# DESIGN FOR EMOTIONS

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## ABSTRACT
Designing products with desired emotions for the intended user is a challenging task for designers. Emotions elicited by product appearance are often considered intangible and difficult to predict. This project is an attempt towards supporting the process of developing products with desired emotional response, by taking inspiration from natural and artificial objects. An Emotional Response Model (ERM) has been developed to understand and how different parameters of objects relate to the kind of emotional responses they evoke. An image based survey was conducted to identify and quantify specific object-related and emotion-related parameters and their cause- affect relationships. The findings were further validated by conducting another survey to identify the emotional response evoked in users by another set of objects, and by matching these with the response predicted by the model. The findings will be used as a basis for developing software that provides visuals as triggers for design for emotions.

*Keywords: design for emotions, product semantics, stimuli, triggers, creativity, industrial design*

## 1    INTRODUCTION
Emotions are the felt tendencies or reactions toward anything like people, object, ideas, events etc. Emotions enrich virtually all our waking moments, with either a pleasant or an unpleasant quality. Studies have shown that a person's general experience of well-being is strongly influenced by the person's day-to-day felt emotions [1]. Given the fact that a substantial portion of these emotional responses is elicited by 'cultural products,' such as art, clothing, and consumer products [2], designers may find it rewarding to design for emotions that appeal to or stimulate the intended users. Emotional appeals play a significant role in consumer choice of products. Emotional responses can incite customers to select a particular product from a row of similar products, and will therefore have a considerable influence on their purchase decisions. Products in an ever-segmented, mature market are increasingly targeted to users with specific, differentiated needs – technical, aesthetic, ergonomic, as well as emotional. For instance, one such market segment may be for young, urban, middle class working women who are in need of a two-wheeler that caters to their emotional choices and aspirations. Consequently, increasingly more producers challenge designers to manipulate the emotional impact of their designs, or, to *design for emotions*.
Design for emotions is hard. Designers are trained in incorporating formal clues in products to indicate emotional features such as aggression. However, their training is highly anecdotal, and prone to subjectivity and bias. In design practice, emotions elicited by product appearance are often considered intangible and therefore difficult to predict or design for. This persistent preconception is partly caused by some typical characteristics of product emotions:

* The concept of emotions is broad and indefinite. Products can evoke many different kinds of emotions since these emotions are elicited not only by the product's aesthetics, but also by other aspects, such as the product's function, behaviour, and associated meanings such as brand.
* Emotions are personal; individuals differ in their emotional responses to a given product.

Product semantics is study of symbolic qualities of product form, in the cognitive and social contexts of their use. It deals with the relationship between the user and the product. The argument is that, through its semantic content and expression, a product can create positive or negative perceptions, emotions, values and associations within the individual person [3]. Product semantics is an approach

to developing a visual vocabulary in products in order to give them an immediately identifiable set of mainly visual (although sometimes tactile or auditory) clues, which become tools available to the designer to communicate through their products, helping to reflect function and underlying cultural associations [4]. It is believed that when product semantics becomes sufficiently well-developed and appropriately applied, products would become more emotionally and psychologically comfortable for users, with eloquent and expressive shapes or details, allowing them to make emotional connections with otherwise impersonal objects.

Development of a theory of object emotions, where features of an object are possible to be linked to specific emotional features and primary emotions expressed by the user, is necessary for a less subjective understanding of the matter, and subsequent support. This theory should be based on empirical data, such as emotional response of users to artefacts with given features.

The overall goal of this project is to understand and support the complex link between designs and emotions, in terms of how object-features, socio-cultural background and personal preferences affect emotions perceived by the user. In this paper, a model is proposed for emotions evoked by features of objects, captured in *images*, which relate to perceived emotions, largely irrespective of the background and personal preferences of the users. The model is validated by matching the response of users to given set of visuals with the responses predicted using the proposed model. These results can be utilized by developing a visual database or library of objects that invoke a predictable variety of emotions, for use as inspirations by designers to design for specific emotions.

## 2    OBJECTIVES AND METHODOLOGY

The specific objective of this work is to study, analyze and validate whether there is consistency in the emotions perceived by subjects of different backgrounds in the same visual stimuli. Using literature and experience of teaching in student courses and projects as well as consulting with industry in this area, a preliminary model of product emotions (called Emotional Response Model, or ERM) is first developed. This model is refined by answering the following questions:

- Are there object features that evoke subject-neutral emotions?
- Are there object features that evoke subject-specific emotions?

