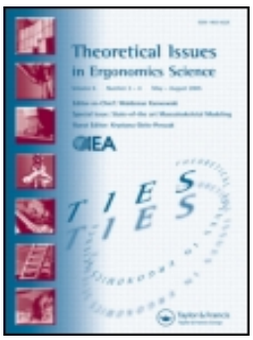

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# Emotional needs of car buyers and emotional intent of car designers

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We investigated the emotional intent of car buyers and designers in two related studies. The first study involved 179 Asian and European car owners from 10 countries who were interviewed in a survey. The results showed that several car design descriptors gave similar emotional associations in Europe and in Asia. Clearly, car owners look beyond functionality to consider emotional design features. The affective descriptors of the Asian sample were used in a second study involving seven car designers from an automotive company in mainland China. They were instructed to include affective features in their design of a car dashboard after first designing without instructions to include those features. The designers had no previous experience of affective car design, but the results revealed emotional changes to their design. It can be concluded that car designers may need to learn how to include emotional design features as a design procedure.

**Keywords:** emotional intent; affective design; customer needs; Citarasa engineering; car design

## 1. Introduction

Affective or emotional design has become important in the highly competitive automotive market and vehicle designers are challenged to consider affective needs of customers (Schutte and Eklund 2005, Chang *et al*. 2006, Jiao *et al*. 2006, Desmet and Hekkert 2007, Nagamachi 2008, Turner *et al*. 2008, Khangura 2009, Kuang and Jiang 2009, Khalid *et al*. 2011). The experiences with vehicles evoke affective responses in customers; it is therefore the customer who evaluates the affects elicited by the interaction with the vehicle, including the meanings attached to the vehicle and the emotional experience (Hekkert 2006, Helander and Khalid 2009). Customers' emotions can be generated by careful design of the vehicle, for example by selection of interior colour schemes, leather seats, climate control and audio system (Sheller 2004, Burnett and Irune 2009, Wellings *et al*. 2010). Emotions therefore play a significant role in car purchase; affective design complements functional design and cannot be ignored by designers (Norman 2004, Khalid and Helander 2006).

Designers are now expanding the semantic approach to design by utilising affective design parameters. The semantic approach prescribes that designed objects have a meaning that goes beyond their functional requirements. Emotions are therefore

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important to design. There are many problems in applying affective design: first, designers need to understand and know how to utilise the components of affective design; second, there is a need to establish valid measures to assess affective responses to design; and third, there is a need to understand the source(s) of customer affect, and predict customer affect to proposed design solutions.

This article presents an approach towards identifying customer affective needs when buying a car, and investigating car designers' intent in applying affective design criteria in their design practices. The motivation is to understand *citarasa* or emotional intent of both customers and designers.



### 1.1. *Citarasa concept*

Customer needs are captured in a concept called *Citarasa* (Khalid 2006). The term originated from Sanskrit and is widely used in regions where Malay or Bahasa Melayu is the spoken language. The word 'Cita' means hope, intent and aspiration while 'Rasa' means taste and feelings. Citarasa presupposes that customers have an *emotional intent* when they purchase a vehicle (e.g. a car), and car design must therefore also address customers' affective needs. The emotional and cognitive components of decision making are driven synergistically by separate brain mechanisms – the affective part in the limbic system and the cognitive part in the frontal lobe. The thalamus receives sensory input from the environment, which is then sent to the cortex for fine analysis. It is also sent to the limbic system, the main location for emotions, where the relevance of the information is determined (LeDoux 1995). From there, it goes to the corresponding primary sensory cortex, which will extract auditory, visual and tactile information. The stimulus is then elaborated in different parts of the associative cortex, where complex characteristics and global properties are analysed. For details on the neural mechanisms, see Helander and Khalid (2012).

In our context, affect refers to the 'heart' and denotes feelings, while cognition refers to the 'head' and denotes thinking. Affect is used to evaluate and judge, while cognition is used to interpret and make sense of the objects, and understand the user (Norman *et al*. 2003, Dong *et al*. 2009). New breakthroughs in neuroscience using functional Magnetic Resonance Imaging validate the assertions that cognition and emotions are unified, and they contribute to the control of thought and behaviour conjointly and equally (LeDoux 1995). Additionally, cognition contributes to the regulation of emotion.

Citarasa is different from the rather passive emotions that one may experience before a purchase of common or less costly products, such as clothes. In citarasa, there is a strong *intentional* component; customers are actively seeking design features that are important for their emotional satisfaction. The customer's citarasa is an expression of emotional intent, needs and taste. To investigate intent, it is possible to ask customers what they are looking for, and thereby obtain an explicit identification of the user's affective requirements when buying a car or a truck. Citarasa offers an operational definition of the role of emotions in vehicle design, whereby customers deliberately seek out design features which will satisfy their needs (Helander and Khalid 2009).

