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An Integrated Model of Smart Home Applications User Experience Based on Cognitive Dissonance

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Abstract: This study constructs an integrated model of user experience in smart home applications (apps) to deeply explore the impact of cognitive dissonance on users' emotional responses, subsequent behaviors, and experiential outcomes. The research emphasizes the importance of addressing emotional management in the design and development of smart home apps. The findings indicate that emotional response plays a critical mediating role in the user experience of these apps, offering new insights for further optimization. By understanding users' emotional reactions and behavioral patterns under cognitive dissonance, developers can more effectively improve interface design and enhance the overall user experience.

Keywords: User experience; Smart home apps; Cognitive dissonance

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1. Introduction

Smart home applications are a type of software that runs on smart devices, designed to provide users with remote control, monitoring, and automated management of their home environment. These applications typically work in conjunction with various smart devices and sensors, enabling users to control and monitor household devices remotely through smartphones, tablets, or other smart devices [1]. Examples include platforms like Amazon Alexa, Google Home, Apple HomeKit, and Mi Jia (China). Through these platforms, users can control lights, temperature, security cameras, appliances, and more using voice commands or mobile apps, creating an intelligent home experience. A well-designed application must consider user interaction habits, information architecture, and visual appeal, making the application user-friendly, practical, and efficient. Such good user interface design is crucial to the success of smart home applications and the loyalty of their users. For instance, computer users perceive Apple's Macintosh Operating System (OS) as having a better graphical user interface than Microsoft's Windows OS, with positive perceptions nearly twice as high among Macintosh users, leading to a 20% increase in brand loyalty [2]. Smart home applications can establish a strong interactive experience between users and devices, facilitating the widespread adoption and promotion of smart home products.

2. Concept statement

2.1. User experience

User experience is an interdisciplinary field encompassing a wide range of content and a broad scope. Factors influencing user experience include the user, the product itself, social culture and environment, and the context of use, among others. User experience is defined as "a person's perceptions and responses that result from the use or anticipated use of a product, system, or service" [3]. It is not merely a matter of perception and emotion but also involves various factors related to smart home systems, such as interface design, interactivity, feedback mechanisms, performance, and reliability. This comprehensive experience shapes users' willingness to continue using, recommend to others, and their attitudes toward the system or product [4]. Donald Norman describes user experience as encompassing all aspects of the user's interaction with the product [3]. Different researchers have proposed various approaches to describe the foundations of user experience. Many have suggested methods for characterizing the basis of user experience with online services. Novak and Hoffman utilized the concept of flow as a fundamental principle to explain the factors that make internet usage an engaging experience [5]. However, while Novak and Hoffman constructed a model and provided an explanation of user experience in the context of internet usage, this approach offers limited assistance in describing and understanding user experience with specific systems.

2.2. Smart home apps

Research from international sources refer to smart homes as "Smart Home" or "Home Automation" which involves the integration and management of previously isolated household appliances through the comprehensive use of network wiring, communication, and control systems. This integration enables the transmission of information and control between humans and devices, as well as between devices themselves, thereby creating a safer, more convenient, comfortable, and environmentally friendly living environment [6]. To facilitate user control and interaction with various smart home products within a space, a number of smart home application cloud platforms have been developed. These platforms connect smart home devices with mobile phone applications, allowing for the control of multiple devices via a mobile phone, offering convenience, safety, and comfort.

2.3. Cognitive dissonance theory

In 1957, Leon Festinger first proposed the cognitive dissonance theory (CDT) [7]. The core idea of this theory is that when individuals recognize an inconsistency between their attitudes or between their attitudes and behaviors, they experience an internal discomfort and attempt to reduce this discomfort by adjusting their attitudes or behaviors [8]. The theoretical foundation of CDT is rooted in Gestalt psychology, and it was one of the most influential theories in the field of social psychology in the Western world during the 1950s and 1960s [9]. Cognitive dissonance theory (CDT) is a significant psychological theory and has been widely applied in information systems research, particularly in exploring individual behavioral responses when there is a cognitive discrepancy between expected and actual product performance [10,11].

3. Theoretical framework

Based on the content and characteristics of user experience, different scholars have proposed various user experience models. Sascha Mahlke introduced a fundamental user experience process and research framework, as illustrated in the following figure (**Figure 1**) [12].

