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Study on the construction of cognitive process model based on user security experience

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ABSTRACT

Aim to the study of the basic principle of security experience and influential factors. Method should be based on the combination of three factors (system, user, and operating environment) from the user experience as well as the security psychology theory research. Related theories about cognitive psychology which are based on user insights are main tools to research into the security psychological influential factors of user security experience. The model building and research of cognitive process of user security experience ought to be instructed by the combination of designer perspective and the characteristics of the ACT learning model. The conclusion will put forward the theory framework of user security experience and confirm the inner essence of security experience, leading to the result which is helpful to improve the rationality of the design so that the user security experience will be enhanced.

KEYWORDS

Security experience; Information processing; ACT theory; Security psychology; Knowledge structure; Cognitive process.



INTRODUCTION

Security experience focus on user's deep subjective feeling about security, mainly including reaction in the area of psychological and physiological changes. These changes will affect the user's change of the external behavior and it will further affect the user's status of using the product. Whether security experience is safe depends on its perceived threat and existing hidden trouble and the essential difference between product safety and security experience is that product safety is referred to as product safety property including the stability and reliability of the product while security experience refers to the user's subjective feelings about security during the interaction of user's contact or use of the product. Security experience is an important part in the study of user experience. The research on the user experience factors such as system, users, and environment provide the study of security experience with certain methods for reference.

USER SECURITY EXPERIENCE FACTOR ANALYSIS

The security experience and safety psychology of user have important relations, so based on safety psychology user security experience factor research is divided into the study of factors such as emotional, attention, environment and the relationship between them under the instruction of security psychology which is meaningful to the study of user security experience^[1].

The influence of emotion on user security experience

Emotion is associated with a certain attitude while people are recognizing things or doing the activities that would change the world and people's experience of these attitudes is called emotion^[2]. Emotion is one of the human traits which is the most liable to be affected by outside factors. Studies have shown that three factors mainly affect the person's emotion, namely, environmental factors, physiological factors and cognitive factors.

Person's emotion can cause a person's physiological changes, and thus reduces the cognition level and ability of objective things which will interfere with the user's correct operation, surely leading to wrong operation and reduction of the user security experience. As a result, the mechanism of emotional influence on security experience can be simply summarized as the following: Figure 1.

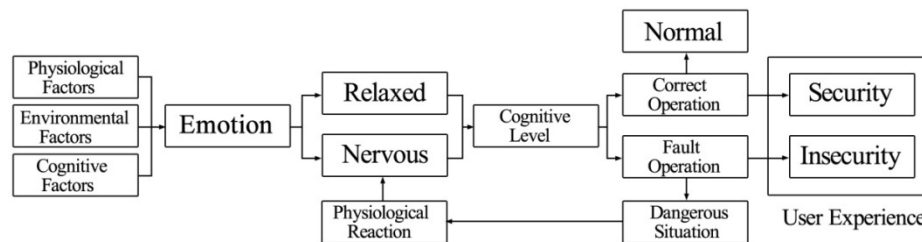


Figure 1 : The mechanism of emotion to the security experience

As we can see from the diagram, only when the outside environment has promoted users to have the positive mood, users can show good physiological and psychological reaction and the correct cognition which can lead to forming the psychological security.

The influence of attention on user security experience

Emotions can lead to the change of user's attention and finally affect the behavior and psychology of user. Attention is the psychological activity which is the directivity and focus of certain objects. Object can be the things and phenomena of the outside world as well as inward experience, so attention in essence is a kind of psychological activity characteristics^[3].

The properties of attention are divided into conscious attention and unconscious attention. Unconscious attention has no clear purpose and arises from the characteristics of the stimulant and things which has a direct interest in main body. Conscious attention is an attention with conscious purpose and certain will efforts. Compared to these two attentions, the difference between them in essence is whether the body of the attention has clear purpose. Compared with unconscious attention, conscious attention is controlled and regulated by the consciousness and belongs uniquely to human. Conscious attention, therefore, have stronger subjective will and users has strong initiative for their own behavior under conscious attention.

The reliability of the user behavior is an important factor to determine whether system is safe. The research proves that good attention and mental state is helpful for users to make the right thinking and judgment under different circumstances so as to choose the correct behavior^[4].