The citarasa concept underlies the citarasa engineering methodology that was developed in the EU IST-CATER project (Khalid *et al*. 2007). A method for elicitation and analysis of citarasa is detailed in Khalid *et al*. (2011). Unlike Kansei Engineering (Nagamachi 2008) which is based on user's sensory experience, citarasa engineering is driven by user's emotional intent or desire for a product, and the evaluation is a

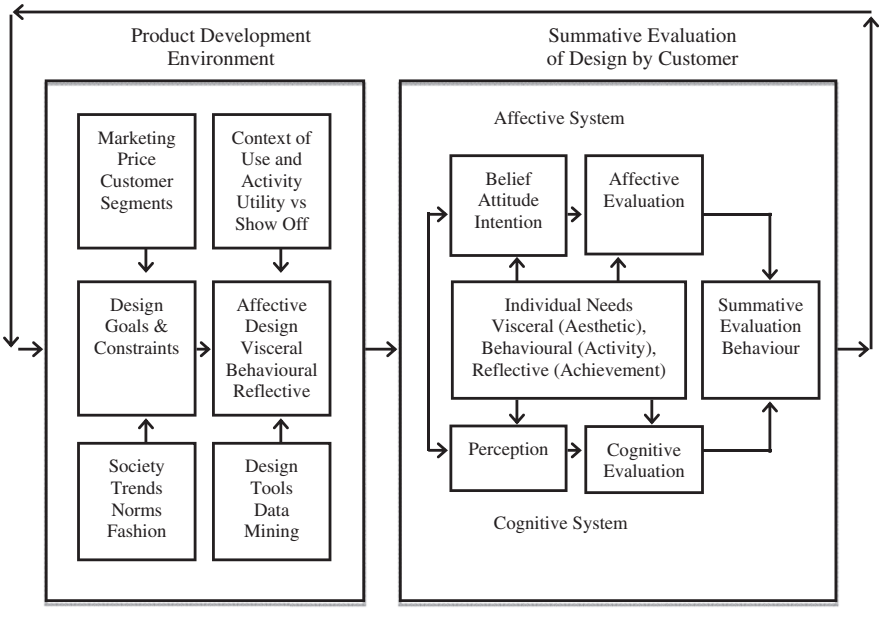


Figure 1. Citarasa (emotional intent) model.

summative experience of both affect and cognition of the user (Figure 1). The citarasa engineering methodology is explicit, comprising a 5-step process from citarasa modelling, elicitation, analysis, semantic mining, to mapping using a design matrix. Kansei Engineering requires more steps to derive at a design solution. The citarasa engineering method has been validated with end users in Europe and Asia in vehicle (car and truck) planning and also applied in the design of kitchens (Golightly *et al*. 2011).

## 2. Theoretical framework

In conceptualising a framework for understanding emotional intent, we need to explore buyers' needs in considering the purchase of a new car. Khoo (2007) investigated affective and functional requirements of customers when buying a car. He made contacts with car buyers in a showroom in Singapore. He probed their reasons for buying a car using Cognitive Task Analysis and Critical Decision Method (Crandall *et al*. 2006). These methods enabled him to identify tacit information such as buyer expertise. Each customer was interviewed several times during a 6-month period. There were three stages:

- *Stage 1*: In the beginning, a customer maintains beliefs about different cars. This stage deals primarily with *affective requirements*. A customer first talks to his friends and reads technical reviews and literature about cars. He may consider the 'dream car' (such as a Porsche), but soon realises that this would be unrealistic.
- *Stage 2*: About 6 months before the purchase, he visits showrooms and test drives cars. This is where the researchers first contacted the customers. During this stage, customers talk to their family about functional requirements; what will the car be used for, how many persons travel, fuel consumption and anticipated repair record. This stage basically deals with *functional requirements*.

- *Stage 3*: Just before making the purchase, the buyer will consider the 'quality' of the car; and several customers upgraded their purchase to a car with higher price in order to improve quality. However, the higher price also brought greater prestige, and it was difficult to distinguish which of the two motives inspired the car buyer. This stage, then, combines affective and functional requirements.

During the 6 months that Khoo (2007) was in contact with the customers, they went through several motivational stages broadly, following the model by Fishbein and Ajzen (1975) from belief (about personal needs including luxury), to attitude (personal preferences), to intention (sorting out the real needs of the family), to behaviour (purchase).



### 2.1. *Modelling emotional intent*

From the foregoing discussion, we developed a framework for modelling emotional intent of car buyers and designers, as shown in Figure 1. To investigate intent, there is a need to identify explicitly customer's or user's functional and affective requirements when buying a car. Citarasa descriptors are generated from the visceral, behavioural and reflective needs of the customer (Norman 2004) or the search for pleasures of the mind (Helander and Khalid 2006). The needs are expressed by probing the customer on his/her intent. For example, a need for 'elegant' car can relate to several interior or exterior characteristics, such as colour, shape, size and capacity that can be manipulated by designers to satisfy customer needs.

In Figure 1, there are two sub-systems: the designer environment (for product development) and customer/user environment (for evaluation of functional and affective design factors).

#### 2.1.1. *Designer environment*

In designing a new vehicle, a product planner/designer uses information from a variety of sources, including marketing, context of use/activity of a vehicle, and society norms and fashions. This information broadly determines the design goals (what one should design) and the constraints (what one should not design). The Marketing department will offer information about customer needs and future markets which will determine design goals. In addition, Marketing will often determine economic parameters, including the sales price, thereby imposing important design goals and constraints.

Affect is elicited not only by perceptual features of the product, but also by the activity with the product and context of use. Hence, product planners must analyse the context of activity, that is, driving. This will determine not only affective requirements but also implicitly the functional requirements of the vehicle. Some design factors are influenced by social norms and fashions. For example, functional requirements concerning fuel efficiency will be regulated by governments as well as by customers. After they are adopted by Marketing, they appear to the designer as design constraints. Trends and fashions in design are important and play a decisive role in affective design.

Product planners and designers need to understand how affective design can be derived. Norman (2004) noted that there are three types of affective design features, namely: visceral, behaviour and reflective.

