A Brief Analysis of User Experience Research on the Multi-Sensory Automobile CMF Design

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Abstract

With the intensifying competition in the automotive industry, consumers' demand for personalized and high-quality driving experiences continues to rise. Multi-sensory automotive CMF (Color, Material, and Finishing) design has become a key element for differentiation in competition. This article systematically explores the core connotations of automotive CMF design and its value in user experience across multi-sensory dimensions such as visual, auditory, olfactory, and tactile. It delves into the purposes, methods, business contexts, and target user groups of user experience research. The study demonstrates that through scientific research methods (such as Surveys, in-Depth interviews, Focus Group Discussions, Field Observation and Testing), automotive companies can accurately capture user needs, optimize product design, enhance brand image, and ultimately improve market competitiveness. Furthermore, the article suggests that multi-sensory CMF design should harmonize technical feasibility with user preferences, seeking a balance between sustainability and innovation, thereby providing theoretical references and practical guidance for future automotive design.

Keywords

Multi-Sensory; Automobile CMF Design; User Experience Research.

1. Preface

As the automotive industry shifts from a function-driven approach to an experience-oriented one, CMF design (Color, Material, and Finish) has become a core element of differentiated competition in automotive products. Traditional CMF design mainly focuses on the aesthetic performance at the visual level, whereas modern multi-sensory CMF design integrates visual, auditory, tactile, and olfactory experiences to create an immersive driving and riding environment for users. This evolution of design philosophy is reshaping the evaluation system of user experience for automotive products. To address the issue that traditional interior evaluation models cannot meet users' emotional experience needs, Gu Fangzhou^[1] employed emotional measurement theory and a multi-level screening method to construct an emotional semantics pool for interior design evaluation. The results indicate that the emotional semantics pool can externalize user cognition, providing a scientific and structured basis for interior design evaluation. Yin Yanqing^{[2],} to explore the perceptual differences in users' perceptions of automotive interior quality, approached the study from the perspective of perceptual modalities and experimentally verified the differences in users' emotional perceptions of interior leather textures under tactile unimodal and visual-tactile bimodal conditions. He proposed that under the visual-tactile bimodal condition, users have a stronger emotional perception of interior quality, suggesting that interior design based on perceptual modalities can enhance emotional communication between users and designers. Chen Yangwei^[3] analyzed the methods, levels, and processes of user perception from the user's perspective, summarizing trends, methods, and processes in automotive interior design based on user perception. They

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pointed out the importance of multi-sensory experiences in interior design and emphasized a user-centered design philosophy. Yang Dan^[4] firstly emphasized the importance of perceived quality evaluation in the CMF design of bus interiors, and secondly proposed a systematic research method and design process. The research findings demonstrated that by integrating perceived quality evaluation in the CMF design approach, the user perception experience of bus interiors can be effectively enhanced, product lifecycle can be shortened, costs can be controlled, and product competitiveness can be improved. The research conducted by Yuan Dongting and others^[5] explores the design application of brand philosophy in the sensory experience of electric vehicle interiors, analyzing the impact of shape elements, functional elements, CMF (Color, Material, Finish) elements, and interactive information on sensory experience. They propose that a multisensory design strategy can effectively convey brand philosophy, enhance user loyalty, and align with the evolving trends in interior design. Zhang Hui^[6] employs methods from affective engineering, combining color, material, and texture (CMF) design to enhance user experience. He points out that through quantitative analysis methods in affective engineering, user feedback can be accurately obtained, providing a scientific theoretical foundation and design recommendations for interior design.

This article is based on a theoretical framework of multi-sensory CMF design and explores the methodology of user experience research in depth. The research content covers: analysis of the key elements of CMF design, the dimensions of multi-sensory user experience, research objectives and business scenarios, as well as the demand characteristics of different user groups. By analyzing the application scenarios of research methods such as surveys, in-depth interviews, and focus groups, a complete closed loop from user demand insights to design implementation has been constructed. The research results can provide methodological support for automotive companies to optimize CMF design, helping products establish a differentiated advantage in the fiercely competitive market.

