RELATIONSHIP BETWEEN INDUSTRIAL PRODUCT DESIGN AND BEHAVIOURAL PSYCHOLOGY

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Abstract
The design of industrial products is affected by the behavioural psychology of both designers and consumers. This paper attempts to identify the relationship between industrial product design and behavioural psychology. The industrial product design was evaluated both based on the theory of behavioural psychology, and through actual application of behavioural psychology in the design. For the theoretical analysis, the elements of industrial product design were analysed, before setting up an evaluation system for the design. For the actual application, the behavioural psychology was applied to the design of mobile phone screen, and the effects were evaluated through eye movement test. The results show that the design of industrial products mainly focuses on product modelling, functional analysis, structural solution determination, product materials, process selection and large-scale production; the behavioural psychology of designers and consumers has an in-depth impact throughout the design process; the elements of behavioural psychology that affect the design include feeling, perception, judgment decision, and reaction execution, attention, long-term memory and short-term memory. The research findings provide a theoretical basis for the application of behavioural psychology in industrial product design.

Key words: Industrial Product Design, Behavioural Psychology, Process Selection, Judgment Decision.

INTRODUCTION
The design of industrial products is the scientific and empirical analysis of human physiological representations, and the use of information and machinery to produce the functionally innovative and effective products, ensuring the consistency of functions between similar products, and directly compensating for the needs of the public (Oswald & Hough, 2008). From the perspective of behavioural psychology, industrial product design often ignores the human body's differences, leading to the lack of a fundamental humanistic spirit (Ding & Bai, 2019). Industrial product is designed for consumers. When selecting products, the consumers are paying more attention to the communication between themselves and the product itself. The design of industrial products has to interact with the psychology and physiology of consumers (Yilmaz & Seifert, 2011; Catulli & Reed, 2017). An excellent industrial product design requires designers to deeply study the psychological, physiological, emotional and thinking factors of consumers, i.e., the behavioural psychology of consumers runs through the whole process of industrial product design (Shailendra, Khan, & Gandhi, 2015).

In the development history of psychology, behavioural psychology is different from other disciplines in that it does not explore people's various responses by their surface phenomena, but by the relationship between the objective things and human behaviour information (Atakan, Bagozzi, & Yoon 2014; Lu, Feng, Zheng
et al., 2016). The study of behavioural psychology cannot leave people's humanistic environment, psychological activities and behaviours, and the behaviours exhibited by people are related to the various activities that they engage in (Bonnardel, 2012). The psychology, physiology, thinking, memory and feelings involved in the industrial product design process are all important factors in behavioural psychology. Using human behavioural psychology, the study of information processing should focus on the designer's cognitive process of human psychological behaviour (Hurks & Petra, 2013). This paper explores the relationship between industrial product design and behavioural psychology from the unique perspective of behavioural psychology using the combination of theory and practice. The research findings provide a theoretical basis for the application of behavioural psychology in industrial product design.

THE DEVELOPMENT AND THEORETICAL BASIS OF BEHAVIOURAL PSYCHOLOGY

With the continuous advancement of the society, the psychology has developed more intensively and extensively, but ultimately it is a complex system of studying the human (Cheng, Lau, Ma et al., 2016). Behavioural psychology is characterized by selectivity, integrity, etiquette and permanence. People's behavioural characteristics of things show the ability to acquire and learn information about objective things. In a narrow sense, it refers to the people's reaction to the digested information (Shafaghat, Keyvanfar, Ferwati et al., 2015). For the industrial product as a kind of object, people need to evaluate its design through their sensory organs which sequentially obtains the information transmitted by the product to the human brain, and then encodes into the human brain. Visual and tactile senses are the most important receptors in the design of industrial products (Rogers & Fisk, 2010). Behavioural psychology is equivalent to the effector of the human body, showing the behaviour and evaluation after processing the information transmitted by the receptor, that is, behavioural psychology can be characterized by people's attitudes (Cole, 2017).

Figure 1 shows the relevant research and analysis of behavioural psychology, including the behavioural representation of natural phenomena and the behavioural performance of social development. The behavioural performance of social development involves the conceptual reasoning of human beings and conceptual reasoning of society. Table 1 lists the basic principle of behavioural psychology. Its basic principles include visibility, good conceptual model, good correspondence and predictability: visibility mainly refers to knowing the state of product design by means of vision and touch, as well as the actions to be taken; the correspondence mainly refers to the correspondence between behaviour and results, operations and effects, status and products.