The specific steps followed are:

- Development of a preliminary Emotional Response Model (ERM)
- Development of a data base of visuals or images of natural and artificial systems for the survey
- Development of a vocabulary of different parameters to assist subjects during the survey
- Image-based survey of users for their response to various images and visuals
- Analysis of results to refine the model
- Validation of the model by comparing predicted response using the model with actual response from subjects on new images.

## 3    DEVELOPMENT OF THE EMOTIONAL RESPONSE MODEL

There are various methods as to how designers should be able to understand the emotional experience of the user [5-6]. For instance, product personality profiling is used to identify a product as a person and characterise its personality profile, or mood-boards – a collection of visual images gathered together to represent an emotional response to a design brief [7]. The problem, however, with such methods is that they rely strongly on the subjective interpretation of the designer, and do not provide a basis for making non-subjective judgement [8].

There are several models that attempt to explain how stimuli (such as a product) lead to emotions felt by a subject. For instance, according to [9], the process of interpreting and decoding the semantic content of an unfamiliar product involves two different reactions. The first one is based on knowledge, and dependent on the social and cultural background of the subject, while the second reaction is emotional. Meaning is then interpreted based on the associations drawn from prior experience. Person [10] describes a 'functional model for describing emotional response to products'. Person points out that emotional response is a result of an interaction between an individual and a product, and this interaction happens within a context (interaction context, and the larger, social context). Person, therefore, sees as potential influences on an individual's concern arising from the social context, interaction context, characteristics of the individual, and characteristics of the interaction. Another model, by Desmet and Hekkert[11-12], uses three key concepts to describe the process of eliciting

emotions: stimuli (such as a product), concern and appraisal. If a stimulus is within the concern of a subject, the person will appraise it, which will lead to elicitation of some emotions.

Earlier models seem to indicate that socio-cultural background, which influences the thoughts, values and beliefs of an individual belonging to that background, along with their personal preferences (which contribute to the variation among individuals within similar background) are the major contributing factors in deciding an individual's emotional response to a particular situation or object feature. What seems to be missing in these models is the lack of detailed focus on the only aspect that is controllable by designers – object features. To what extent do specific object-features evoke specific emotions? Are there object features that evoke specific emotions irrespective of the subject involved? Research so far seems to be unable to identify object features that link subject-neutrally to emotions.

We also note that responses of a subject could have great variety, and any consistent patterns between objects and patterns are unlikely to be found unless there is some fundamental emotional similarity between human beings - a finite set of emotions shared by all humans. These are provided by the finite set of *basic emotions* and *arousal states* identified by researchers in human psychology, which are taken as the final output in our model. Based on the widely accepted model by Plutchik [13], there are eight basic human emotions - acceptance, anger, anticipation, disgust, joy, fear, sadness, and surprise. According to Ekman [14-15], there are three basic arousal states - boredom, interest and calm. In our study, these eleven elements are used together under the category of *primary emotions*.

Our focus is primarily on identifying relationships between specific, identifiable object features and emotions evoked. The preliminary model created in this work – called the *Emotional Response Model* or *ERM* - is an adaptation from the current stimuli-emotion models, where object-features are stimuli to the user, and the background and personal preferences of a subject trigger one or more primary emotions in response to the stimuli.

