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# KANSEI CULTURAL RESEARCH ON PRODUCT AND COLOUR PERCEPTION

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*Resume: This paper has been written as a part of a collaboration between Toyota Motor Europe (TME) and the LCPI (Design Product Laboratory and Innovation) of the Engineering school Arts et Metiers Paristech. This paper is a brief overview of the final master thesis led in this industrial context which focuses on the influence of colours on the product perception. The second focus of this research is done on the cultural aspects of the user: how much does it influence the perception? By answering these questions, our hope is to create an accurate tool for colour choices in early design.*

*Keywords: Culture, product perception, colour perception, product design, colour effects*

## 1 INTRODUCTION

Nowadays, product design companies face three challenges. First, the individual customer's affective needs for a product have become more and more important: consumers are now looking forward to have more emotional products and expect a pleasurable aesthetic experience. Second, the market has become more and more competitive, and products with equivalent functionalities have begun to emerge. Third, with nowadays globalisation, companies have to design for several countries, which are culturally different. Then, for designers, it is important to design products that will « fit » the expectations of the different culture users and that will attract the customer.
In this research, a special focus will be done on the colour of a product as a determinant of its personality and perception, taking into account the specific values of a culture.
Few researches have been done on the aesthetic experience of a user experience with a product. Then, this research also has for purpose to highlight how a designer can attract a consumer by designing a product that will emotionally appeal the user through the colour.
This paper will be composed by a state of the art that will explore the main topics of this thesis research: the user experience, le colour and the user-centred design. Based on this, a research problem is proposed with hypothesis to solve it. A methodology to validate all the hypothesis is then explained as well as the expected results.

## 2 STATE OF THE ART AND RESEARCH OBJECTIVES

### *2.1 State of the art*

In this state of the art, a first focus is done on user experience for several reasons. One of them is from this project point of view: the customer is studied as well as the product, which are the two main actors in user experiences framework. Another one is about the industrial context of this study: the Kansei Design department of TME is dedicated to this subject. Then, it was interesting and relevant to start from the user experience for this state of the art. The second topic of this state of the art is the colour. Finally, the topic of user-centred design will be explored as our intention is to create a tool for early design, which will fit customer's preferences, expectations and culture.

### *2.1.1 User experience*

According to the standard of human-centred design for interactive system, a user experience is a person's perceptions and responses resulting from the use and/or anticipated use of a product, system or service. This definition highlights a first interesting point which includes all the user's responses, from its belief to its psychological responses. This response also depends on the user's internal and physical state resulting from prior experiences, attitude, skills and personality (ISO9241-210, 2010). Based on this definition, two topics will be explored: the user and the product.

#### 2.1.1.1 The user

A user can be define as the person using or interacting with the product. In user experience frameworks, the user and its reaction to the product are always describe with multiple dimensions. In the literature, some authors defined the user by its values, cognition and affection, needs, motivations and expectations and finally by its personality traits (Ortiz & Aurisicchio, 2011). Focusing on the consumer response to the visual domain in product design, another research showed that the consumer response is separated in three : the cognitive response which includes the aesthetic impression, the semantic interpretation, and the symbolic association(Crilly, Moultrie, & Clarkson, 2004). The two other responses are the affective one and the behavioral one which are both influenced by culture and situational factors. In a simpler way, Desmet and al also describe the consumer response by three elements : the experience of meaning, the emotional experience and the aesthetic experience (Desmet, Hekkert, & Hillen, 2004). Figure 1 is resuming the different dimensions described in all the models cited:

| | Ortiz and Aurisicchio | Crilly et al | Desmet and Hekkert |
|---|---|---|---|
| Dimensions of the user or user experience | Values<br>Cognition<br>Affection<br>Needs<br>Motivations<br>Expectations<br>Personality traits | Cognitive response :<br>- Aesthetic impression<br>- Semantic interpretation<br>- Symbolic association<br><br>Semantic interpretation and Symbolic association influenced by culture and situational factors | The experience of meaning<br>The emotional experience<br>The aesthetic experience |

***Figure 1: Dimensions of the user or user experience***

The design Map Space is the model of user experience developed within the Kansei Design at Toyota by Alexandre Gentner and Theo Mahut (Gentner, 2010) (Mahut, 2014). Based on the model of Ortiz Nicolas and Aurisicchio, this model can be explained by its two axes. The horizontal one is about the user and the product and the vertical one separates the concrete from the abstract. All the dimensions in the above table have been taken into account and classified in the Design Map Space.