2. The Meaning and Key Elements of Automobile CMF Design

Automotive CMF design (Color, Material, and Finishing) refers to the design of colors, materials, and finishes for both the exterior and interior of vehicles. It encompasses the design of external elements such as the body, roof, doors, front face, and wheels, as well as internal elements including seats, dashboards, center consoles, and door trims. CMF design is of great importance in the automotive industry, as it directly influences consumers' perceptions and choices regarding vehicles, and also serves as a manifestation of automotive brand image and differentiation.

Color: refers to the color matching scheme of the product. By choosing the right colors, you can convey different emotions and styles. The use of different colors can present an image of dynamism, stability, luxury or youthful vitality, and can also form a unified color identity with the brand.

Materials: Materials refer to the substances used in the manufacturing of products, such as leather, metal, plastic, wood, carbon fiber, and glass. The selection of different materials can provide varying tactile and visual experiences, while also impacting the texture and quality perception of the automobile. For instance, the use of high-quality soft materials can enhance the luxury feel of the interior, whereas the choice of lightweight materials can contribute to improved fuel efficiency.

Finishing: Surface treatment is a type of product processing technology and is one of the important means to achieve the desired appearance effects of a product. Different surface treatments can impact various aspects of a product, including visual effects, tactile sensations, and overall texture, providing consumers with diverse experiential responses. Common surface

treatment processes mainly include anodizing, wire drawing, sandblasting, embossing, acid etching, electroplating, baking paint, and water transfer printing.

CMF design needs to take into account the preferences of the target user group, market trends, brand positioning, and other factors. During the design process, the design team takes these factors into account to create a unique and attractive exterior and interior through the combination and use of colors, materials and finishes.

3. The Content of Multi-Sensory Automobile CMF Design User Experience Research

The multi-sensory automotive CMF (Color, Material, Finish) design user experience refers to providing users with a rich, comfortable, and attractive automotive experience through stimulation and feedback from different senses. Specifically, it encompasses the following aspects:

Visual experience: Creating a pleasant and aesthetically appealing visual sensation through the color, shape, and detail design of the car's exterior, as well as the interior color schemes, lighting, and entertainment screens.

Auditory experience: Creating a high-quality sound enjoyment and a tranquil, comfortable riding environment through the vehicle's audio system, engine sounds, and sound insulation of closed doors.

Olfactory Experience: By controlling the air quality inside the vehicle, utilizing the air conditioning system, and incorporating ambient fragrances, a fresh, comfortable, and pleasant atmosphere and scent can be created within the car.

Gustatory Experience: Though less associated with automotive CMF design, certain internal environments of vehicles (such as mini-refrigerators, coffee machines, and small kitchens) can provide gustatory experiences for both drivers and passengers.

Tactile Experience: Through the design of car seats, steering wheels, control buttons, and material textures, a comfortable and tactilely pleasing contact feel is provided.

By comprehensively considering the five senses of vision, hearing, smell, taste, and touch, multisensory automotive CMF design can enhance user perceptions and satisfaction with the vehicle. An outstanding multi-sensory automotive CMF design can deliver a pleasurable driving experience for users while also reflecting the brand's uniqueness and competitive differentiation.

4. The Objectives and Functions of the Multi-Sensory Automobile CMF Design User Experience Research

4.1. Understanding User Needs

Research can assist automotive design teams in better comprehending users' demands and preferences regarding multi-sensory automotive CMF design. By collecting user feedback and opinions, valuable market information can be obtained to guide product design and improvements, thereby providing a car experience that meets user expectations.

4.2. Optimizing Product Design

The results of the research can offer automotive companies valuable references for optimizing car CMF design. Based on user feedback, design teams can adjust aspects such as color combinations, material selections, and finishing treatments. This also enables products to be more environmentally friendly and sustainable, aligning with market and societal demands for sustainable development.

4.3. Enhancing Brand Image

By listening to the voices of users, design teams can better understand users' perceptions and evaluations of different brand CMF design styles. Accurately capturing user sentiments can help brands establish a unique CMF design style, thereby enhancing brand image and market competitiveness.

