Strategies for Improving the Comfort of Product Design Based on Ergonomics

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Abstract: This paper discusses the application and strategy of ergonomics in improving the comfort of product design. In terms of research methods, through in-depth analysis of ergonomic principles, including human size, physiological characteristics, psychological perception and so on, this paper integrates them into the product design process. The specific implementation steps cover requirements analysis, design iteration, user testing and other links, so as to ensure that the product design not only conforms to ergonomic principles, but also meets the actual needs of users. Applying ergonomic principles to product design can significantly optimize the size, shape, material and adjustability of products, and improve the comfort and ease of use of products. These improvements reduce the fatigue of users in the use process, and improve the satisfaction of users and the market competitiveness of products. The paper also puts forward the challenges that may be encountered in the implementation process, including cost control, technical restrictions, user acceptance, etc., and gives corresponding solutions or suggestions.

1. Introduction

Ergonomics is an interdisciplinary science, which deeply studies the structure, function and psychological characteristics of the human body, aiming at making the design better adapt to people's needs and improving the harmony between people and the environment [1]. In the field of product design, the application of ergonomics is crucial [2]. It can guide designers to create products that are more in line with the natural form and usage habits of the human body [3]. It can also effectively improve the comfort, usability and safety of products and meet the diverse needs of users.

In the current product design, the problem of comfort is still widespread. Some products pursue appearance or function too much in design, but ignore the principles of ergonomics [4]. This causes users to feel uncomfortable or tired during use. In electronic products, furniture, transportation and other fields, due to long-term use or frequent operation, the problem of product comfort is particularly prominent [5]. These problems significantly affect the user experience, and may also pose a potential threat to the user's health.

In view of this, this study aims to explore how to improve the comfort of product design through ergonomic principles. This paper will analyze the specific application of ergonomics in product design, reveal the comfort problems existing in current design and put forward practical solutions. This research can provide useful reference and guidance for designers and promote the development of product design in a more humanized and comfortable direction. In terms of expected results, this paper hopes to put forward a set of comfort improvement strategies for product design based on ergonomics principles, which will provide strong support for product design practice.

2. Ergonomic principles and product design

A deep understanding and application of ergonomics principles is of great significance for improving the comprehensive quality of products and user experience [6]. Ergonomics is a subject that deeply discusses the interactive relationship between people and objects. Its core idea runs through anthropometry, physiological characteristics and psychological cognition. At the beginning of product design, the consideration of human size is the cornerstone. This includes accurate measurement of detailed data such as the length, width and height of various parts of the human

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body. These data provide a scientific basis for designers to determine the size and shape of products. Designers need to ensure that products can adapt to different body types and improve the universal applicability of products [7]. The study of physiological characteristics focuses on the movement mechanism, mechanical function and sensory system function of human body, aiming at ensuring that the product can adapt to the natural movements of human body and reducing the risk of fatigue and injury during use. For example, in the design of office chairs, the designer will carefully build the curve of the chair back to maintain the healthy state of the spine, taking into account the support needs of the spine when the human body is sitting. The research of psychological perception is more delicate, which discusses people's psychological reaction and cognitive process to elements such as color, shape and material, which together constitute the user's initial impression and use experience of the product [8]. Every detail, such as the choice of color, the design of shape and the texture of material, may affect the emotion and behavior of users. Table 1 specifically shows the multi-dimensional considerations in product design:

Table 1 Multidimensional Considerations in Product Design

Consideration Dimension	Specific Content	Design Application Examples	Impact on Product Design
Anthropometry	Precise measurement of various body lengths, widths, and heights; Provides scientific basis for product size and form; Ensures product adaptability to different body types, enhancing universal applicability	Office furniture dimensions designed to accommodate individuals of different heights and weights	Ensures product comfort and functionality, improving user satisfaction
Physiological Characteristics	Study of human movement mechanics; Analysis of mechanical interactions; Consideration of sensory system functions; Aligns with natural body movements, reducing fatigue and injury risks	Office chair backrest curve designed to support the spine and maintain spinal health; Tool handle designed to conform to hand grip mechanics, reducing hand fatigue	Enhances product usability and safety, reducing user discomfort during use
Psychological Perception	Psychological reactions to color, shape, and material; Shapes initial impressions and user experience of the product; Color choice, shape design, and material texture influence user emotions and behavior	Product color schemes tailored to the target user group's aesthetics; Shape design intuitive and user-friendly; Material selection considers tactile feel and durability	Enhances product appeal and user loyalty, elevating overall user experience and brand value
Comprehensive Consideration	Combines anthropometry, physiological characteristics, and psychological perception; Considers multiple user needs comprehensively; Achieves overall optimization of product design	In the product design process, multiple factors such as size, shape, material, and color need to be considered comprehensively	Creates high-quality products that align with ergonomic principles and satisfy user psychological needs

In product design practice, the application of ergonomics is pervasive [9]. Ergonomics has a far-reaching impact on product comfort, ease of use and user satisfaction. A product designed according to ergonomic principles can effectively reduce the user's use burden, improve the convenience of operation and enhance the overall satisfaction of users. On the contrary, products that ignore these principles may cause inconvenience to users, even physical injury, and ultimately affect the market performance and user evaluation of products.

