# A comparative study on designer and customer preference models of leather for vehicle

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A R T I C L E  I N F O

A B S T R A C T

The purpose of this study is to examine the difference in the tactile perception between designers and customers for leathers in vehicle interiors and to derive preference models that describe the relationship between the tactile perception and physical measurements the leathers. An experiment was performed on ten natural leathers manufactured in the automotive industry. The questionnaires were designed based on six pairs of adjectives: *wet-dry*, *slippery-sticky*, *smooth-rough*, *flat-bumpy*, *hard-soft*, and *thin-thick* for sensory evaluation. In addition, eight physical measurements were selected to identify the characteristics of leathers that affect the tactile perception of designers and customers. The relationship between the experiment results and physical measurements was determined by correlation and regression analyses. The statistical results show a significant difference between designer and customer in the tactile properties of the leathers. Also, the tactile perception from both designers and customers was associated with more than one physical measurement, while the designers and customers showed different tactile association with physical measurements. This study contributes to the comprehension and recognition of the differences in preferences for leathers in vehicle interiors between designers and customers and, by designing the prediction model of preference based on the physical measurements, the uncertainty in the market for automobile manufacturers can be reduced.

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## 1. Introduction

As competitions in the automotive industry overheats, more attention has been paid not only to the improvements of the mechanical performances and designs but to the satisfaction of preferences and affective facets of customers (Helander et al., 2013). Moreover, it has become more important in the automobile production to consider the affective facets of customers as a car takes a significant part of human life (He et al., 2011; Lai et al., 2005; Nagamachi, 2002; Shen et al., 2015).

The customer's impression on a vehicle interior is determined through various sensations (Ersal et al., 2011; Yang et al., 2015; Yoon et al., 2015), and the feeling from tactile sensation, in particular, influences how people assess the quality of the vehicle interior (Picard et al., 2003; Bhise et al., 2005). Accordingly, numerous researchers have carried out studies on vehicle interiors (Faye et al.,

2006; Giboreau et al., 2001; Sarma et al., 2010; You et al., 2006). Giboreau et al. (2001) performed a sensory evaluation on various types of fabrics used for automobile seats to derive a multi-dimensional scaling (MDS) map. Faye et al. (2006) also derived a map, but focused on the preferences of customers and trained panels on types of leathers for automobile seats. You et al. (2006) performed quantification I analysis on six selected major interior parts in vehicles, along with their physical measurements to derive a satisfaction model. Sarma et al. (2010) investigated the relationship between subjective ratings and objective measurements of cloth and leather according to age and gender differentiation.

Various studies on vehicle interiors have been performed on a range of materials, particularly by (Farag, 2008). Recently, automobile manufacturers used leather as their interior material to increase customer satisfaction and luxuriousness in their vehicles (You et al., 2006; Shen et al., 2006).

From the beginning of the product development, designers and developers in companies manufacturing vehicle interiors strive to deliver aesthetic satisfaction to customers. Customers also have an input in the aesthetic decision-making process when asked to evaluate the quality of a vehicle and make their preferences based

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on their sensory and visual impressions of the vehicle interior (Yun et al., 2004). Therefore, it is very important to understand the affective experiences by both the designers and the customers of leather used in a vehicle interior (Shen et al., 2006).

The many studies in a range of fields that have examined the affective difference between experts' and customers' preferences - particularly in sensory evaluation — show that the affective perception and assessment vocabularies of these fields varies according to the level of expertise (Bahn et al., 2009; Kanai et al., 2011; Soufflet et al., 2004). Soufflet et al. (2004) utilized the MDS method to investigate the perceptual differences of various fabrics between experts and novices while restricting stimuli other than tactile stimuli. Bahn et al. (2009) analyzed the elements of luxuriousness in vehicle crash pad designs, and investigated the significant difference in the perception of luxuriousness between designers and customers in a visuo-tactile evaluation. Kanai et al. (2011) investigated the fundamental factors of fabric aesthetics which lead to different assessments of the same material by expert groups and untrained customers based on visual and tactile sensations. Studies on sensations other than visual or tactile also showed interesting differentiation between experts and novices.