Now, what we note in interaction with users and designers in this area is that, expressions about emotions elicited by a product are often associated with features that are neither purely objective (such as 'geometric shapes'), nor pure emotions (such as 'anger'), but in-between (such as 'sporty') - we call these *emotional features*. We argue that emotional features provide the bridge between object features and primary emotions. The model proposes that object features have particular relationships with emotional features, which in turn have specific relationships with primary emotions. Both background and individual preferences play a role in determining these relationships. What is new in the proposed model is the way in which the process of appraisal happens: a user sees object features that trigger perception of emotional features. It is the triggering of emotional features that acts as the vehicle to primary emotions being evoked.
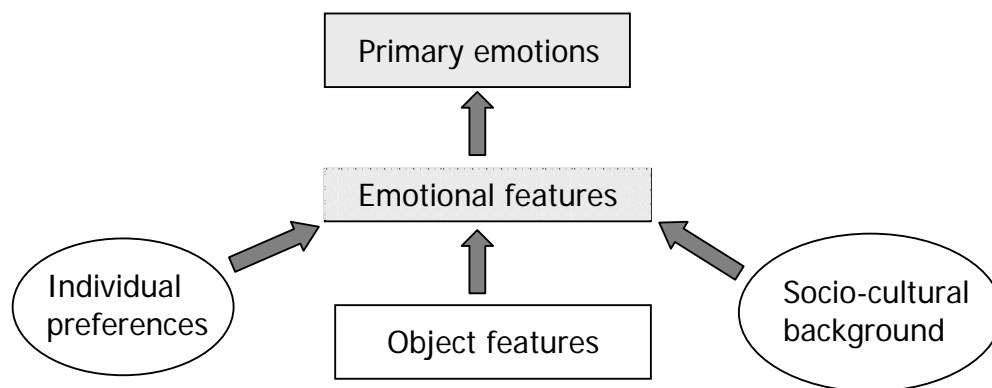


Figure 1. Emotional Response Model (ERM)

The model therefore has the following constructs: *object-features* which include aspects of form, colour and texture of an object, *socio-cultural background, personal preferences*, *emotional features* perceived, such as 'sporty' and 'aggressive', and *primary emotions* like 'joy' and 'surprise'. Desmet [11] speaks about two kinds of emotions: emotions expressed by a stimulus (as viewed by the subject), and emotions elicited by a stimulus (as felt by the subject). In our model, emotional features provide the emotions expressed by a stimulus, whereas primary emotions provide the emotions elicited by the stimulus in the user.

Object features are the sensory features (in this work these are visual features, but in general can be stimuli to any combination of senses) imbibed in an object. They can be objective as well as subjective in nature. Objective features can be observed in an object without any subject-related variation, like 'rounded', 'transparent', 'sharp' etc, while subjective features require some subject-interpretation, which may differ from person to person, like 'robust', 'delicate' etc. Emotional features are the emotional qualities associated with an object, observed by an individual. These are based upon the object features, socio-cultural background, and personal preferences of the individual.

## 4    DEVELOPMENT OF DATABASE OF IMAGES

For refinement of the proposed model (by understanding the relationships between object features and emotional response), an image-based survey and interviewing of users were carried out. It was decided to use visuals or images of various natural and engineered objects. Visuals were collected from the following categories: animals, plants and products. Possibility of high emotional response, lack of ambiguity and diversity (tested by a pilot study) were the selection criteria. A group of 15 images was selected, each of which depicted a natural or engineered object or system.

## 5    DEVELOPMENT OF VOCABULARY

To understand the relationship among different parameters proposed, an image based survey was conducted. Initially the survey was open ended, but the pilot study indicated that subjects needed some assistance in terms of vocabulary to express their responses. This also enabled us to compare the subject responses obtained during the experiment. Thus, a list of words was formulated to express each parameter: object-features, emotional features, and primary emotions.

## 6    IMAGE BASED SURVEY

The survey was conducted on 15 subjects for 15 images. Each image was shown individually to each subject, who was asked to describe the emotions elicited by the image, what object features she thought were responsible for this, what (if any) emotional features were responsible, and why (if clear). The empirical data collected was the basis for refinement of the model.

Each subject was asked to follow these steps during the survey:
- Observe each image
- Identify the primary emotions associated with the image
- Identify responsible emotional features, if any, using the vocabulary given or your own words, for expressing these features.
- Choose appropriate object features responsible for each emotional feature, with justification.
- Mention your background, and your personal preferences, thoughts and beliefs related to the image, if any.

## 7    RESULTS AND ANALYSIS

The results from the survey were analysed to identify any of the following possible relationships:
- List of emotional features responsible for each primary emotion
- List of object features responsible for each emotional feature
- Subjects' background and individual preferences responsible for these.