The stimulants such as sharp security signal and reasonably safe operation guidance can cause the unconscious attention of user and it can efficiently turn user's unconscious attention into conscious attention to guide the user to do correct operation, reducing the occurrence of the dangerous situation, and finally result in improvement of the user security experience in essence.

The influence of environment on user security experience

Environment has impact on user's emotion and attention through the regulation of physiology. Light, color and sound has greater influence on people's body and mind, and at the same time different environments have different impact on the user's cognitive ideas, so the mechanism of these three factors' influence on the safe mind of user will be illustrated.

Research shows that about 84% of the outside information is gained through the visual way, the stand or fall of the day lighting and illumination in the environment directly affects the user's visual level of receiving information. The poor lighting conditions could make user produce false visual illusion, cause visual fatigue, reduce the cognitive level and brings negative impact to the user's emotion.

Color is physical display of light. People capture several of color information from the outside world through the cones. Color has effects on people's feeling by lighting which causes psychological activity, changes user's emotion and attention, and affects user's psychology and behavior.

Noise makes people upset and has a negative impact on people's physiology, especially resulting in reducing the auditory sensitivity, causing auditory fatigue and transferring the user attention. Lack of concentration can lead to user's wrong operation and cause danger while good sound environment is helpful for users to have good mood and attention.

The influence of knowledge structure on user security experience

By analyzing the influence of emotion, attention and the external environment on user security mind, overview mechanism of knowledge structure's influence on the user security mind. The user's knowledge structure is the guidance to the user's behavior and reaction, so we can deduce that the user's knowledge structure, to a certain extent, affect the security mind and the corresponding security behavior.

User's knowledge structure itself has two characteristics: one is the common knowledge structure which is called human nature that users have owned at their birth. For example, when people accidentally fall down, they will naturally use hand to support themselves to ensure the safety of the body and head. The other one is the personal knowledge structure referring to users' gain of knowledge in their growth. In the process of forming knowledge structure, the differences of natural and cultural environment, educational degree and past experiences between individuals caused the differences of knowledge structure of each human, especially the cultural educational environment and the working environment leads to the users' various education, experience and knowledge level as well as the difference in users' prediction and awareness of risk, in addition, the individual's knowledge structure of awareness of risk will also make a big difference because of different physical conditions. Color blindness cannot receive, for example, information that color conveys as well as the safe or dangerous signal the color shows.

The users' personal knowledge structure has plenty of types and differs greatly between different individuals, so it's difficult to be researched specifically. And the lack of their own knowledge structure will lead to the user's nervousness and scatter their attention to use the product. According to the actual situation of the research, explore the essence of the user security experience has strong feasibility for studying cognitive process and occurred mechanism of security experience.

THE STUDY ON COGNITIVE PROCESS OF USER SECURITY EXPERIENCE

Nowadays, what the information processing psychology do is trying to use the basic laws of the physical symbol system hypothesis to explain people's complex psychological phenomenon^[5]. Security experience is the user's cognitive process on safety, which essentially belongs to the category of cognitive psychology. Cognitive psychology is a branch of psychology, which in a narrow sense is called information processing psychology.

The overview of general model of cognition process

Security experience is the process of getting, processing and expressing outside information, which is similar to the process of information processing theory. Therefore, narrowly applying information processing theory contained in cognitive psychology to research into user security experience, which namely is the study of the combination of information conveyed by users to the system and the environment and knowledge structure owned by themselves as well as the process of the acceptance, processing, applying, storage and feedback of secure belief, including the study of emotion, attention, memory, psychology, thinking, etc^[6]. According to the common features of cognitive psychology, general process of cognitive psychology can be built. As shown in Figure 2.