4.4. Enhancing Product Competitiveness

A multi-sensory user experience in automotive CMF design is one of the key factors for differentiation in the automotive market. By gaining in-depth insights into user experiences and feedback regarding CMF design, automotive companies can differentiate themselves from competitors, create a unique brand image and product characteristics, win over more users, and increase market share.

4.5. Improving User Satisfaction

The multi-sensory user experience in automotive CMF design is a significant factor influencing users' vehicle purchasing decisions. By researching users' needs and preferences across visual, auditory, olfactory, gustatory, and tactile experiences, automotive companies can focus on details during the design and production processes to offer products that better meet user expectations, thus enhancing user satisfaction and loyalty.

In summary, conducting research on multi-sensory user experiences in automotive CMF design is of great importance for manufacturers and designers, as it can enhance product competitiveness and user satisfaction while also aiding brand building and market positioning. By understanding user needs and expectations, automotive companies can better fulfill their customers' automotive experiences and desires.

5. The Business Contexts of Multi-Sensory Automotive CMF Design User Experience Research

Exterior Design: The research involves user experiences related to the color, shape, and detail design of the car's exterior. This can be conducted through methods such as surveys, interviews, or focus group discussions to collect users' preferences and evaluations of different color combinations and exterior design styles.

Interior Design: The research focuses on user experiences concerning the color schemes, material textures, lighting effects, and smart configurations of the car's interior. Feedback during actual seating and usage, collection of user opinions, and observation of user behavior can be employed to understand users' satisfaction and needs regarding the comfort, aesthetic appeal, and functionality of the interior.

Sound and Audio Design: The research involves user experiences related to automotive audio systems and engine sounds, which can be understood through field tests, auditory assessments, and acoustic evaluations. This will help in gauging users' perceptions and evaluations of sound quality, volume, sound effects, as well as their preferences and acceptance levels regarding specific sounds (such as engine start sounds and indicator sounds).

Olfactory and Fragrance Design: The research encompasses user experiences related to automotive air conditioning systems, in-car fragrances, and indoor air quality. This can be achieved through surveys, scent tests, and olfactory assessments to understand users' feelings and opinions about different scents, fragrances, and air quality.

6. The Research Methods for Multi-Sensory Automotive CMF Design User Experience Research

Survey: Distribute questionnaires to a large user group to collect their opinions and feedback on the multi-sensory automotive CMF design user experience. The questionnaire can cover aspects such as design elements, color choices, material preferences, sound perception, and fragrance preferences.

Interviews and In-Depth Interviews: Conduct face-to-face interviews with leading users or experts to explore their usage experiences, needs, and expectations in more detail, obtaining richer feedback and insights.

Focus Group Discussions: Organize user and expert group discussions to share perspectives and experiences, exploring optimization solutions for the multi-sensory automotive CMF design user experience.

Field Observation and Testing: Gain direct user experience data by observing and testing users' behaviors, reactions, and satisfaction during the usage process, such as organizing user test drives and cabin experiences.

7. Analysis of the User Groups in Multi-Sensory Automotive CMF Design User Experience Research

The user groups for the research on user experience related to multi-sensory automotive CMF design include the following categories:

7.1. Automobile Manufacturers

Automobile manufacturers are one of the primary customer groups. They need to understand consumer demands and preferences regarding multi-sensory automobile CMF (Color, Material, Finish) design in order to incorporate relevant technologies and elements into their product design and development processes. These manufacturers may include traditional car manufacturers, emerging electric vehicle brands, or luxury car manufacturers.

7.2. Automobile Designers and Engineers

Automobile designers and engineers represent another major customer group. They require feedback and opinions obtained through user experience research on multi-sensory automobile CMF design, focusing on aspects such as exterior design, interior layout, sound systems, and odor control, to enhance the attractiveness, functionality, and practicality of their products.

7.3. Automotive Parts Suppliers

Automotive parts suppliers also hold a certain interest in the market demand and trends of multi-sensory automobile CMF design. They can leverage the results of user experience research to provide automobile manufacturers with innovative components and technical support related to multi-sensory automobile CMF design.