- *Visceral design* refers to the visual aspects of the design, such as shape, colour, materials, ornamentation and texture. Visceral design is applied to many designed

objects with aesthetic value. For vehicle design, there are several basic factors, including the vehicle exterior and interior, and elements such as dashboard, seats and controls. By gathering citarasa from buyers, designers can identify both affective and functional requirements.

- *Behaviour design* has to do with the pleasure in using the object, such as steering a smooth and well-balanced vehicle, driving at a very high speed and intuitively finding controls. Steering a vehicle with a well-designed steering system along a curvy road can similarly be very satisfying.
- *Reflective design* has to do with things that have been learnt over the years. A vehicle buyer may take much interest in an aesthetic design, because his/her father was a painter, and he/she was surrounded by beautiful objects from early childhood. The interest and preferences for aesthetic design are learned and will typically increase with age (Norman 2004).

There are also cultural differences in learned preferences, e.g. Chinese will buy red items, which is also common in car purchase. In evaluating reflective design, a customer reflects consciously and deliberately about his/her options. This is different from the evaluation of visceral and behaviour design. In these cases, people are often unaware of their reactions and what caused them. Designers should consider first hand the conscious reflective needs, which would comply with the current fashion trends and a person's cultural background. Reflective design assumes that the emotional intent (affective requirements) drive customer choice, together with functional requirements. Customers reflect on the suitability of various design options and select a vehicle that suits both types of requirements.

Design features of a car will be addressed by the designer one by one, whereas the customer uses a holistic evaluation; e.g. 'I like it', without reflecting on what exactly triggered his reaction. It is important that designers are well informed about these different and complementary design options and understand how to implement them. This will require training, so that designers can make conscious decisions and fully understand when and how to utilise visceral, behaviour and reflective design.

### 2.1.2. *Customer/user environment*

This sub-system is made up of a user's affective and cognitive systems. The affective system is based on the capability of the product to elicit affect. Due to uniqueness in style and personality, some products are more capable of evoking affect than other products (Seva and Helander 2009). The prospect of owning such a product generates a variety of emotions that are not experienced when confronted with standardised products. In essence, deep seated desires of users for individuality, pleasure and aesthetics cause emotion in user's evaluation of the product.

Products also elicit cognitive responses, appraised according to fulfilment of identified functions. For example, a car must not only be capable of transportation but must also be reliable. In the process of evaluation, the user employs previous knowledge to determine if the product is acceptable to one's standard or not. There are very clear criteria that have been set forth by the user that can be rationally measured to arrive at a decision. The cognitive system shown in Figure 1 follows the human information processing model that explains the psychological processes involved in interacting with a system. The system begins with the perception of the artefact's attributes. The attributes trigger cognition and memory recall. Information stored in memory about a product is retrieved and used for

evaluation and decision making. When evaluating a car, for example, knowledge obtained from past experiences, published material and other customers' opinion come to mind and are used to make the best decision. The decision is then used as a basis for one's action – to make or forego a purchase.

Customer's individual needs influence information processing. A person's attention is attracted by visual items that stand out because of colour, brightness and size (Treisman and Souther 1985). Attention is also drawn by unique design features that lead customers to feel awe, surprise and excitement. Emotions are experienced because some needs are fulfilled just by the sight of a product or the prospect of owning it. Visual aesthetics affect the consumer's perception of a product in many ways and influences the evaluation of a product (Bloch *et al*. 2003). Like aesthetics, achievement drives people's emotion and influence perception. People feel pleasure at the thought of accomplishing something well such as purchasing a car that is worth the money (Kubovy 1999). It makes them happy to know that they have done something that most people have not done before. The need for achievement is comparable to the need to satisfy one's curiosity by gathering more information. A customer who wants to buy a car or a truck suddenly becomes aware of the models and brands that are available when she/he had been oblivious of this information in the past.

A person's need for power can also draw him to products that can enhance this image such as a car. Colour is one product attribute that elicits strong emotion and association (Karjaluoto *et al*. 2005, Tsai *et al*. 2006, Hsiao *et al*. 2008, Wu and Chen 2009). It may communicate complex information and symbolism, as well as simple messages. Automobile design is an area where colour seems to have fairly consistent associations. In western countries, black is a colour associated with status and sophistication like the black limousines used to carry national dignitaries.

### 2.2. *Applying the framework*

Understanding customer (affective) needs is the first step in the life cycle of product development (Khalid 2006, Norman 2010). Hence, a field survey was conducted to document customer citarasa needs in Europe and Asia, for further application by car designers in the field. Design of the survey tool considered the components in the citarasa/emotional intent theoretical framework (Figure 1). Questions were designed to measure sensory characteristics in terms of touch, visual, smell and auditory, functional requirements and needs for trends, status and style. Examples are given below for visceral, behavioural and reflective needs.

#### 2.2.1. *Visceral needs*

(1) Describe your feelings that you associate with these colours (A set of colours were given). What paint effect (e.g. matte, glossy, etc.) is good for each colour?
(2) Describe your favourite car shape (e.g. squarish, roundish, etc.).

#### 2.2.2. *Behavioural needs*

(1) What do you use your current car for mostly (e.g. drive to work, shopping with family, travel on holiday, etc.)?

(2) What are your functional requirements of a car (e.g. space, storage, speed, etc.)? How important are these requirements in considering your next purchase? How can the requirement be met in design?