3. Strategies and methods to improve the comfort of product design

In order to significantly improve the comfort of products, this paper has carefully formulated a series of innovative design schemes. The first task is to finely optimize the size and shape of the product. Through the in-depth analysis of anthropometric data, we can ensure that the product design matches the user's physical characteristics perfectly, and both portable devices and household items can make users feel extremely comfortable and comfortable when using them.

When designing the product form, this paper takes into account the human motion trajectory and mechanical principles. For example, the backrest design of a chair should conform to the physiological curvature of the spine to provide comfortable support. Besides size and shape, selecting suitable materials is also the key to improve the comfort of products. This paper tends to use materials that can fit the physiological curve of human body. These materials can better fit the contour of human body, reduce the pressure point and improve the sense of contact. For example, memory cotton or ergonomic cushion materials can effectively disperse weight and reduce fatigue after long-term use. Enhancing the adjustability of products is an important strategy to improve comfort. In view of the differences in physical characteristics and usage habits among users, the product should have certain adjustment ability to meet the needs of different users. For example, the height, inclination angle and armrest position of the office chair should have adjustment functions, so that users can make personalized adjustments according to their own situation and work habits to achieve the best use effect.

These design schemes are based on the principle of ergonomics, aiming at significantly optimizing the use experience of products. Through the optimization of size and shape, we ensure that the product conforms to the natural shape and movement law of the human body. By selecting materials that conform to physiological curves, the discomfort and fatigue of users in the use process are alleviated. The enhanced adjustability of the product makes it more adaptable to the diverse needs of different users and improves the comfort and satisfaction of use. To sum up, the implementation of these strategies will effectively enhance the comfort of products and bring users a more pleasant experience.

4. Implementation and challenge: put theory into practice

It is a systematic and meticulous process to integrate ergonomic principles into product design process [10]. First of all, in the demand analysis stage, we must deeply understand the physical characteristics, usage habits and potential needs of the target user group. This requires us to conduct market research, collect user feedback and even conduct one-on-one interviews to ensure that the design can really meet the actual needs of users. Next, in the design iteration process, the designer will constantly adjust and optimize the size, shape, material and adjustability of the product according to the principles of ergonomics. This process requires many times of prototyping and testing to ensure that the product design not only conforms to ergonomic principles, but also meets the aesthetic and functional needs of users. Table 2 summarizes the product comfort improvement design scheme:

Table 2 Overview of Product Comfort Enhancement Design Schemes

Design Scheme Category	Specific Strategy	Implementation Details	Examples
Size and Form Optimization	In-depth analysis of anthropometric data	Ensure product design matches user's bodily characteristics	Portable device size fits hand grip, home product size adapts to human use habits
	Consideration of human movement trajectories and mechanical principles	Design product forms that conform to human physiological structure	Chair backrest conforms to the physiological curve of the spine, providing comfortable support
Material Selection	Choose materials that fit the human physiological curve	Materials better contour to the human body, reducing pressure points	Memory foam cushion, ergonomic chair pad
		Enhance tactile feel, distribute body weight, reduce fatigue	Use special materials to distribute pressure from prolonged use
Enhance Adjustability	Adapt to different users' bodily characteristics and usage habits	Products have adjustment capabilities to meet individual needs	Office chair height adjustable
			Office chair tilt angle adjustable
			Office chair armrest position adjustable

It is inevitable to face some difficulties in the implementation process. Cost management is a link that must be paid attention to. Because choosing better materials or more complicated designs often leads to higher costs. In order to find a balance between cost and comfort, we must carefully select materials and optimize the design scheme, and strive to reduce the cost as much as possible on the premise of ensuring product comfort. Technical bottleneck is also a challenge that cannot be ignored. Some design concepts may exceed the existing technical level. In this case, we need to work closely with the technical department to explore new breakthroughs in technology or make appropriate adjustments to the design to adapt to the existing technical conditions. On the other hand, user acceptance is also an important test. Although this paper is committed to creating products that conform to ergonomic principles, consumers' preferences and habits vary widely. Some users may prefer traditional design and hold a wait-and-see attitude towards the new design of ergonomics. In order to improve the user's acceptance, it is necessary to fully consider the diversity and individual differences of users in the design stage and provide diversified choices or adjustable functions to meet the needs of different users. Through user education and marketing, we can improve users' understanding and acceptance of ergonomic design.

5. Conclusions

Ergonomics plays a vital role in improving the comfort of product design. It is found that integrating ergonomics into product design process can significantly optimize the size, shape, material and adjustability of products, thus greatly improving the user experience and satisfaction. These improvements reduce the fatigue of users in the process of use, and also improve the ease of use and safety of products. Therefore, ergonomics is an indispensable part of product design.

With the continuous progress of science and technology and the increasing demand of users for comfort, the application prospect of ergonomics in product design will be broader. Future research can further explore the combination of ergonomic principles and emerging technologies to develop more intelligent and personalized comfort products. At the same time, researchers can also deeply study the human characteristics and usage habits of different user groups, and design products that better meet their needs for specific groups, so as to promote the continuous innovation and development in the field of product design.

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