Such differences have attracted the attention of many researchers, motivating studies on various objects and corresponding sensations (Byrnes et al., 2015; Tani et al., 2014; Torri et al., 2013; van Paasschen et al., 2015). Torri et al. (2013) found that, based on the sensory profile, differences were shown in the quality and sensory evaluations of the wine aroma. Tani et al. (2014) demonstrated differences between experts and novices preferences when evaluating pearl quality, where the perceptions of color and glossiness of the pearl differed in their regression analysis. Byrnes et al. (2015) identified a difference in the perception of chemesthetic stimuli depending on the level of culinary experience, and van Paasschen et al. (2015) found that expert and novice groups with different training levels reflected preferences for different aesthetic features in artworks, regardless of their affective evaluation which showed no difference. Throughout these many studies in various fields, the experts showed better distinction and articulation than did the untrained customers.

Such results may infer that the experts and customers have different approaches and perspectives when they assess vehicle interiors and leathers. Therefore, it is important to comprehend such difference and take an appropriate approach when designing leather products for vehicle interiors.

However, systematic studies on the preferences of leather and its tactile properties have been limited despite the importance of

leather in vehicle interiors. In particular, few studies have been conducted on the tactile sensation of leather used for vehicle interiors based on the difference in tactile perception and preferences between designers and customers. Previous studies have either focused on particular groups (Chen et al., 2009) or have considered the affective response from various sensations other than tactile sensation (Kanai et al., 2011). Although there are a few studies that relate affective properties to design properties for various materials (Klöcker et al., 2013; Tiest and Kappers, 2006), only a few such studies focus on vehicle interior materials or leather.

Due to the difference between the affective responses arising solely from the tactile sensation and those from visuo-tactile sensations, a preference model needs to be designed by segregation of two dominant sensations of visual and tactile (Wongsriruksa et al., 2012); thus, the tactile sensation for leather used in vehicles interior is the main objective. Although many studies have been carried out on the tactile properties of textiles for vehicle interiors (Schwarz et al., 2015), studies on leather have been limited.

In response to this gap in the literature, in this study, a sensory evaluation is conducted for the tactile sensation of leather used for vehicle interiors, as experienced by designers and the customers. The preference models for the tactile sensation of leather are designed from correlation and regression analyses of both designers and customers. In order to measure the designers and customers' perceptions of leather, six pairs of adjectives were used and seven variables were selected to find the relevant physical variables for each pair of adjectives. By statistical analysis and from the relation between the physical measurements and the evaluation scores, preference models for the designers and the customers were designed and the difference between the two models was then identified.

## 2. Method

### 2.1. Samples

In this study, a total of 10 different natural calf leather samples were selected. These samples are furnished in various automobile interiors. All samples were trimmed into 20 cm × 20 cm squares for the sensory evaluation. The samples used in the evaluation are given in Fig. 1.

### 2.2. Participants

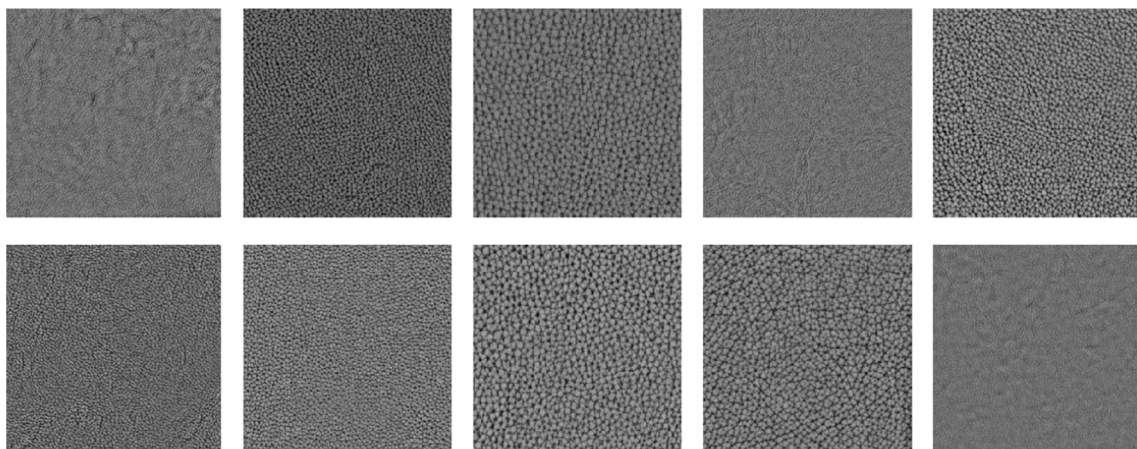A total number of 63 participants were recruited, including 21



**Fig. 1.** Ten samples of automotive leather utilized for sensory evaluation.