#### 2.2.3. *Reflective needs*

(1) Why do you like the design (e.g. retro, trendy, futuristic, etc.)?
(2) Marketing advertisement usually describe a car using words like cute, cool, sexy. What do these words mean to you in terms of feeling? How do the words relate to car design elements? (A matrix showing the words and design elements, with examples as hints was provided).

In the next section, we describe the methodology for evaluating the emotional intent of both customers and designers.

## 3. Study objectives

There were two field studies. The first study was a survey of customers' affective needs that identified their emotional intent (citarasa) in car purchase. In the second study, we observed car designers applying affective criteria derived from the customers. The purpose of this study was to understand design practices and designer's emotional intent when given customers' affective needs.

## 4. Methodology

In general, the survey employed a questionnaire that was completed using probe interview technique similar to laddering (Chen *et al*. 2002, Helander and Khalid 2009), while the field study involved observation that was recorded on video, complemented with an interview using a checklist (Jobe and Mingay 1991, Wilson and Corlett 2005).

### 4.1. *Survey of car buyers' affective needs*

#### 4.1.1. *Purpose of study*

The purpose of this study was to provide customer information that can be used to conceptualise and define car components (e.g. dashboard) by a product design team using the citarasa information as input. To achieve this end, a field survey was employed, with probe elicitation interview to probe sufficiently the emotional intent of customers.

#### 4.1.2. *Location*

The survey was conducted in 10 locations, spanning two continents, Europe and Asia. In Europe, the survey was carried out in Finland, France, Germany, Greece, Italy, Sweden, Switzerland and UK. In Asia, the study covered Malaysia and Singapore. Given the coverage of countries in Europe, a range of customer tastes and lifestyles were identified. Customers from the target market were purposively selected to participate in the survey.

4.1.3. *Participants*

A sample of 177 respondents, representing car owners/drivers, was interviewed; 137 were from Europe and 42 were from Asia. Of these, 99 were male and 80 were female. The respondents were categorised into three age groups: 18–24 years ($n = 37$), 25–55 years ($n = 106$) and 56–65 years ($n = 34$). Subjects represented three car types: small/compact car ($n = 80$), family/mid-size car ($n = 78$), and luxury/sports car ($n = 19$).

4.1.4. *Equipment*

An open-ended questionnaire with 60 questions was used in the survey. It required detailed responses from the participant. There were also some close-ended questions relating to customer personal data and knowledge. The questions were driven by the citarasa model (Figure 1). There were four parts:

*Part I: customer experience and general needs* elicited customer experiences with the car, such as driving experience, previous experience, expected criteria, etc. The information was needed for the 'Marketing' section in the model, which focused on factors like price, customer segments, etc. Questions were designed to probe customers about cars driven currently and previously, and whether it constituted a good buy. To measure customer citarasa relating to visceral, behavioural and reflective design, questions measured sensory characteristics (tactile, visual, olfactory and auditory), functional requirements and needs for trends, status and style.

*Part II: specific requirements for design* measured affective and functional requirements of existing cars or shown images. The purpose was to generate a set of citarasa descriptors for developing the citarasa engineering database. Questions were referred to both exterior and interior requirements of cars, based on samples drawn mainly from the Consumer Reports 2007 Annual Car Reliability Survey, http://www.baileycar.com/CReliability.html and The Car Design Yearbook (Newbury 2006).

*Part III: customer expertise* evaluated customer knowledge, expertise, goals and affordance. This relates to the 'Design Goals, Constraints' and 'Marketing' aspects of the citarasa model. Questions include: how to obtain information on cars, how to decide it is a good car, etc.

*Part IV: customer demographics* obtained customer personal data, such as driving experience, handedness, living arrangement, education level, income, etc. The data collected in this part would be used to construct the 'Society' constraints in the model (Figure 1).

None of the questions recorded customer name or contact details, as the information remained anonymous. A pilot study was conducted to test the usability of the questionnaire. Questions that were found to be difficult, and/or ambiguously worded were modified. The results also identified potential answers that could be used for creating response categories.

4.1.5. *Procedure*

The interview was conducted by two persons – one person to conduct the interview in the target language, and the other to record the responses onto the soft/hard copy questionnaire. The interviewer applied the probe elicitation technique, following

Table 1. Feelings associated with specific colours.

| Colour | Europe | Asia |
|---|---|---|
| Maroon red | Happy/cheerful; sporty | Happy/cheerful |
| Navy blue | Calm/sober/peaceful; boring | Calm/sober/peaceful; boring |
| Lime green | Happy/cheerful; modern | Young |
| Black | Elegant; executive; cool | Elegant; executive; boring |
| Dove grey | Boring/dull; calm/sober | Boring/dull; common/ordinary |
| Beige | Boring/dull; old; calm | Boring/dull; modern; disgusting |



the why-why-why sequence (Chen *et al*. 2002, Helander and Khalid 2009). This allowed the interviewer to penetrate the reasons behind the answers.

The participants were first debriefed by the interviewers about the aims and contents of the questionnaire. In most cases, the participants completed the questionnaire using a paper copy, and in some cases they entered their responses directly into the laptop. The interviewers intervened to clarify only when requested. Answers in languages other than English were translated by the interviewers to English and recorded.

The interviews were conducted in various venues, from offices, shopping complex, to cafés. The duration of each interview ranged from 90 to 160 min.

