judgment [15]. The halo effect results when the consumer becomes blind to all the good features of a product and focuses only on the problem areas. Assumptions are narrowed down to one or two prominent characteristics that overshadow all other traits. When consumers found that they were not able to eat the fake cake or hear the right sound for the motorcycle, they focused only on that issue. They were unable to enjoy the other aspects of the product and the experience was essentially ruined. It took only one negative side to collapse the delicate balance of the semantic frame. (Figure 18, 19 & 20)

Sound omission does change the emotional expression of a product. The feeling of power is one of the important emotions that a rider seeks and that is not limited to mechanical vehicles. Before the invention of the automobile, people looked for expressions of power in their animals. When buying a horse or an elephant, one looked for an animal with a powerful figure. The animal was often elaborately decorated for a better "power expression".

The same is true for motorcycles. Riders have chopped, lowered, striped and painted their bikes to epitomize speed for as long as people have been straddling two wheels. A powerful motorcycle needs a powerful sound. Artificial sound alleviates some of the negative emotions experienced by the lack of genuine sound and creates greater levels of consumer satisfaction. Electric motorcycles can be marketed successfully if designers insert artificial sound in the engines. The future of high tech electric motorcycles depends on an electronic soundboard to compensate for the omission of sound.

Appendix

List of Automobiles, scissors and motorcycle pictures and the brand names used as samples for experiments.

labels in this paper	Brand	Source
#1	Mercedes-Benz model C63	http://www.mercedes-benz.com
A	Cartini scissors	
B	Cartini scissors	
No 1	Kawasaki	http://www.khi.co.jp/mcycle/eng/
No 2	Honda Vmax	http://world.honda.com/
No 3	Derbi Atlantis	http://www.derbi.com/

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