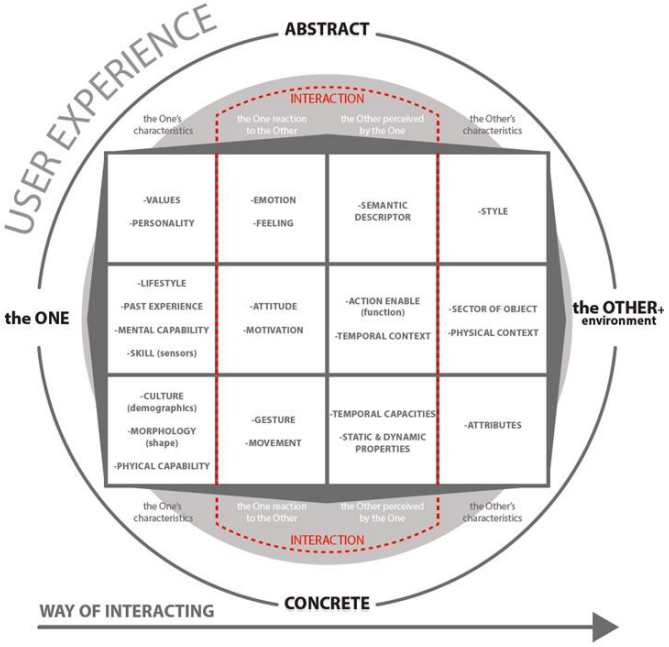


***Figure 2: the Design Map Space***

Based on this model, we supposed that to create the most accurate global tool to help colour decisions in early design, it is important to consider all these dimensions in our study. Then, it is important to define what model or what corpus of words to choose to study all the dimensions. Below is a brief overview of the different existing model which have been taken into consideration while thinking about the methodology to create our tool.

**Values**

Many models of values exist and one of them is one from Rokeach (Rokeach, 1973). This model is composed by 36 values, split in half. 18 of them are terminal values which refer to desirable end states of existence or goals that a person would like to achieve during his or her lifetime. The other 18 values refer to preferable mode of behaviour or how the terminal values can be achieved. The Rokeach Value Survey (RVS) ask the participants to order the values by their importance in their life. Another model is the Schwartz Value Survey (SVS) (Schwartz, 1995) which defines ten basic values and describes the dynamic relations amongst them.

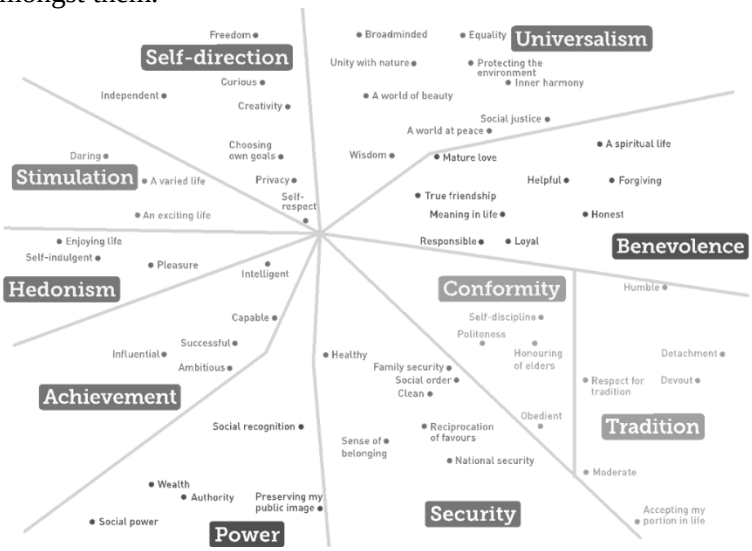


***Figure 2: Schwartz Value Survey***

On this map, some antagonisms or compatibility can be seen. For example, achievement values can be in conflict with the benevolence values. In further studies, Schwartz also defined a model with seven cultural values, where a relation with the individual values is made. Another model of values can also be described as it is a very used one: the Hofstede model (Hofstede, 1991) which splits the culture in 5 dimensions: long/short term orientation, Masculinity/Feminity, Individualism, Uncertainty avoidance and Power Distance Index. For Hofstede, culture is a part of a mental programming and is always a collective phenomenon, shared by people who lives or lived in the same social environment, even if everyone has its own way of thinking, resulting of a continuous learning. Culture has to be distinguished from the human nature and from the individual personality. Based on this, Hofstede defines three levels for a person:

- Personality: unique to each person inherited and acquired
- Culture: specific to one group or one category and always acquired
- Human Nature: universal and unherited

**Emotions**

As the values, the emotions have long been theorised. Below are presented some models which have been taken into consideration during our study.

The Plutchik model (Plutchik, 1980) is interesting in a way that it shows some intensity levels. The eight primary emotions are situated in the second inner circle, and are all declined in their highest and lowest intensity form. More, Plutchik described some blends between primary emotions. For example, anticipation and joy equals optimism. This model is interesting for this intensity scale as we can easily imagine that product won't elicit strong emotions while seeing them.

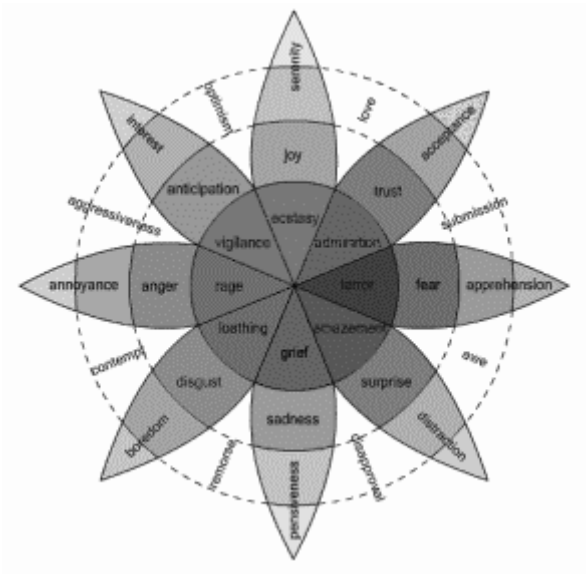


***Figure 3: Plutchik model***

For the prEmo tool development, Desmet chose emotions which were elicited by product appearance and classified them into two axes: pleasant/unpleasant, high activation/low activation. (Desmet, 2002). This led to a number of 41 emotions divided in six categories: unpleasant-excited, unpleasant-average, unpleasant-calm, pleasant excited, pleasant average, pleasant-calm. The final tool of PrEmo, after validation is made of 14 emotions, 7 which are positive and the other seven which are positive. Desmet's model is an interesting one as the emotions are already chosen in order to mesure the emotional impact of products.

The Geneva emotion wheel should also be cited in this state of the art, as it represents the most exhaustive model of emotions, mapped in four axes: active-aroused/passive-calm, positive/negative, high power-control/low power-control, conducive/obstructive. (Scherer, 2005)

#### 2.1.1.2 The product

According to Ortiz&Aurisicchio, a product is an artefact with either aesthetics, social or technical functions. However, more than functions, the product carries on some symbols for the user who is buying it, and can represent the user. For Crilly et al, this is the symbolic association of which means that products can carry and communicate symbolic meanings (McCracken, 1986). These meanings can be a key determinant for the product selection as the symbolic association is determined by what the product is seen to symbolise about its user, or the socio-cultural context of use (Crilly, Moultrie, & Clarkson, 2004). Products may evoke thought, feelings and allow persons to communicate their identity and even to express social status (Creusen & Schoormans, 2005). For other authors, it refers to what they call the product personality. The concept of product personality fits in the tradition of symbolic consumption, have symbolic values and cultural meanings. The concept of product personality refers to the profile of human personality traits that people use to describe a product variant (Govers P. C., 2004). Product personality is an overall description of a single product and is strongly influenced by a product's appearance. What we mean about appearance is all the products characteristics that people can perceive by looking at products. Product appearance is a major determinant of product personality because people will get an idea about the personality of the product just by a casual glance of the product (Govers, Hekkert, & Schoormans, 2002) (Mugge, Govers, & Schoormans, The development and testing of a product personality scale, 2009). More, Creusen (Creusen M. , 1998) showed that affective responses to product appearance influence purchase decisions. According to Desmet et al (Desmet, Ortiz Nicolas and Schoormans, 2008) the effect of appearance on personality is more powerful than the effect of dynamic interaction.