Figure 1. Relevant research and analysis of behavioural psychology
**Table 1. Basic principles of behavioural psychology design**

| Basic principle | Connotation |
|-----------------|-------------|
| Visibility      | Users can visually know the state of the system or product and the behavior they should take |
| Good conceptual model | Industrial product designers provide users with a good conceptual model, which has consistency of operation and results, and can produce a consistent system image |
| Good correspondence | A definite correspondence can be established between behavior and results, operations and results, the state of the system, and what is seen. |
| Predictability  | Consumers can predict the outcome of their actions |

**INDUSTRIAL PRODUCT DESIGN METHODS BASED ON BEHAVIOURAL PSYCHOLOGY**

**Analysis of industrial product design elements**

The comprehensiveness and extensiveness of industrial product design requires the designers to master much knowledge of process technology, design performance techniques and psychology. The design process of industrial products must also involve the texture, process, functional structure, emotion and culture of the products. The design will cause changes in people’s behavioural psychology. Consumers are no longer only concerned about the appearance of products when making decision-making behaviours, but prefer their own psychological and physiological satisfaction. In addition, the design of industrial products should focus on product modelling, functional analysis, structural solution determination, product materials, process selection and large-scale production, which are also the main design elements. A complete industrial product design process includes four steps: design preparation, preliminary design, detail design, and design implementation. Starting with the target user of the product, the product design process follows the behavioural psychology design concept, aiming to improve people’s quality of life and emphasize the interdependence between people, products, environment and society.

**Constructing the evaluation system model of industrial product design**

There are various types of influencing factors that are interconnected during the design of industrial products. In the evaluating process of the industrial product design, it is important to determine the key factors affecting the design. The construction of the evaluation system model for industrial product design process needs to comply with the principles of comprehensiveness, quantification, and enforceability. Figure 2 shows the influencing factors of industrial product design. Figure 2(a) shows the visual image factors, mainly including...
the colour and shape; Figure 2(b) shows the social image of industrial product design, including the key factors such as cognitive recognition, innovativeness, and safety; Figure 2 (c) shows the physiological sensory factor such as tactile and visual sense; Figure 2 (d) shows the psychological feeling factor, and the key factors include convenience, comfort and safety.

APPLICATION RESEARCH OF BEHAVIOURAL PSYCHOLOGY IN INDUSTRIAL PRODUCT DESIGN

Actual application of behavioural psychology in industrial product design

**Figure 3. Usability design principles of behavioral psychology**

When designers design products or consumers choose industrial products, they will first recognize the products, or experience products in terms of emotions, psychology and physiology. Behavioural psychology and product design theory are combined to design the product in line with people’s psychological and physiological needs. With the increasingly mature development of behavioural psychology, designers have focused more on consumers’ behaviour cognition, and perceived the importance of behavioural psychology concepts in industrial product design. Figure 3 shows the usability design principles of behavioural psychology. The design principles include the combination of industrial product design and user intrinsic information, simplifying the operation information of product design as much as possible, and emphasizing on the matching relationship and visibility between products and users. Figure 4 shows the behavioural information processing system model. In the whole function of behavioural psychology, feeling, perception, judgment decision, and reaction execution, attention, long-term memory and short-term memory can all be regarded as the elements in behavioural psychology.

**Empirical research**

There are many types of industrial products ranging from nanometre to tonnage. This paper takes the design of mobile phone screen as an example to study the application of behavioural psychology in industrial product design. Using eye movement test as an evaluation index of behavioural psychology, 10 consumers were selected for test. Figure 5 shows the difference between the performance model and the psychological model. The product is designed and processed for the actual used of the consumer. The performance model is the specific designed product, while the psychological model is the behavioural process produced during the using process of the consumer. Figure 6 shows the experimental flow of behavioural psychology (eye movement experiment). In order to explore the behavioural psychology of consumers on mobile screen products, the whole experimental process was divided into four stages, including the preparatory stage, the explanation stage, and the experimental stage, and data collection stage of experiment. Figure 7 shows the experiment results of behavioural psychology. Figure 7(a) shows the results of gaze time. The overall variance analysis of gaze time indicates that there is a significant difference between the average gaze time and the maximum gaze time, namely behavioural psychology has a great influence on industrial product design; Fig. 7(b) shows the results of scanning time. The results of gaze time and scanning time show the same change law, and the average scanning time and the maximum scanning time also demonstrate significant differences.
CONCLUSIONS

This paper aims to explore the relationship between industrial product design and behavioural psychology from the unique perspective of behavioural psychology using the combination of theory and practice. The specific conclusions are as follows:

(1) The basic design principles from the perspective of behavioural psychology include visibility, good conceptual model, good correspondence and predictability, etc.; the correspondence mainly refers to the relationship between behaviour and result, operation and effect, state and product;

(2) The construction of industrial product design process evaluation system model needs to comply with the principles of comprehensiveness, quantification and enforceability. In industrial product design, the key factors of physiological feeling include tactile and visual sense, and the key factors of psychological experience include convenience, comfort and safety;

(3) In the whole working process of behavioural psychology, feeling, perception, judgment decision, and reaction execution, attention, long-term memory and short-term memory can all be regarded as the elements in behavioural psychology. Empirical studies have shown that behavioural psychology has a great impact on industrial product design.

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