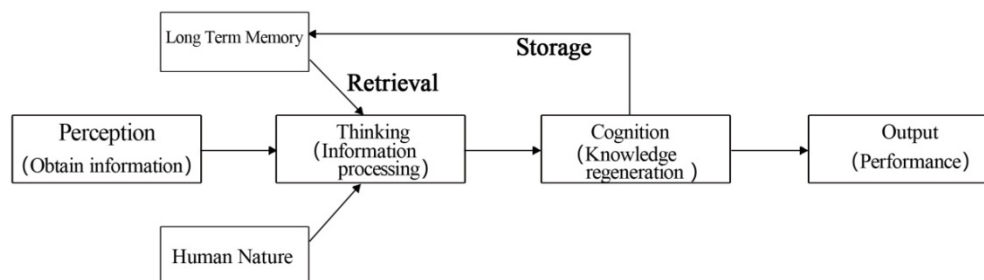


Figure 2 : The general model of cognitive process

As we can see from the diagram, the user's cognitive process is very complex. As an information processor, the user will acquire the relevant information through his organs like eyes, ears, hands and noses and do effective processing which is necessary to make the correct judgment and processing of information, eventually leading to the corresponding judgment^[7].

The overview on user's cognition process based on act learning model

In order to study the inner process of cognitive process of security experience, ACT learning model should be introduced into the research of security experience. Anderson's (1983, 1987) ACT theory^[8] uses the production system framework which makes the difference between declarative knowledge and procedural knowledge. Production formula is the most basic unit to represent procedural knowledge which refers to the sequence of conditions stored in people's memory chronically---action form of knowledge rules. ACT theory points out that the human brain usually have to undergo three stages of development from declarative knowledge to procedural knowledge^[9]. Security experience in essence is a kind of cognitive process from which users can keep learning and accumulating the belief and experience of safety, so the security experience also accords with a condition -action rule. Security experience is a kind of production formula. Summaries of three stages of general cognitive process are as follows:

The first stage is declarative or "active conscious" phase. In the process of the using product or system, new cognitive information related to security is considered as declarative facts and temporarily exists in the brain's working memory. The brain can only rely on the declarative knowledge in the initial stage of generating new production formula. At this stage, the user must take the initiative to consciously use the general rules of production formula to process declarative knowledge consciously. During this period, users need to make more efforts to acquire cognition.

The second stage is knowledge organization or the "contact" phase. In this phase, the relationship storage and retrieval matching phase between new acquired cognitive information and existing knowledge structure should be done. The brain needs to constantly invoke the long-term memory of knowledge structure and the general generation rules, attempting to make relationships between the knowledge structure and related cognitive information in further-programmed and combinative ways.

The third stage is the stage of conversion between process of new production formula and existing production formula and the stage of "automatic unconscious" phase. At this stage, the user will search in the long-term memory for production formula or general generation rules which match with the current conditions. If the production formula or generating rule is retrieved, they will be used to solve the current problem. When there is no production formula, this subject needs to take some cognitive efforts. In the end, when the subject becomes familiar with the type of product or system, production editor will help form a new and simpler production formula which does not need too much cognitive efforts and it will be stored in long-term memory. When the new production formula appears, the main body runs across the similar cognitive information and the brain will automatically call the production formula.

ACT theory can further study the cognitive process of the user security experience and its inner mechanism to provide a reasonable basis for improving the user security experience. Therefore, on the basis of ACT theory research, the model of cognitive process of user security experience is finally established by using security psychology as the research object and studying security experience directed by the idea of information processing in cognitive psychology.

THE MODEL BUILDING OF COGNITIVE PROCESS OF USER SECURITY EXPERIENCE

Compared with any theory in the past, considering the brain as a computer and speculating the programming process of mental activity can let us make more accurate and detailed explanation on the operating mechanism of the mind, and doing simulation with computer is helpful for us to understand the achievements and limitations of various theoretical models^[10].

ACT study theory can not only describe cognitive learning process of user security experience well, but also can explain the cause of unconscious security experience. Therefore, the research and application of the general process model of combination between cognition and paper, the factors of security experience and ACT learning model in the security experience, the construction of the cognitive process model theory knowledge framework of user's cognitive security, and a preliminary understanding of the basic principle and mechanism of security experience should be completed.

Summary of secure in user experience layer

User element is the most core element of the security experience, and is also the main body of the generation process of production formula in the ACT theory. Security experience is for the user and it is about the user's trust in the product safety. The Change of system and the environment will only affect the process of user experience, but the final result of experience is decided by the user. Therefore, the study about user part of cognitive process of security experience should focus on the user knowledge structure, emotion, attention, etc.