### *2.1.2 Colours*

As seen just above, the product appearance of a product is a major determinant for purchase decisions. Then in this part of this state of the art dedicated to colours, it seemed important to justify the importance of the colour, and then to explore the colour with the different parameters of this study: the product and the automotive in particular and the culture.

#### 2.1.2.1 Importance of colours while designing product

Studies showed that colour was the most important factor catching the consumer's eye (Satake, et al., 2011). More, in a study using an user-oriented design approach to transform users' perception into product elements, results showed that product colours are more influential than product form. What has also been shown is that all product forms are not suitable for any colours. (Lai, Lin, Yeh, & Wei, 2006)

#### 2.1.2.2 Context of colours and colour appropriateness

Many studies have shown the importance of the context while studying colours. The colour context is linked to the support of the colour (objects, walls, cars etc.) and also to the environment surrounding the colour (landscapes, luminosity etc.). More, colours perception and then preferences are dependant of very simple things like shapes. Indeed, study results showed that colour preferences and shapes preferences are correlated (Chen & Tanaka, 2015). Talking about objects, a Berkeley project showed contextless colours preferences differs from favourite colour for particular artefacts. (Holmes & Buchanan, 1984). For instance, they found that people never reported "brown" as their contextless favourite colours but brown is reported as being one of the most appreciated colours for carpets and sofas. As seen, the context is very important for the colour perception, but more than the context, even the product category is important. According to Hanss and Bohm, colour appropriateness differs as a function of object type (Hanss & Bohm, 2012).In their hypothesis which have been confirmed by the study experiment, the affective qualities that people ascribe to colours as well as to the products create a match between colour and product. The better is the match, the higher we expect the appropriateness of the colour to be. Results of this study revealed that colours that are car specific, regarding the affective qualities of both car and colours.

Findings suggest that product colours appropriateness differs as a function of product category. Grossman and Wisenblit supposed that the colour appropriateness may have its origins in associations that people learn from combinations of colours and their culture-specific meanings. (Grossman & Wisenblit, 1999). Manav, worked on the determinant of colour appropriateness for resident wall paints. Finds showed that people consider light blue colours to be most appropriate for the living room and that the affective qualities assigned to light blue colours (relaxing, calming, peaceful and modern) resembled the desire atmosphere in the living room. (Manav, 2007) On the same topic, Doyle and Bottomley investigated the determinant of the perceived appropriateness of fonts for describing different product types. Their results indicate that the perceived appropriateness of fonts for products partly depends on the congruity between the affective qualities of the font and those of the products.

#### 2.1.2.3 Colours in the automotive context

Concerning cars, some studies have also been done. As previously mentioned, there is a difference between contextless colour preferences and colours on cars (Saito, 1996). Results of the same study showed that colour preferences are influenced by the shape and segment of an automotive. Also, other studies showed that colour preferences in the automotive context is dependant of many factors: the car type or segment, the gender, the culture and the geographical area of residence. The Japan research color institute has surveyed favourite colours for a sedan and a mini vehicle. Results showed the dependence of favourite colours on car category, with black being the favourite colour for a sedan and vivid red for a mini vehicle. Palmer&Schloss (Schloss, Strauss, & Palmer, 2012) also found striking differences: the most preferred colour for a luxury sedan were achromatic, consistent with their conventional formality as serious, sophisticated cars, whereas colour preferences for a VW bug tended towards brighter, warmer, more saturated colours, consistent with their conventional informality as fun, sporty cars. (Schloss, Strauss, & Palmer, 2012). In Saito study, a relation between colour preference and subject lifestyle has also been shown. Results of the survey demonstrated that colour preference could be influenced by difference of age, gender and geographical area of residence.

#### 2.1.2.4 Culture and colours

Culture is an important determinant of the interpretations that consumers give and the associations they have with certain factors of a product's appearance (Creusen & Schoormans, 2005).