In particular, we are interested in identifying possible generic relationships between features of images of various objects and systems and the emotions evoked by them. This could be validated by checking to see if there is consistency in the emotions perceived across subjects with different backgrounds for the same object features. First, responses were obtained in terms of primary emotions, emotional features and object features responsible for them, as experienced for each individual image. The figures in Section 7.1 show the image based results, where responses with higher frequency (equal or more than 20%, i.e. 3 responses out of 15) were identified. In Section 7.2, the results were further analysed in terms of relationships between primary emotions and emotional features. Similarly, Section 7.3 shows the relationships between emotional features and object features.

### 7.1    Image based results – an example

As an example, the following are the results obtained for one image.
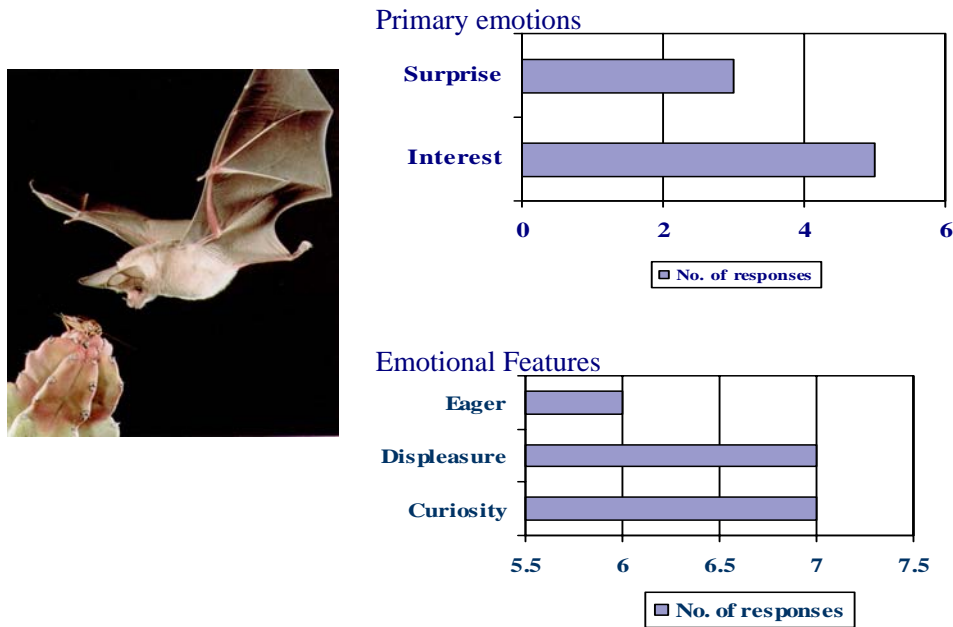


Figure 2. Major results for an image (Bat)

This example shows one of the images used for the survey. Here the first graph shows that 'Interest' and 'Surprise' are the two major primary emotions evoked. The second graph shows the major emotional features evoked due to the visual, across all subjects. Since a primary goal of this work is to identify subject-neutral relationships, only those parameters that were chosen by more then 50% of the subjects for a given image are considered subject-neutral parameters related to that image. Table 1 shows the primary emotions for each image that get such high response - 10 out of the 15 images have at least one primary emotion that has a frequency of more than 50%.

Table 1. Major primary emotion for each image

| Sr. No. | Image name | Major primary emotion | Frequency of response (More then 50%) |
|---|---|---|---|
| 1 | Rosebud | Happiness | 14/15 |
| 2 | Watch | Interest | 11/15 |
| 3 | Swan | Calm | 10/15 |
| 4 | Car | interest | 10/15 |
| 5 | Horse | Happiness | 9/15 |
| 6 | Butterfly | Happiness | 8/15 |
| 7 | Chair | Interest | 8/15 |
| 8 | Motorbike | Interest | 8/15 |
| 9 | Orchid | Happiness | 8/15 |
| 10 | Pitcher plant | Disgust | 8/15 |

Table 2 shows the emotional features with high response. 13 out of 15 images have received a high response in at least one emotional feature, with frequency more then 50%. Based on these results, it can be concluded that images or visuals can arouse particular primary emotions or emotional features, with considerable consistency across individuals.