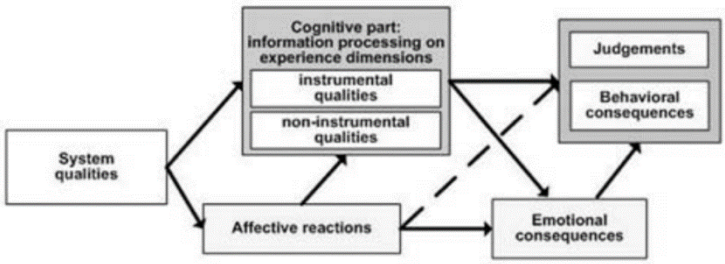

Figure 1. User experience research framework [12]

In the user experience process, the information processing related to the characteristics of experience dimensions is defined as the cognitive component. On one hand, the features of the interactive system influence information processing, with users perceiving these features through their interaction with the system. On the other hand, information processing leads to various experiential outcomes, such as users' behavior and evaluation of the system. Emotional responses and emotional outcomes play a crucial role in user experience, as they interact with and influence the dimensions of experience and information processing. This model includes both the immediate emotional responses generated by interacting with the system and the more complex emotions resulting from product use.

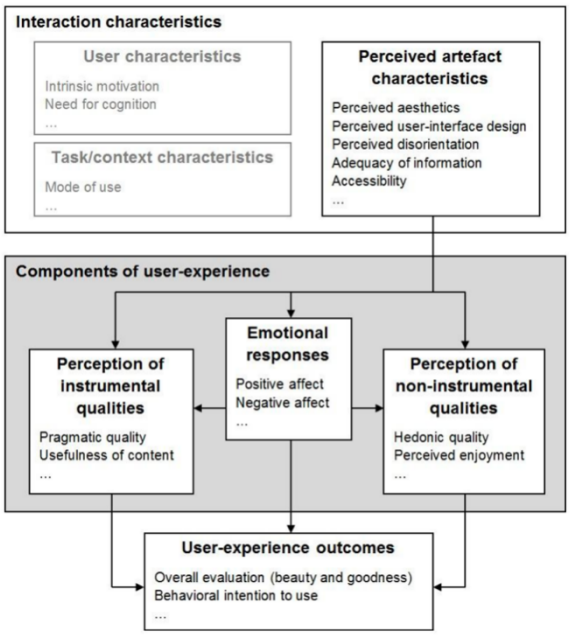

Figure 2. Comprehensive model of user experience [13]

In 2015, Aranyi adopted the CUE model proposed by Thuring and Mahlke as a research framework to explore multiple aspects of user experience in smart home systems [13,14]. The model consists of three stages. The first stage is interactive characteristics, which includes three modules and focuses on various characteristics of smart home systems. The second stage is the user experience part, which includes the user's emotional response (negative and positive) and the perception of the system's functions. The third stage is the result of user experience, which is the user's overall evaluation of the smart home system (and willingness to use it). The model established the existing measurement criteria of user experience factors and collected the questionnaires of news website users on website characteristics, demand satisfaction, emotional response, technology acceptance, and user experience construction

through online surveys. The study constructs a comprehensive user experience model to explain news websites' reception and quality evaluation. The main contribution is to integrate user experience model and technology acceptance model into online website research.

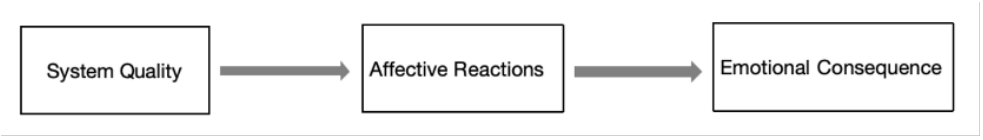

Figure 3. Research framework (adapted from Aranyi, 2015)

Figure 3 shows the research framework of this paper, adapted from Aranyi and Schaik's 2015 user experience framework [13]. This research framework examines how system quality affects emotional responses and how those responses influence user experience outcomes. The relationship between system quality, emotional response, and emotional consequences indicates the transformation process of users' perception of intelligent system performance to generate emotional experience. An important basis for smart home application experience, system quality involves factors such as technical performance, reliability, and interactivity of the system, which will directly affect users' immediate emotions and long-term emotional states [15]. Of course, the user's emotional response to the system is not only triggered by the direct interactive experience but also may be jointly affected by the convenience and security of using the smart home system [16].