Summary of secure in systematic experience layer

Production system is the objective part of security experience activity, including products like website construction, physical product and APP that has a direct or indirect contact with users. Product attribute contains function, form, color and brand effect, etc. When the user is in an unsafe situation, they tend to feel uncomfortable or nervous which will affect the user's security experience. In this case, users need to release the psychological burden. If properties of a good product design

can solve the user's sense of psychological potential insecurity very well, then the user will consider this product as "safety", resulting in user's trust on the product.

Summary of secure environmental experience layer

Environmental elements, referring to environment which contains only climate, illumination, color and sound, etc., here are referred to as natural environment. The former analysis of study on secure psychology shows that the natural environment will produce certain affection on the user's physiology and psychology which will influence the user's cognitive level and correct efficiency. In the user's cognitive process, not only the natural environment, but also social environment and cultural environment can affect the user's cognitive conception. In this case, the user's cognitive conception and focus can make a difference. Therefore, the design of products should be consistent with the user's cognitive conception under the current environment, and product should be positioned differently according to different circumstances. At this time, the design and positioning of the product should further highlight integrity of security experience.

Cognitive process model of user security experience

Three phases of user cognitive process which are put forward combined with ACT theoretic study model framework and cognitive process model of user security experience which is preliminarily built targeting the factors of user security experience are as follows: Figure 3.