#### 4.1.6. *Data analysis*

The survey data were analysed using SPSS 15.0 Text Analysis for Survey, and Microsoft Excel. First, the data from each country were screened for words that are in English only. If the data were found to be in another language, the interviewers were asked to translate the data into English. The data from all countries were then combined into a single Excel file. The statistical tests compared customer needs between Europe and Asia, and evaluated the significance of differences at the 5% probability level. The results were plotted as graphs, frequency and tables.

#### 4.1.7. *Results*

Table 1 presents the results of feelings associated with specific colours. The responses from European and Asian car owners were largely in agreement. For example, they agreed that 'maroon red' evoked a feeling of 'happiness/cheerfulness'. In addition, maroon red also evoked a feeling of 'sportiness' among European customers.

The participants were asked to describe design implications of words that were often used in advertisements, such as: cute, cool, sexy, and so forth. The results are summarised in Table 2.

Table 2 shows the feelings associated with each citarasa word. About 41% of the participants associated 'cute' with small/compact, while 12% associated it with girly/feminine. The 'cute' descriptor refers to visceral design. For 'elegant,' 15% associated it with luxury, and 11% with classy. These feelings concern reflective design, resulting from enhanced status and experience over the years. Similarly, for sporty, 27% associated it with fast/speedy, an attribute of behavioural design.

Although the terms used in Europe were somewhat similar to Asia, there was one large difference in the evaluations. In interpreting the car descriptors, people in Europe anthropomorphised the car design features by referring to the characteristics of the driver, such as: feminine, girly, youthful, young and old. Asians, however, gave a more neutral evaluation that referred to the design features of the vehicle.

Table 2. Evaluation of common affective car descriptors (several anthropomorphised design features in Europe are italicised).

| Affective car descriptors | Corresponding design features in Europe listed according to response frequency | Corresponding design features in Asia listed according to response frequency |
|---|---|---|
| Cute | Small, compact, *feminine,* sweet, attractive | Small, compact, round, bright |
| Cool | Trendy, modern, sporty, *youthful* | Sporty, modern |
| Sexy | Attractive, *girly, feminine*, desirable, no feeling, sporty | Red, sporty, no feeling |
| Trendy | Fashionable, modern, *young*, new | Modern, new, popular |
| Elegant | Luxurious, classic, sophisticated, *old,* timeless | Upper class, executive, luxurious |
| Sporty | Fast, speedy, aggressive, *young,* active | Powerful, *young,* small, low |
| Rugged | *Old*, positive, robust, solid, big, reliable | Big, jeep like, boxy, durable, high |
| Aggressive | Angry, fast, powerful, sporty | Sporty, powerful, load |

Table 3. Associations between affective car descriptors and car design elements (the two highest values in each row appeared in bold and italics).

| Affective Car Descriptors | Shape | Colour | Material | Sound | Size |
|---|---|---|---|---|---|
| Cute | ***0.66*** | ***0.30*** | 0.09 | 0.03 | 0.42 |
| Cool | ***0.50*** | ***0.46*** | 0.23 | 0.20 | 0.11 |
| Sexy | ***0.45*** | ***0.35*** | 0.13 | 0.15 | 0.08 |
| Trendy | ***0.41*** | ***0.48*** | 0.22 | 0.08 | 0.08 |
| Elegant | ***0.57*** | ***0.41*** | 0.36 | 0.11 | 0.28 |
| Sporty | ***0.54*** | 0.25 | 0.15 | ***0.33*** | 0.19 |
| Rugged | ***0.41*** | 0.13 | ***0.27*** | 0.22 | 0.31 |
| Aggressive | ***0.42*** | 0.30 | 0.10 | ***0.40*** | 0.23 |

Table 3 provides responses to associations of car descriptors to design elements. It can be seen from Table 3 that the strongest association is with the shape of the car. The *shape* of a car can be: cute, cool, sexy, trendy, elegant, sporty, rugged and aggressive. *Colours* can be selected to be: cute, cool, sexy, trendy, and elegant. The *sound* of a vehicle can be sporty and aggressive. The *material* of a car can be sporty.

Specific design features are attractive to customers. The results revealed that 26.9% of the car owners were attracted to the 'appearance,' 24.6% by the 'design' and 16.4% to the 'shape,' followed by colour, styling, car body, and dashboard. This suggests that customers tend to evaluate a car holistically.

### 4.2. *Field study of car designers' emotional intent*

#### 4.2.1. *Purpose and study design*

The purpose of this study was to document the extent to which affective car descriptors played a role in car design during the conceptual phase. The study was conducted in a real world car manufacturing plant to enhance ecological validity. It employed a one-shot case

study design. The 'instruction' to apply affective criteria in design was manipulated to compare the design outcome before and after. The assumption was that designers would arrive at different design solutions when given affective descriptors.

#### 4.2.2. *Location*

The study was conducted at Chang'an Motors in Chongping, Central China.

#### 4.2.3. *Participants*

Seven designers participated in the study, aged between 27 and 40 years (Mean = 31.43, SD = 5.32). There were five males and two females. All had bachelor degrees in different areas – two in industrial design, two in mechanical engineering and three in business and marketing. They have worked between 2 and 10 years (Mean = 5, SD = 2.94). The first design team comprised three designers, while the other team had four designers. The team was made up of an engineering design manager, a product planner, a lead stylist, an engineering designer, a manager of product planning and a product marketer. Hence, they represented the various skills that are typical of a concurrent engineering design team, and are subject matter experts in their respective expertise. Some of them had worked together in a team. They were paid $100 each for their 4 h participation in this study.