According to Satake study, there may be various reasons for differences in colour preferences, but the two main factors which should be considered are the sex differences and the characteristics of colour emotions for each countries (Satake, et al., 2011). Study showed that colour tastes for automotive exteriors depends on various factor, including environments and traditional colours emotions. In the same study, a sensory profile of an automotive has been done and the result is that the image of an automotive is different depending on the countries.

Many studies had for interest the difference of colours preferences, colour emotions, colour combinations across the world. (Ou et al, 2004, 2005, 2012). What appears is that responses are consistent all over the cultures for scales like warm/cool, heavy/light but not for the scale like/dislike which refers to emotions.

Another study showed some significant cultural differences in observer responses to colours in both semantic and affective terms. Consistent responses across cultures for warm/cool, heavy/light and active/passive dimensions are showed whereas there is a strong effect of culture for the like/dislike response (Ou and Luo, 2012).

### *2.1.3 User-centred design*

Our intention is to create a tool to help the colour choices in early design, taking many factors into account: the customer preferences, expectations and culture. This approach is a user-centred design one, as it considers the end-user's needs within the design process and development. Then, it was interesting to dedicate this last part of the state of the art to some existing user-centred methodologies.

#### 2.1.3.1 Emotional design

People differ with respect to their emotional responses towards a given product. More interesting than to know which particular emotions are evoked by a product, is to understand why it evokes these particular emotions. Then, theorical propositions about how these emotional responses are related to the product's appearance and the characteristics of the person who experiences the emotions. Desmet, (2002) proposed a general model of product emotions that sets three main parameters: appraisal, concern, stimulus (product).

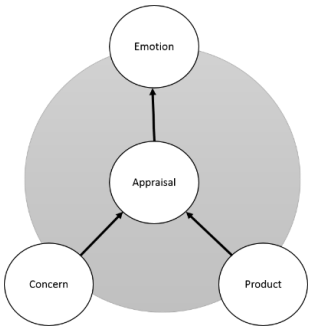


***Figure 4: Desmet general model of product emotion***

Figure 4 shows that an emotion is triggered by an appraisal which is also triggered by a concern. Then, Desmet considered that an emotion is triggered by a human concern. Designers should then be aware of the concerns of the users for whom they are designing products. According to this, culture, personal values and expectations should be some parameters to take into account while designing products. Some studies have been done on theses parameters. Desmet et al (2008) found a correlation between personal life values (like security, challenge and family life) and emotional responses elicited by automotive design and differences in emotional responses both between and within culture. In the flow of theses researches

#### 2.1.3.2 Designing product personality

Product personality, as said before, means that products carry some values and cultural meanings. Then, designers can create a predetermined product personality that consumers can recognize as there is a relation between product personality and product appearance. Designers use the relation between impression and appearance by manipulating the product appearance.

According to Janlert and Stolterman (Janlert & Stolterman, 1997), people use their association based on person perception as an analogy for their perception of products and they use product personality as a cue for evaluating functional attributes that are difficult or even impossible to verify (Mugge, 2011). More, like human personality, product personality is assumed to be relatively stable over time and literature suggests that people may use products to express a consistent and positive view of themselves. Govers showed that it was possible to design products with pre-determined personality. In this study, design students have been asked to design some happy or cute irons and results showed that these objects have been assessed afterwards as cute and happy (Govers, 2002). More, Ortiz Nicolas and Desmet worked on the personality of product through the interaction, and results shows that it is possible to convey a personality trough an interaction. Following these studies, it is possible to assume that there is a contribution of product personality in product design and that this should be further explored.

#### 2.1.3.3Kansei design

Prior to Kansei Design has been developed the Kansei Engineering (KE) which had for purpose to translate the measured Kansei of users into a design (Schutte S. , 2005) (Lokman, 2010). Kansei engineering was a method developed to find relationships between product experience and product properties, in order to use these properties to design products that elicit desired experiences (Schutte, Eklund, Ishihara, & Nagamachi, 2008).

This method implies to analyse consumer's implicit needs and to associate these needs with product design attributes. KE, since its creation, has been developed as a productive research discipline, connected to the industrial world. The design of the Mazda Miata (Nagamachi, 1995) is known to be the first and most famous project based on KE.