*Table 2.Major emotional feature for each image*

| Sr. No. | Image name | Major emotional features | No. of responses (More then 50%) |
|---|---|---|---|
| 1 | Car | Luxury | 14/15 |
| | | Sporty | 9/15 |
| | | Pride | 8/15 |
| 2 | Swan | Peace | 13/15 |
| 3 | Watch | Sporty | 12/15 |
| | | attract | 8/15 |
| 4 | Motorbike | Sporty | 12/15 |
| | | Attract | 11/15 |
| | | luxury | 9/15 |
| 5 | Rosebud | Romance | 10/15 |
| | | Freshness | 10/15 |
| | | Love | 9/15 |
| | | pleasure | 8/15 |
| 6 | Chair | Attract | 10/15 |
| 7 | Lotus | Freshness | 10/15 |
| | | liveliness | 8/15 |
| 8 | Orchid | Peace | 9/15 |
| | | freshness | 8/15 |
| 9 | Pitcher plant | Dislike | 9/15 |
| | | astonishment | 8/15 |
| 10 | Beer mug | pleasure | 8/15 |
| 11 | Butterfly | Liveliness | 8/15 |
| 12 | Eagle | Hostile | 8/15 |
| 13 | Horse | Sporty | 8/15 |

## 7.2   Primary emotions and emotional features

In order to understand the relationships between primary emotions and emotional features, all the responses for a particular primary emotion, i.e., 'happiness', were added up to get the overall trend. From these results, it is possible to identify those emotional features that are more likely to invoke a particular primary emotion. In this case, *frequency* represents the total number of responses for a particular relationship between emotional feature and primary emotion (across all images). Emotional features with higher frequency are more closely associated with the particular primary emotion.
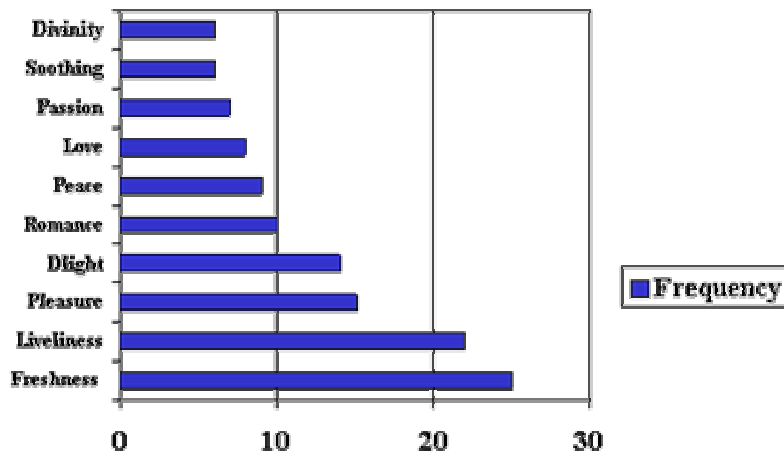


*Figure 3. Frequency of choice of emotional features for sthe primary emotion 'Happiness'*

## 7.3 Emotional features and object features

Using a similar approach as in Section 7.2, we identify the relationships between emotional features and object features. The frequency of responses for each object feature invoking a particular emotional feature, i.e., 'attract', were added up across the images in order to get the overall trend. From these results we identify those object features which are more likely to invoke a particular emotional feature. Here frequency represents the total number of responses for the relationship between a particular emotional feature and each potential object features responsible for invoking it. Object features with a higher frequency are more closely associated with the particular emotional feature. The images shown represent the respective emotional feature with a higher frequency response.
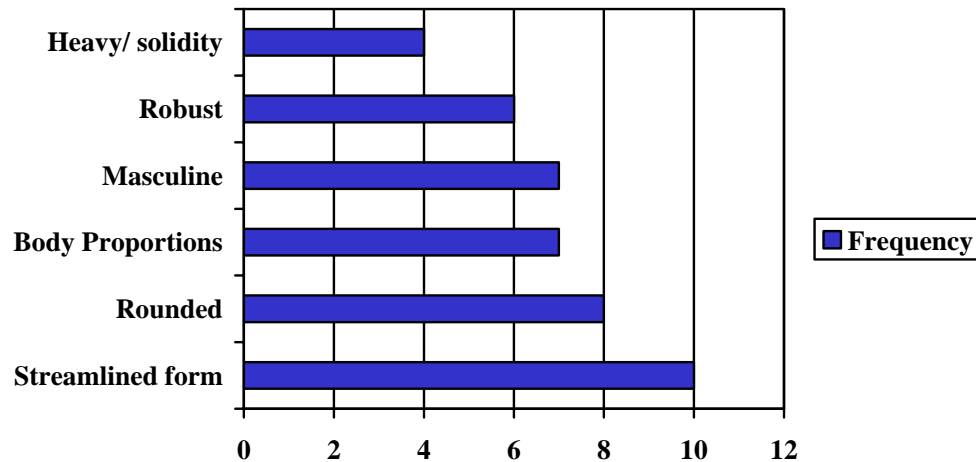