#### 4.2.4. *Equipment*

The design tasks were recorded on video and detailed notes were made to complement the video. Interviews were then conducted using a questionnaire that contained open-ended and close-ended questions. The affective descriptors derived from the customer survey were given to the designers in the instructed task condition.

#### 4.2.5. *Procedure*

Participants were contacted via email and phone; they were first asked to explain their job responsibilities and the procedures they used in car design prior to performing the design tasks. Below is an excerpt from the instructions that stated some constraints (in bold):

> *Recently your company has studied the new trends and opportunities for the* ***Asian market*** *and has decided to develop a new product for* ***young adults*** *who are going to buy their first car. They want a modern car with* ***state-of-the-art safety features*** *and also* ***within their budget****. Your team has been involved in developing the interior of the new car. Your company wants your team to set the product features of the* ***dashboard****. Your team needs to expand the market requirements of the dashboard based on your experience and expertise. The dashboard features should be in accordance with your company's background. Your team needs to list down all considerations in the planning process.*

There were two design tasks:

- *Task 1*: Plan and design a dashboard for an automobile.
- *Task 2*: Plan and design a dashboard considering customers' affective requirements. In this task, the designers were given results from the CATER project (Khalid *et al*. 2007) including data and pictures for car dashboard design.

#### 4.2.6. *Results*

There was agreement among participants on the procedure applied in car design. They identified a four-stage sequential product development process, which was used by the

Table 4. DRs and design outcomes for a conventional dashboard for Group 1 designers.

| Customer segment groups (DR) | Practical and economic | User-friendly | Performance and fashion | Brand and luxury |
|---|---|---|---|---|
| Styling | Simple | Technology | Fashion | Luxury |
| Airbag | One airbag | Dual airbag | Dual airbag | Dual airbag |
| Centre console | CD/MP3 player | Multi-CD/MP3 player | USB, MP3 CD/DVD player | USB MP3 comp. CD/DVD, Bluetooth |
| Aircon | Normal | Automatic | Automatic | Constant temperature |
| Control | None | ECU | ECU | ECU |
| Steering wheel | Normal | Entertainment system button | Entertainment system button | Entertainment system Bluetooth |
| Dashboard material | Plastic | PVC | PVC | PVC/TPO thermoplastic olefin |
| Colour | Original | Silver colour | Silver colour | Wooden laminate |
| Dash receiver | Manual | Semi-automatic | Semi-automatic | Semi-automatic |
| Tool box | Plastic | Light damping | Light damping | Light damping |

company and also in the current study: product planning, engineering design, production and product launch and sale. We will discuss the results of Group 1 and Group 2 separately.

### 4.3. *Group 1 design team*

#### 4.3.1. *Task 1. Plan and design a dashboard for an automobile*

In order to analyse the requirements of different customers, the team used customer segmentation. The segmentation was based on: age, occupation, income, preferences, family, context of use, purchasing capability, interest and personality. Several potential sources of customer satisfaction with product design were analysed. The main issues were: form, style, function, layout, material and colour.

Four customer segments were identified: (1). practical economic, (2). user-friendly, (3). performance and fashion and (4). brand and luxury (Table 4).

#### 4.3.2. *Task 2. Plan and design a dashboard considering customers' affective requirements*

In this task, the team was asked to incorporate affective design elements in the dashboard design. They highlighted four affective design strategies: simplicity, high-tech, fashion and luxury.

- *Simplicity*: has no direct relationship to price; a luxury car design can be simple.
  - line is the major formation of shape: smooth and streamlined design;
  - easy to control, user friendly design;
  - simple and elegant colour; and
  - simple and clean layout.
- *High-tech:* is mainly reflected by colour, design, function and layout.
  - black, grey or silver colour, with metallic trim;
  - round shaped air-condition vent; and
  - layout of controls or buttons is a bit complicated.

Table 5. Design outcomes for an affective dashboard for Group 1 designers.

| Customer Segment Groups | Economic and practical | User-friendly control | Performance fashionable | Brand and luxury |
|---|---|---|---|---|
| Steering wheel | Four-spoke | Four-spoke<br>Metallic<br>Integrated cruise control | Four-spoke<br>Metallic<br>Integrated cruise control | Four-spoke<br>Metallic<br>Integrated cruise control<br>Quality leather |
| Panel | Simple | Technological | Fashionable | Luxury |
| Air-condition vent | Square | Rounded | Rounded | Square |
| Colour theme | Original colour | Silver colour theme, metallic texture | Silver colour theme | Wooden texture theme |
| Centre console | CD player | DVD few controls | DVD many controls | DVD, GPS, touch screen |
| Control type | Knob dial | Knob dial | Press button | Press button |

- *Fashionable*: use trendy design which reflects mainstream needs.
- *Luxurious*: can take several forms.
  - classic and elegant design;
  - high quality material: genuine leather, wooden trims, metal accents, polished; and
  - high capability, spacious.

The team retained the Customer Segments Groups that had been identified for task 1. The outcome of the Affective Design Task is shown in Table 5.

In going from normative to affective design, there were several changes.

(1) *Shape of air-conditioning vents*: from square to rounded, square vent gives the feeling of practical, simple and classic, while rounded shape is more sporty and trendy;
(2) *Control type*: from knobs to buttons – standardised control;
(3) *Steering wheel*: from four-spoke to two-spoke, trendy design; and
(4) *Dashboard shape*: more solid feel.