Since KE, a whole discipline has emerged, which can be called Kansei Design. Kansei design can be split into two groups (Levy, 2013). The first group focuses on the physical materiality of artefacts and their evaluation or preference by the user and the second group focuses on the interactive materiality of artefacts. The aim of KD is to focus on subjectivity, on people believes, dreams, culture, notion of beauty and to comprehend the phenomena of perception and experience. By exploring the user experience, the colour which is a very subjective phenomena and the culture, this study adhere the philosophy of the Kansei Design.

### *2.2 Research problem*

As part of Arts et Metiers ParisTech, the Product Design and Innovation Laboratory is specialized in the field of industrial engineering. The LCPI is promoting a multidisciplinary approach of the design process, by developing methodologies and new tools to help this whole process of designing products. In this way, Kansei Design, by bringing the user experience into earlier steps of design, is completely in the scope of LCPI's studies. To put this master thesis research in the scientific context of the LCPI, it is important to locate it in time in the whole process of product design. According to Bouchard, (Bouchard & Aoussat, 2002), design process can be based on the three phases: generation, information and evaluation-decision phase. By the industrial context of this master thesis, this study is situated in the third phase: decision-evaluation phase as we are trying to answer this research problem:

How to create a tool that will help the colour choice in early design for different countries?

### *2.3 Hypothesis*

From the Design map space (Figure 2) point of view, this study has for aim to define some links between several user experience dimensions:

1. If the culture (demographics) is changing, how does it influence the values, the emotions/feelings and semantic descriptor?
2. If the attribute (colour) or the product is changing , how does it influence the semantic descriptor and emotions/feelings?

Applied to our study, these links lead us to three hypothesis:

***H1: Culture influences product and colour perception***
***H2: Colours, effects of the colour and proportion of the colours influence product perception***
***H3: By knowing product expectations, it is possible to anticipate user colour preferences***