7.4. Automotive Industry Research Institutions and Consulting Firms

There is a certain demand for market analysis and trend forecasting related to multi-sensory automotive CMF (Color, Material, Finish) design from automotive industry research institutions and consulting firms. They require relevant data and research results to provide strategic guidance and decision-making support for clients in the automotive industry.

7.5. Automotive Consumers

The ultimate customer group is consumers, who are the direct beneficiaries of products designed with multi-sensory automotive CMF principles. Consumers have a high pursuit for personalization, high quality, and diverse driving experiences, and they are willing to choose products with multi-sensory automotive CMF design for a better sensory experience.

In summary, the customer groups for multi-sensory automotive CMF design user experience research include automobile manufacturers, automotive designers and engineers, automotive parts suppliers, automotive industry research institutions and consulting firms, as well as the end consumer group. By meeting the needs of these customers, further development and innovation in the field of multi-sensory automotive CMF design can be promoted.

8. The Multi-Sensory Automotive CMF Design User Experience Research

8.1. Automotive Manufacturers

They will utilize the results of user experience research on multi-sensory automotive CMF design to guide product development. They may conduct user research and market studies in the early stages of product design to understand user needs and trends. During the product development process, they may collaborate with designers and engineers to discuss and determine the selection, layout, and overall user experience of the sensory elements. Testing and validation after the preliminary design of the product is another scenario where they will invite users to participate in test drives and provide feedback to evaluate the effectiveness of the product's experience, which will be used for final optimizations before market launch.

8.2. Automotive Designers and Engineers

They will translate the creative and innovative elements based on the results of user experience research on multi-sensory automotive CMF design into practical design and engineering solutions. Designers and engineers may utilize virtual reality or models to showcase and demonstrate design concepts for discussion and decision-making with team members and stakeholders. During the product development phase, they will collaborate with component suppliers to consider how to integrate sensory elements and ensure their feasibility and practicality.

8.3. Automotive Component Suppliers

They may participate in the product development phase, providing sensory elements and technical support, such as sound systems, lighting systems, and scent control. Suppliers may collaborate with automobile manufacturers to conduct product sample demonstrations and tests to ensure the applicability, quality, and performance of their sensory elements within the overall product.

8.4. Automotive Industry Research Institutions and Consulting Firms

These institutions may conduct market research and user studies to understand consumer expectations and needs regarding multi-sensory automotive CMF design. They will collect data, analyze market trends, and prepare reports to provide automobile manufacturers with insights on market competition, technological developments, and potential opportunities.

8.5. Automobile Consumers

For the final automobile consumers, they may engage with multi-sensory automotive CMF design user experience research during the pre-purchase stage. This could occur through exhibitions, showrooms, advertisements, or social media. They will consider multi-sensory experience factors such as sound, smell, lighting, and sensory elements of both the interior and exterior of the vehicle in their purchasing decision-making process. During the actual driving

and usage process, they will experience the multi-sensory automotive CMF design firsthand and evaluate and provide feedback based on their personal preferences and experiential outcomes.

9. Summary

The user experience research on multi-sensory automotive CMF design represents a market with immense potential. As consumers increasingly demand personalized, high-quality, and diverse driving experiences, multi-sensory automotive CMF design can meet these needs and provide users with richer, personalized, and enjoyable experiences.

Market trends indicate a growing consumer demand for multi-sensory automotive CMF design, prompting mainstream automobile manufacturers to respond by integrating advanced technology and innovative design elements to enhance user experience. However, entering this market requires overcoming technical challenges, conducting in-depth research on user needs, managing costs, and addressing competition. Additionally, brand building and reputation accumulation are critical factors in establishing industry barriers.

In summary, research into user experience in multi-sensory automotive CMF design holds vast market prospects and opportunities, but for companies to successfully enter the market and maintain a competitive edge, they must continuously innovate, understand user needs, control costs, establish brand identity, and collaborate with relevant technology suppliers and partners to meet market challenges and achieve long-term profitability.

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