### 4.4. *Group 2 design team*

#### 4.4.1. *Task 1: Plan and design a dashboard for an automobile*

The team identified three customer segments: fashionable, practical and middle class. Design requirements (DRs) and design outcome for Group 2 designers are given in Table 6.

#### 4.4.2. *Task 2: Plan and design a dashboard considering customers' affective requirement*

Group 2 used several drawings to illustrate design changes. An example is illustrated in Figure 2. The differences in design practice, from normative to affective design, are summarised in Table 7.

To understand what 'fashion' represents, the designers noted that they needed to gather designers and customers together to discuss a common image or concept; fashion

Table 6. DRs and design outcome for Group 2.

| Customer segment groups | Fashionable | Practical | Middle class |
|---|---|---|---|
| DR1: styling | Trendy, cool design | Traditional | Quality |
| DR2: instrument panel location | Centre | Centre | – |
| DR3: display | Digital metre | Analogue metre | Analogue metre |
| DR4: colour theme | Colourful | – | – |
| DR5: audio device | CD/MP3 player | CD player | CD/DVD player<br>High quality |
| DR5: air-condition | Simple, basic | Mainstreamed | High quality |
| DR1: dashboard material | – | Durable | High quality |
| Other design | – | Spacious | Spacious |
| DR3: accessories | None | None | GPS |

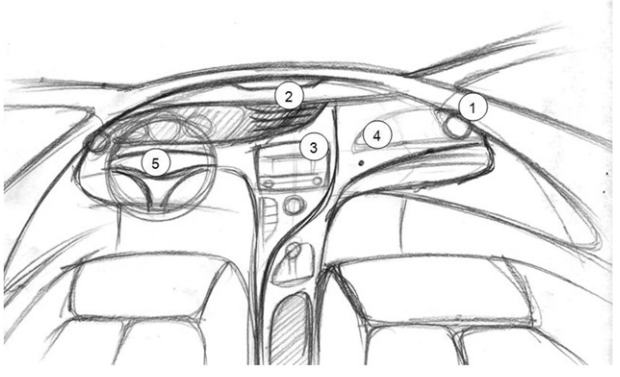


Figure 2. Design for Group 2 'fashionable'.

cannot be defined by either part alone. They noted that the current trend for dashboard design was dark colour (black) or single colour theme. Black gives a cool impression and was becoming popular in car interior design; black colour should have metallic lustre; and it should not be monotone black.

### 4.5. *Post-task interview result*

#### 4.5.1. *Opinions about the affective design framework*

The designers agreed that it is important to consider customer's affective and emotional requirements in product planning and development. They regarded this approach as an 'innovative and promising' trend in car design. They also pointed out that many customers are becoming more demanding, and they voice their preference for customised and personalised products. By utilising knowledge of customers' affective needs, they claimed that customer satisfaction may be enhanced.

Understanding affective design was also important to designers. However, they felt that introducing affective design strategies may be too early for China. While they have considered some aspects of affective design, due to the diversity of customer affective

Table 7. Design changes going from phase 1 (normative) to phase 2 (affective).

| |
|---|
| 1. Extend original dashboard to side doors |
| 2. Use air-condition with invisible/hidden vents, and constant temperature control |
| 3. Use central touch screen LCD display to control air-condition, temperature, calendar, etc. |
| 4. Add a dash top on passenger's dashboard: for working, resting and eating |
| 5. Change steering wheel from four-spoke to three-spoke |



requirements, it was difficult to implement. Moreover, to achieve affective design, the concept must be accepted at the management and design level – from engineers to stylists.

Despite these constraints, the automotive manufacturers acknowledged that the proposed framework was 'novel and useful'. Both design groups would definitely consider the citarasa model in future developments. This entails an understanding of the emotional intent of customers, the identification of emotional intent and the corresponding design features.

#### 4.5.2. *Affective requirements in design*

To consider customer's affective requirements in design, the product planning team emphasised four perspectives: (1) customer's aesthetic perception; (2) functional needs; (3) user-centred design; and (4) trade-offs in design. The incorporation of affective design features can increase cost and effort. However, personalisation has already been considered by customers, although it carries a higher price. Designers need to guide customers to consider affective/emotional needs and help them to prioritise among requirements. It may be impossible to satisfy all customer requirements, and trade-off decisions in design are used to compromise.

## 5. Discussion

### 5.1. *Emotional needs of car buyers*

Overall, across Europe and Asia, specific citarasa descriptor holds various meanings to car customers, as summarised in Table 8.

The findings from the survey suggest that design of vehicles must be tailored to the affective needs of the market segments, and there is no such a thing as a generic template that 'one citarasa fits all'. On the basis of the data, it is possible to create a customer affective needs database that can be exploited in product planning (Khalid *et al.* 2011).

### 5.2. *Emotional intent of car designers*

In relation to Figure 1, car designers were driven to consider affective criteria at the visceral, behavioural and reflective levels.