# 3 EXPERIMENTATION

## *3.1 Experiment overview*

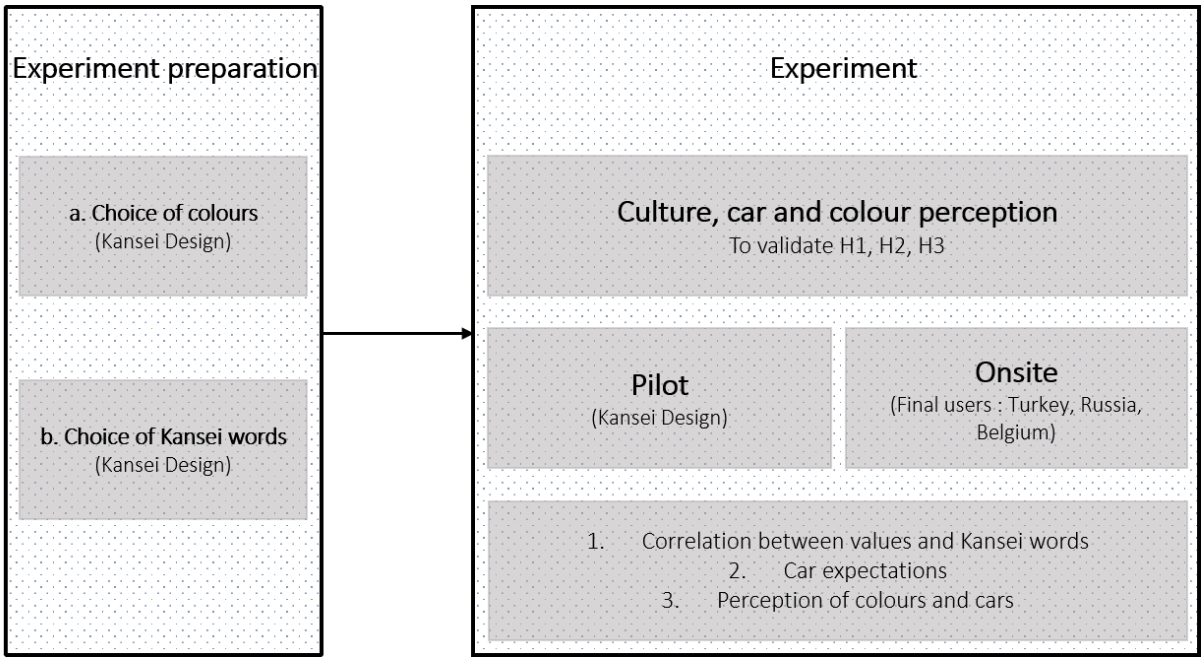


**Figure 5: Experiment overview**

Figure 5 is an overview of the methodology used to validate all the hypothesis. For this paper, a focus will be done on the experiment 1, as all the hypothesis are validated at that one. Even if not explored in this paper, the experiment preparation step has not been neglected as it determined input data for experiment 1.

## *3.2 Experiment*

### *3.2.1 General objective*

There are several objectives in this experiment:

1. The first one is to correlate the Kansei words with the Schwartz values
2. The second one is to learn about car expectations according to the countries and also to know more about the values of individuals.
3. The third one is to know more about the car expectations
4. The last one is to understand the colour and the car perceptions

### *3.2.2 Input data of the experiment*

The chosen model of values is the Schwartz one as it is mapped and easy to read. Kansei words are also an important data, as it represents all the words used to describe the colour and the car perception.
The Kansei words is a list of 20 words, chosen among the different model of emotions, personality traits, semantic and sensory words. Below is the table with all the used words:

| | | | | |
|---|---|---|---|---|
| Classical | Inventive | Elegant-refined | Nervous | Energetic |
| Sporty | Cold | Efficient | Powerful | Premium |
| Robust | Aggressive | Serious | Authentic | Fun, amusing |
| Warm | Serenity | Trust | Retro | Joy |

**Figure 6: Kansei words list**

Ten words are semantic words, four are emotions, another four are personality traits, and there is finally 2 words of related to sensory criteria.

#### 3.2.2.1 Colours stimuli

Twelve colours have been chosen among existing Toyota colours. Only blues and reds have been chosen as they are the most sold colours after white, black and grey. (Axalta C. S., Global Automotive 2014 popularity report, 2014) (Axalta C. S., Global Automotive Color Popularity Report, 2013) (Axalta C. s., 2015).

Most of the automotive colours have effects, like metallic or pearlescent effects which make the colour looking different, depending on how we look at it. As colours is a very complex subject to study, it has been decided to convert all the metallic and pearlescent colours into solid colours for this first experiment, using the RAL references. This also permits to classify the colours of Toyota in function of hue, saturation and brightness and to exactly the same renderings between the colours as the RAL can be converted into RVB and CMJN colours. The second experiment will be devote to the influence of effects colours. For the experiment 1, the colours have been tailor made and painted on metallic supports.

#### 3.2.2.2 Car stimulis

The same twelve colours have been used for the 3D renderings of car. Three vehicles will be studied: the Corolla, the RAV4 and the C-HR. Each of these three vehicles have renderings in each of the twelve colours.

#### 3.2.2.3 General principle

The experiment 1 will be led into three different countries, one representing Western Europe (Belgium) and the two others Eastern Europe (Turkey and Russia). In each of these countries, 20 participants with a gender equality and English speakers will be interviewed. The questionnaire will be displayed as a booklet, presenting all the questions.

#### 3.2.2.4 Expected results

The first expected result is a correlation between Kansei words and individual values. Statistically, the results will be shown as a PCA. If the PCA highlight some correlations, then we will be able to use these correlation to have some more information about the participant. More, as the second objective is to learn more about the car expectations, it will be possible to compare the individual values with the car expectations of an individual, and of the culture by bringing together the results of all the individuals.

Another expected result is to better understand the customer's preferences and perception regarding colours and coloured cars. About the colours, we do expect results which will help to understand the influence of the colour on the car perception from the user.

## 4 CONCLUSION AND PERSPECTIVES

Colours is a wide topic to explore, especially in the automotive context. In this study, many parameters have been reduced for a matter of timing and we believe that to study properly the colours, parameters should be separated in a first time. In the second experiment planned in this master thesis, effects are going to be explored and this is another step leading to some others studies. As examples of other parameters, harmony of colours on a car, two-tones coloured cars (in different proportions), interior of cars etc are still subjects to be explored.

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