*Figure 4. Frequency of choice of object features for the emotional feature 'sporty'*

## 8 VALIDATION OF THE FINDINGS

In order to validate the findings of the survey, a subsequent test survey was conducted. Three new images were selected. Using the object features and the relationships identified from the first study, the most likely emotional features and primary emotions were predicted for each image. The test survey was conducted over 15 subjects (all different from those who took part in the first survey), so as to check whether or not these images invoke similar emotional features and primary emotions as predicted by the model. The images and corresponding results are shown below.

### 8.1 Test image 1 - Rabbit

The object features identified were:

- Organic
- Bright colour (white)
- Soft
- Surface with furs
- Rounded

Expected major emotional features were:

- Peace
- Freshness/ liveliness
- Love

Expected primary emotions were:

- Happiness
- Calm



The frequency responses for emotional features identified by users for this test image are:
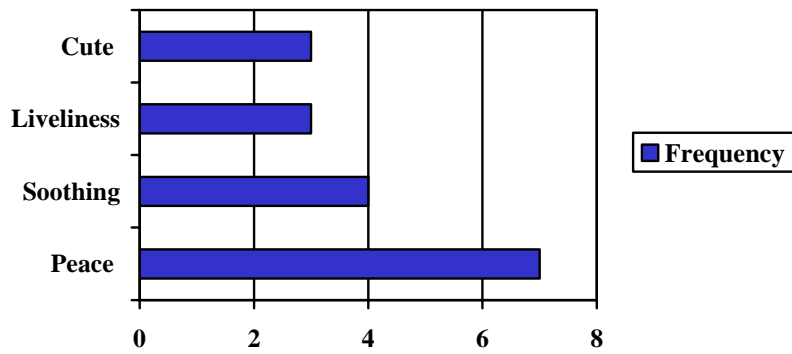
*Figure 5. User identified emotional features for image 'rabbit'*

The frequency responses for primary emotions identified by users for this test image are:
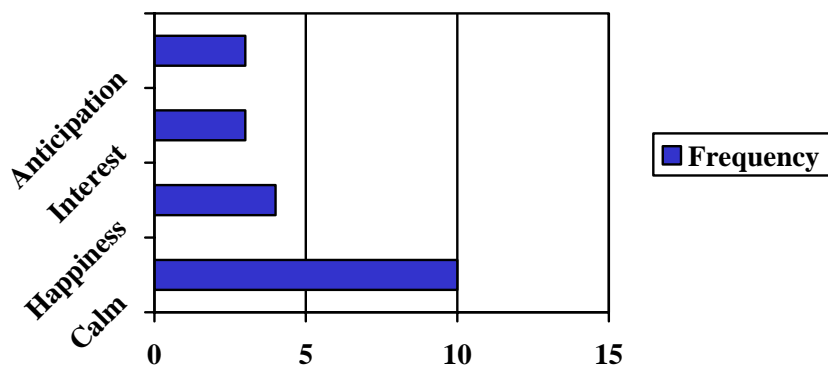


*Figure 6. User identified primary emotions for image 'Rabbit'*

## 8.2 Test image 2 – Vacuum cleaner

The object features identified were:
- Streamlined form
- Glossy/ lustrous
- Shining
- Free form