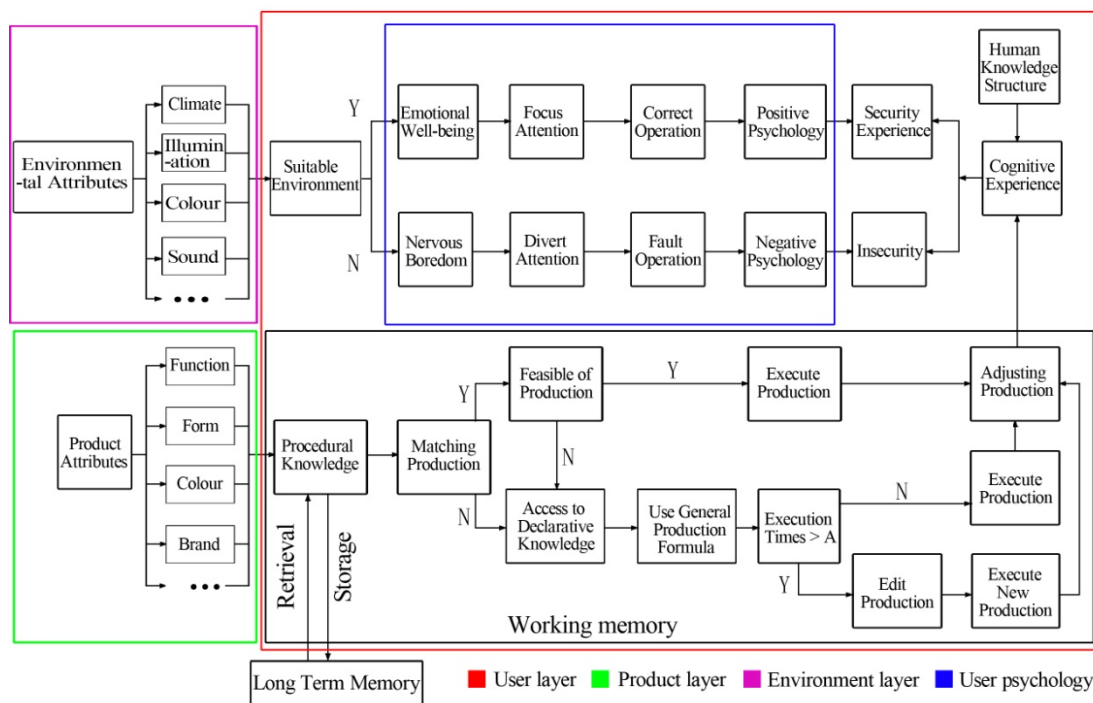


Figure 3 : The cognitive process model of user security experience

We can see from the diagram that when users begin to contact with the product, the user's brain will firstly turn all product information including color and shape into declarative facts, then the brain will retrieve from the working memory if there is a suitable procedural knowledge or a general rule, that is to say, the user previously whether or not to use the product or similar products or have the similar operation process. If the production is feasible, the user's brain directly execute and adjust production. At this time, under the joint influence of the external environment and user psychology, user will produce the belief of product called "familiar" and "security", and produce the relevant secure psychology. If there is no such procedural knowledge or the general rule, experience process will become complicated. At this time, the brain will get the information of product or system, namely obtaining the corresponding declarative knowledge. At this time, the brain will retrieve the existing declarative knowledge and use the general rules to process information, and generate the initial production. When the quantity of executing general production reaches A, the initial production will be simplified and declarative knowledge are integrated into the new production. New production does not have to retrieve the declarative knowledge and directly gets into the working memory to be carried out. The new production will produce corresponding user experience under the influence of factors such as user emotion, attention and external environment which will write into long-term memory. At the same time the production will be stronger to promote the later match and increase the possibility used to solve the problem, finally automatically being used and developing into habitual security experience. In the process of security experience, declarative and procedural knowledge cooperate with each other and working memory and long-term

memory cooperate and transfer between each other which collectively complete task about user's security experience under the action of environmental factors, the product system and user knowledge structure.

CONCLUSION

Exploring the main influence factors of user security psychology through the research method of the security psychology theory and the application of theoretical results, the results show that mood, attention and knowledge structure of the user and the external environment play an important role in the influence on user security psychology. The study on security psychology also shows that good security psychology helps reduce the occurrence of unsafe situation and is the most direct way of improving user security experience. Therefore, based on the affective mechanism of emotion, in addition to the irresistible natural physiological factors, user will be allowed to achieve the purpose of the using product function with fewer steps to a large extent through simple and reasonable product functions and the reasonable layout and design of the interface. On the above basis, the user's boredom and helplessness may occur rarely to help users produce the correct cognition and the joyful mood and reduce the user's unpleasant feeling of usage which can reduce wrong operations and ultimately enhance its security experience. Based on the mechanism of attention, let users produce conscious attention to the possible dangerous situation and take the initiative actions to consciously operate and use the product or system and reduce the happening of the risk in order to enhance security experience through a simple perfect tutorials and a training before usage. Based on the mechanism of environment, intensity of illumination and color use in the working environment or operating environment must conform to safety standards. Reasonable and comfortable environment can ensure the user's physical health while in the use of products and reduce the happening of dangerous situation due to physical discomfort, finally enhancing its security experience. Based on the mechanism of knowledge structure, while the user is doing dangerous operations, there is a clear hint and user is required to confirm the danger to make sure that the user can get the appropriate protection. In addition, adopting reasonable protection device and reversible operating procedures on error will allow the user to generate and enhance confidence in the system security so that users can use product safely and won't have the nervous moods which eventually lead to dangerous situations because of the defects of their own knowledge structure. Finally, the research of user cognitive process based on cognitive psychology and the study on cognitive process model of user security experience which combines the learning model theory of ACT and building theoretic framework of security experience can further understand the inner mechanism of user security psychology. In addition, the relevant theoretic study which specially discusses human cognition in ACT theoretic study and the cognitive psychology has made some practical achievements, providing a new research perspective for the user experience research.

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REFERENCE

- [1] Jizu LI; Safety Psychology., Chinese labor and Social Security Press; Beijing,(2007).
- [2] W.G. Parrott; Emotions in social psychology: Essential readings., Psychology Press/Taylor & Francis; Philadelphia, PA, (2000).
- [3] Hui SHAO, Qing Xian ZHAO, Xiukun GE; Safety Psychology and Behavior Management., Chemical Industry Press; Beijing,(2011).
- [4] Jiazheng-ZHAO, Liqing-CUI, Yongjun-LI; China Safety Science Journal.,8,54, (1998).
- [5] Sima He; Human Cognitive - The Information Processing Theory of Thinking., Science Press; Beijing,(1986).
- [6] Cheng-BAI, Liren-GAN, Xianchen-ZHU; Information Theory and Practice., 32,94,(2009).
- [7] Ling-ZHANG, Guotao-ZHOU; Psychological Science.,26,870,(2003).
- [8] Anderson, J.R.; The Architecture of Cognition. Cambridge., Harvard University Press; (1983).
- [9] Anderson, J.R.; Learning and memory: An integrated approach., Harvard University Press;(1995).
- [10] P.Sagard, Jing-ZHU translate; An Introduction to Cognitive Science., University of Science & Technology China Press; Hefei, (1999).