#### 5.2.1. *Visceral design*

At the visceral (visual) level of design, both groups made changes to enhance aesthetic appeal. The curvy and streamlined dashboard in Group 2 fits the needs for fashionable

Table 8. Citarasa semantics of cars.

| Affective descriptors | Semantics (meanings) |
|---|---|
| Cute | Small, compact, girly, feminine, round, sweet, nice, mini, attractive, funny, young, bright, pleasant, happy |
| Cool | Sporty, trendy, modern, young, youthful, fashion, unique, cool, stylish, elegant, sleek, funny, nice, small, high class, black |
| Sexy | Attractive, no-feeling, girly, feminine, red, sporty, black, desirable, curvy, convertible, cabriolet, nice, appealing |
| Trendy | Fashionable, modern, current, young, youthful, new, latest, cool, sporty, popular, positive |
| Elegant | Luxurious, high class, classy, sophisticated, executive, old, timeless, classic, serious, stylish, positive, business, beautiful, dark, fashionable |
| Sporty | Fast, speedy, young, youthful, aggressive, active, powerful, agile, low, racing, small, compact, convertible, cabriolet, dynamic, exciting |
| Rugged | Big, huge, old, robust, squarish, boxy, jeep, positive, high, rough, reliable, tough, durable, strong |
| Aggressive | Sporty, angry, powerful, fast, loud, red, mean, strong, muscular, nasty, pushy, young |



design. Group 1 proposed a three-dimensional dashboard, which would improve the aesthetic quality of the car.

Both groups changed the design of air-condition vent. The vent in Group 1 was square and flat and it became round with depth – a sporty and affective style. Group 2 made the vent invisible. This was definitely innovative and created a seamless aesthetic finish. The invisible vent would however not satisfy needs for behavioural design, since it cannot be manipulated. The steering wheel was redesigned by both groups. The traditional four-spoke was replaced by three-spoke in Group 1 and two-spoke in Group 2. This made the steering wheels fashionable. They were also covered with leather, which provided a great touch sensation and comfort and improved manipulation and holding. Both the styling and the leather improved impressions.

Colour is an important design element that affects aesthetics and overall visual pleasantness. It is also one of the easiest design features to customise (Crilly *et al*. 2009). Both groups preferred dark colour. Designers from Group 1 used a two-tone theme – black colour for upper part of the dashboard and a lighter colour for the lower part. This provided an interesting contrast and a fashionable design. Group 2 designers proposed a monotone black dashboard, which they associated with cool and fashionable design. The selection of colour is important for emotion and affect in automobile design; Dark colour also satisfies safety requirements, since it minimises reflections.

#### 5.2.2. *Behavioural design*

Behavioural design has to do with pleasure/satisfaction in manipulating objects – such as a joystick or a keyboard. To identify behavioural design modifications, the designers tried to adjust their designer's mental model to a customer's mental model. Partly guided by the new outlook, they added a 'dash top' to the passenger's dashboard. This considered the customer's needs for a flat surface, which can be used for resting, working and eating and taking a nap.

To prevent driver errors, Group 1 designers located the cruise control and the entertainment control on the steering wheel. This arrangement minimised movements and may increase safety, since the driver can keep his hands on the steering wheel. They also standardised control types to button, which increase the consistency of the design. However, the appropriateness of using buttons instead of knobs can be questioned, since knobs may induce more affect (Swindells *et al.* 2007).

Group 2 designers replaced the original centre console with a touch screen LCD display, which simplified monitoring and control. The display integrated much information, including temperature inside/outside, calendar and radio. The calendar could be programmed to fit various cultural and social preferences. These are examples of a human-centred approach with good behavioural design.

#### 5.2.3. *Reflective design*

Some design can enhance socioeconomic status and self-image. In this study, both groups designed dashboards with fashionable and functional features, which can portray the social background (age group, lifestyles and economic status) of a customer group.

Many product design features can be perceived as 'social accessories' (Jordan 1998). Examples are: leather for steering wheel and black colour. Customers may want to purchase a product which defines their social image. For example, people who drive a sports car may be perceived as fun, and risk-taking. Group 2 designers thought that the air-condition vent represents a service that is taken for granted and it can therefore be hidden. However, a multifunctional dash top and programmable lunar calendar fit the Chinese culture and should be displayed. Such features represent a cultural adaptation and can create a bonding between driver and passengers.

## 6. Conclusion

The proposed citarasa (emotional intent) framework can enhance affective design as the results of the field study among designers showed significant design improvements. Their design outcome clearly identified three aspects of affective needs, namely, visceral, behavioural and reflective.

Due to company strategies, some designers felt that the proposed framework could be difficult to implement in the new product development process. One concern was that the affective needs can vary over time. In addition, the method might not be practical to use for China market at present. However, with increased customer sophistication, there may be a greater market for personalisation in mass customisation of cars.

Effective utilisation of the citarasa framework also depends on the acceptance of designers, stylists and engineers. To minimise gaps between customer perception and designer's design, automotive companies should guide customers in understanding affective design through advertisement and promoting a series of designs so that they have a clear idea of the current trend, and how it can be adapted to fit individual needs. Our field study revealed that the greatest support for affective design came from product planners who have a broader outlook on new trends than engineers and designers.

This investigation was an exploratory field study; therefore, there were many unknown parameters that could not be manipulated like in experimental studies. As such, it is not possible to draw firm conclusions from the results, but the results have ecological validity as it involved professional car designers who are usually difficult to access. Future work may propose an extension of experimental research to evaluate the effectiveness of

affective design factors. To maintain ecological validity, it is critical to involve real car designers. A combination of subjective and objective methods may be used. For a complete review of methods in affective design, see Helander and Khalid (2012).

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### Relevance to ergonomics study

Official definitions of human factors/ergonomics have yet to incorporate affective design criteria that can complement current design goals. The citarasa/emotional intent concept contributes towards user evaluation of affective design. Therefore, human factors design process such as EQUID (IEA 2009) should consider affective design criteria in defining an ergonomically designed product.