Based on these findings, this study developed an integrated model of user experience (**Figure 4**) grounded in cognitive dissonance theory (CDT). Research hypotheses are proposed from the user perspective, and on this basis, an integrated model of user experience was constructed, combining related research on CDT and user experience theory.

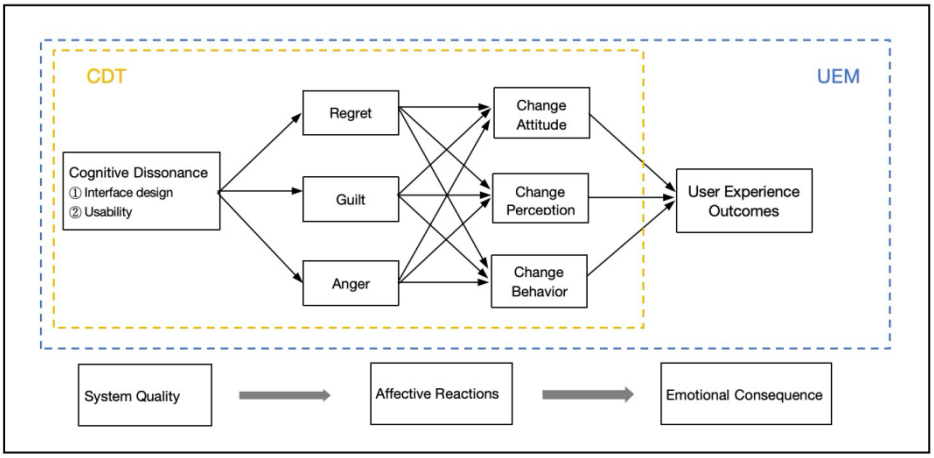

Figure 4. User experience integration model

Figure 4 shows the user experience integration model of this study. According to this model, users tend to have certain psychological expectations before they come into contact with technology or service, and when they actually use the technology, they will be compared with the expectations, which may result in a confirmed or uncertain psychological state [17]. Users tend to be satisfied if their actual experience meets or exceeds their expectations [18]. However, when actual experiences deviate from expectations, cognitive dissonance can be triggered, leading to a range of emotional responses such as regret, guilt, and anger [19,20]. These emotional responses further motivate users to search for information that is consistent with their expectations and beliefs, a phenomenon known as "empathic information searching" [20,21]. Additionally, to minimize this mismatch, users

may take a range of measures such as changing attitudes, changing perceptions, or changing behaviors [22,23]. These measures ultimately affect the outcome of the user's experience with the technology [19]. A positive user experience can increase the adoption rate of smart home systems, while a negative experience may cause users to give up and trigger negative word of mouth [19]. To address these issues, it is critical for designers and developers to understand and mitigate the cognitive dissonance of the user experience.

4. Retrospect and prospect

With the development and popularization of digital media technology, user experience design plays an increasingly important role in the process of continuous exploration and development of interface design. While apps design is getting more mature, it is clearly not possible for designers to rely solely on experience and intuition. Nowadays, users are more concerned about the experience and service. By constructing an integrated model of smart home app user experience, this study explored the effects of cognitive dissonance on users' emotional responses and their subsequent behaviors and experience results. The model suggests that deficiencies in system quality may trigger cognitive dissonance in users, leading to emotional responses such as anger, guilt, and regret. These emotional reactions affect the results of user experience through different behavioral reaction mechanisms and ultimately affect the overall evaluation and satisfaction of users on the app. This study reveals the importance of paying attention to users' emotions. Developers should pay attention to users' emotional responses under cognitive dissonance. By optimizing system quality, providing timely and effective feedback mechanisms and improving user support services, negative emotions arising from app use can be alleviated, so as to enhance users' overall satisfaction and loyalty. The integrated model of this study provides a theoretical basis for the next quantitative research on smart home apps.

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Disclosure statement

The authors declare no conflict of interest.

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