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Development of customer satisfaction models for automotive interior materials

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Abstract

As the functional characteristics of passenger vehicles reach satisfactory levels, customers' concerns with the ergonomic and aesthetic aspects of the interior design have increased. The present study developed satisfaction models of automotive interior materials for six parts including crash pad, steering wheel, transmission gearshift knob, audio panel, metal grain inlay, and wood grain inlay. Based on literature survey, customer reviews on the web, and expert opinions, 8–15 material design variables were defined for the interior parts. The material design characteristics of 30 vehicle interiors were measured and customer satisfaction with the vehicle interiors was evaluated by 30 participants in the 20–30-year-old range. The material design variables were screened by evaluating their statistical, technical, and practical significance and satisfaction models were developed by quantification I analysis. The satisfaction models were used to identify relatively important design variables and preferred design features for the interior parts.

Relevance to industry

User satisfaction is an important aspect in the design of a human–system interface. The model development process presented in the present study is applicable to establish a user satisfaction model by evaluating design variables in terms of statistical, technical, and practical significance.

Keywords: Automotive interior material; Customer satisfaction model; Quantification I analysis; Variable screening; Relative importance of variable; Preferred design feature

1. Introduction

As the mechanical performance (e.g., acceleration, breaking distance, and fuel consumption efficiency) of passenger vehicles reach satisfactory levels, issues of ergonomic and aesthetic designs are highlighted. When making purchase decisions, more customers are placing high importance on driving comfort, availability of convenience features (add-on features for convenience, such as automatic headlight on/off, anti-lockout device, and underseat storage), luxuriousness of materials, and quality of finish rather than engine power and fuel consumption rate (Jindo and Hirasago, 1997; White, 2001; Welch, 2002).

Few studies have been conducted on the design of automotive interior materials in terms of customer satisfaction. Automotive manufacturers use luxurious materials (such as leather, wood, nonglossy metal, and polished chrome) in the interior to attract customers and continue their efforts to develop novel materials which are economical but look luxurious (White, 2001). Kansei engineering and ergonomic methods have been applied to identify preferred design features by analyzing the relationships between design characteristics and customer impressions. While many Kansei engineering studies on the interior design (e.g., Jindo and Hirasago, 1997; Nakada, 1997; Tanoue et al., 1997) have focused on the visual design characteristics (such as part size, shape, and color) of

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interior parts by using slides of various designs, few studies exist focusing on the material design variables (e.g., softness and slipperiness) of interior parts. It is desirable to consider both the visual (e.g., embossing shape and surface shininess) and tactile (e.g., surface roughness and softness) properties of interior materials because customer satisfaction with an interior material is determined by visual inspection as well as by touch (Ryu et al., 2003).

The present study was intended to: (1) survey the design variables of automotive interior materials; (2) develop customer satisfaction models for the interior materials with material design variables having statistical, technical, and practical significance; and (3) identify relatively important design variables and their preferred design features based on the satisfaction models.

2. Evaluation of satisfaction with interior materials

2.1. Interior parts and vehicles

Six interior parts including crash pad, steering wheel, transmission gear shift (TGS) knob, audio panel, metal grain inlay, and wood grain inlay (see Fig. 1) were selected to examine customer satisfaction with interior materials. These selected parts, located in the front of the interior, are most frequently experienced by the hand of the driver.

The present study used 30 vehicles (23 compact and seven sport-utility vehicles) to survey the design characteristics of interior materials and customer satisfaction. The vehicles were placed at a yard of an auto manufacturing company; of the vehicles, six were domestic and the other foreign, having various material design characteristics. The number of vehicles evaluated for each interior part varied as shown in Table 1 because some interior parts were absent in some vehicles.

* Wood or metal inlays can be added on gearshift knob, door handle, power window switch, etc. for decoration.

Fig. 1. Interior components of a passenger car.

Table 1
The number of vehicles evaluated (by interior part)

Interior part	Number of vehicles
Crash pad	30
Steering wheel	30
Transmission gear shift (TGS) knob	30
Audio panel	28
Metal grain inlay	14
Wood grain inlay	5

2.2. Material design variables and measurements

The material design variables of each interior part were identified by surveying customer reviews of car interiors on the web, opinions of interior design engineers, and published papers. For example, for crash pad, shininess was selected based on a customer review of a car interior stating that the metal surface is too shiny, pattern size from an opinion of a design engineer at an auto manufacturing company, and softness from the study of Nishimatsu et al. (2001). Through this variable identification process, 8–15 design variables and corresponding design levels were defined for the interior parts; Table 2 illustrates 13 material design variables and corresponding design levels for crash pad.

The material design characteristics of each interior part of a vehicle were measured by objective and subjective methods. For example, vernier calipers and the standard color table by Korean Color Research Institute (1991) were used to measure the size of embossing and the properties of a color, respectively. For a design variable (say, shininess) to which an objective instrument was unavailable, the design value was determined by subjective evaluation of four experimenters with a seven-point scale as illustrated in Table 2. When the subjective evaluations were different for a design variable, a consensus was reached through brainstorming; in case consensus was not drawn, the average of the subjective evaluations was used for the value of the design variable.

2.3. Participants

In the present study, 30 Korean males participated in the material satisfaction evaluation for the 30 vehicles. Of the participants, 21 were in their 20s and nine in their 30s (mean = 28.7 and SD = 6.6). Their participation was compensated.

2.4. Satisfaction evaluation scale

The level of customer satisfaction with the interior materials of a vehicle was evaluated by using a modified magnitude estimation scale, as shown in Fig. 2. The participants were asked to evaluate the material of each interior part for a vehicle after visual and tactile inspection. The magnitude estimation scale has been employed in satisfaction evaluation studies such as Han et al. (2000) and Yun et al. (2001) because subjective evaluation with high sensitivity is obtained and various statistical techniques are applicable.

2.5. Procedure

The satisfaction evaluation in the study consisted of three sessions: introduction, satisfaction evaluation, and debriefing. At the introduction session, the purpose and method of evaluation were explained to the participants.