Expected major emotional features were:
- Sporty
- Attract
- Luxury

Expected primary emotion was:
- Interest



The frequency responses for emotional features identified by users for this test image are:
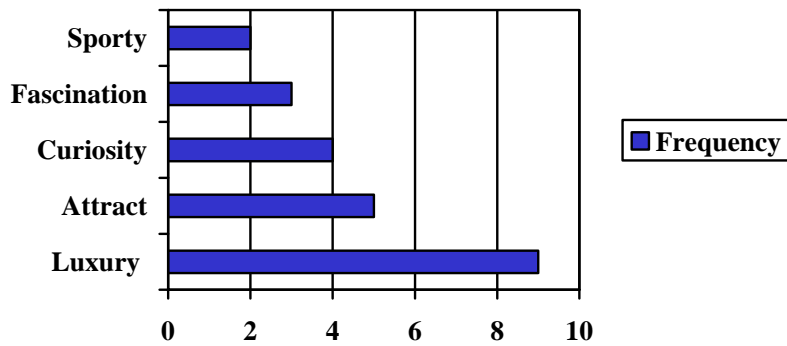
*Figure 7. User identified emotional features for image 'Vacuum cleaner'*

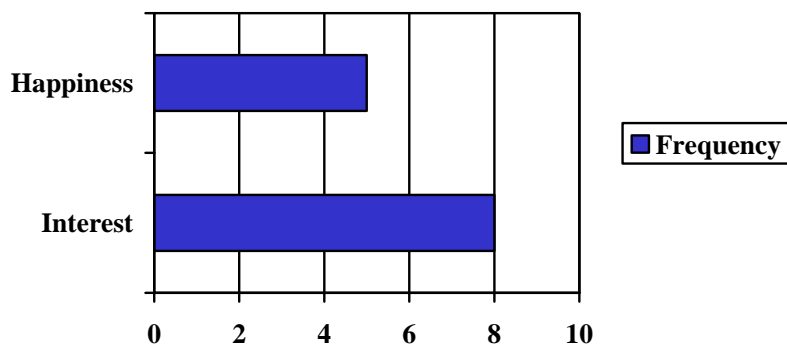The frequency responses for primary emotions identified by users for this test image are:



*Figure 8. User identified primary emotions for image 'Vacuum cleaner'*

## 8.3   Test Image 3 - Shark

The object features identified were:
- Heavy/bulky
- Dynamic/Agile
- Sharp
- Masculine
- Rugged
- Body posture

Expected major emotional features:
- Danger

Expected major primary emotions:
- Disgust
- Fear

The frequency responses for emotional features identified by users for this test image are:
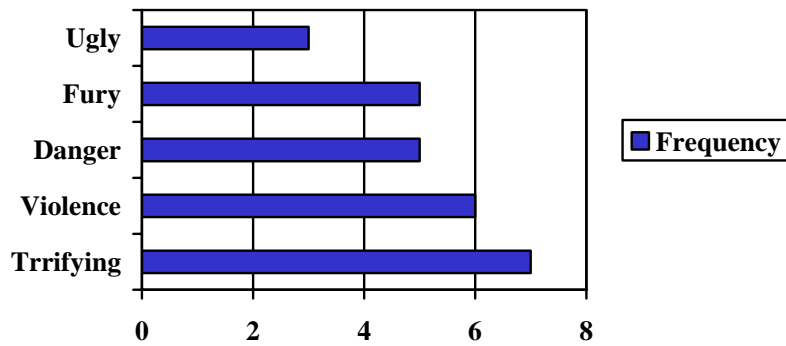
*Figure 9. User identified emotional features for image 'Shark'*

The frequency responses for primary emotions identified by users for this test image are:
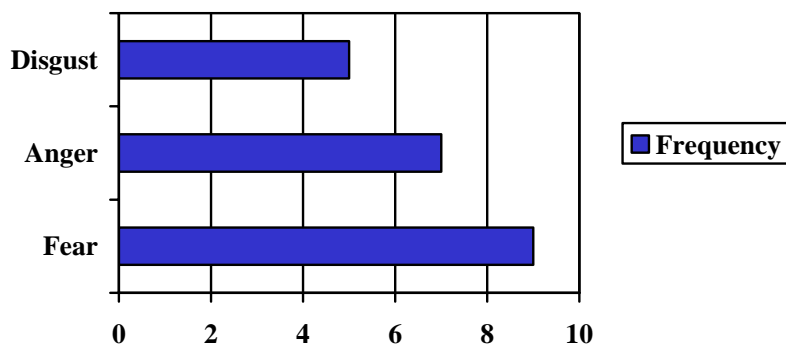


*Figure 10. User identified primary emotions for image 'Shark'*

## 8.4 Observations

For each test image, the observed emotional features (e.g., 'terrifying', 'violence' etc. in case of Shark) are closely related to the predicted response (e.g., Danger' in the case of Shark). Similarly, the primary emotions elicited by the images in its users are included in or identical to those predicted by the model (e.g., 'fear' in case of Shark). Even other emotions and emotional features are closely associated with the predicted responses. This is taken as a validation of the model developed.

The high degree, to which the same relationships are identified, by various users in various images, indicates that there are general relationships that exist between features of objects and their potential emotional responses. However, the variations in what the subjects see as relationships in the same image also indicates that subject-specific influences also play a substantial role in the emotional response evoked by an image.

## 9   CONCLUSIONS AND FURTHER WORK

The goal of this work has been on developing and validating a model for eliciting emotions by a product. In particular, the focus has been on identifying subject-neutral relationships between object features and emotions. This partially validates the ERM. The responses of the test indicate that the survey findings are validated. One area that has not been explored much in this work is the relationship between individual preferences and background and the variation in the responses due to differences in these factors. Also, it might be possible to quantify the strength of the relationships using more sophisticated analytical methods. Further work will include exploration of these aspects, which should provide a more complete validation of the ERM. This will followed by developing a support with images and their emotional response maps to help designers in design for emotions.

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## APPENDIX 1: LIST OF PRIMARY EMOTIONS

Acceptance, anger, anticipation, disgust, joy, fear, sadness, surprise, Boredom, interest and calm

## APPENDIX 2: LIST OF EMOTIONAL FEATURES

Delight, Liveliness, Luxury, Pleasure, Pride, Love, Romance, Freshness, Welcoming, Sporty, Astonished, Eager, Fascinated, Enthusiasm, Passion, Cuteness, Attract, Attentiveness, Tranquillity, Radiance, Divinity, Peace, Harmonious, Soothing, Sombre, Composed, Undisturbed, Eternity, Approval, Consent, Permission, Recognition, Adoption, Agreement, Belief, Expectation, Apprehension, Awaiting, Contemplation, Expectancy, Impatience, Hope, Eagerness, Awareness, Divine, Distaste, Dullness, Indifference, Monotony, Annoyance, Discomfort, Displeasure, Frustration, Uneasiness, Dejection, Boredom, Grief, Disturbing, Hopelessness , Subdued, Repellent, Dejection, Depression, Misery, Dislike, Hatefulness, Antipathy, Sickness, Shame, Fatigue, Irritation, Revulsion, Annoyance, Antagonism, Displeasure, Fury, Impatience, Indignation, Enmity, Impatience, Violence, Demonic, Terrifying, Cruel, Ugly, Hostile, Danger, Apprehensiveness, Panic, Uneasiness, Anxiety, Astonishment, Curiosity, Unexpected, Wonder, Disappointment, Bewilderment, Miracle, Overwhelm, Complexity, Perplex.

## APPENDIX 3: LIST OF OBJECT FEATURES

Object Features: Light, Heavy/solidity, Simple, Complex, Irregular form, Organic, Geometrical, Free form, Geometric /rigid form, Aerodynamic form/ streamlined form, Sharp, Rounded, Solid,

Perforated, Opaque,, Transparent, Translucent, Perforated, Body posture, Body proportions, Sophisticated/royal, Slim/elegant/graceful, Heavy / bulky, Timidity, Dominance, Dynamic/agile, Dull/subdued, Symmetric/ balanced, Unsymmetrical /unbalanced, Stable, Unstable, Masculine, Feminine, soft, hard, Warm, Cold, Sleek, Robust, Delicate, Rugged, Modern, Traditional/classic, Minimalistic/simplicity, Ornamental / opulent, Hi-tech/sophisticated, Antique, Flexible, Rigid Rustic/natural/earth.

Texture/colour: Glossy/lustrous/shining, Matt, Rough/ Natural/ rustic, Smooth, Fine, Coarse, Regular, Irregular, Hard, Soft, Like velvet, Small furs, Silky, Opaque, Transparent /translucent, Solid, Perforated, Surface with pattern, patches etc, Opulent (highly decorative), Clear, Muddy, Diffused.

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