The Research on the Application of Incentive Mechanism in Interactive Design of Rehabilitation Products for Elderly Stroke Patients

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Abstract. The challenge of aging has become increasingly serious in today's China. Among the elderly population, stroke is a disease with characteristics of high incidence, high morbidity and high mortality. Based on the understanding and analysis of aging users and stroke rehabilitation status in China, this paper discusses the way to improve the interaction between the users and the product, so to provide the elderly patients with more convenient, relaxed and interesting experience, as well as a positive and optimistic atmosphere through focusing on their emotional experience and the real needs. To achieve these, the incentive mechanism is introduced. The aim is to help the elderly restore activities of daily living and return to society soon through a more scientific and humane way. Moreover, this paper attempts to explore the interaction design approach and application measures based on the incentive theory, and provide reference for the design and development in this field.

Keywords: The aged · Stroke · Rehabilitation · Incentive mechanism Interaction design

1 Introduction

China is facing an increasingly serious challenge of aging. 241 million Chinese people are aged 60 and above, accounting for 17.3% of the population [1]. Stroke is a cerebro-vascular disease with a high incidence among the middle-aged and the elderly. It is predicted that, by 2030, China will have 31.77 million stroke patients. Besides, inadequate prevention and intervention lead to high incidence of disability. Compared with the recovery rate of over 80% in developed countries, 70% to 80% stroke patients in China cannot live independently because of hemiplegia, aphasia and different levels of disability. Patients with Severe disability accounted for about 40% of the total [2, 3]. A large number of patients with stroke will generally have one or more kinds of obstacles, such as motor disorder, speech disorder, cognitive disorder, psychological disorder, etc.

Yet Medical science has proved that timely, continuous, standardized and reasonable rehabilitation procedures and rehabilitation programs suitable for the patients can reduce the disability rate of patients, reduce the incidence of complications, promote rehabilitation [4]. This can also improve patients' quality and satisfaction of life, reduce potential nursing costs and save social resources. Therefore, the question of how to provide better rehabilitation treatment and services for elderly stroke patients is of significant meanings and challenge.

2   User Needs Analysis of Rehabilitation Process and Rehabilitation Products for Elderly Stroke Patients Based on Incentive Mechanism

2.1   Incentive Mechanism and Its Basic Process

Motivation Mechanism is also called Motivation System. It was originally a western management mode, guided by the motivation principle of psychology, with management psychology and economics as the core. According to the theory of incentive mechanism, the incentive subject takes the corresponding incentive measures to the incentive object in order to achieve the established purpose, so that the motivation of the incentive object can be produced, maintained and reinforced. An effective incentive mechanism emphasizes endogenous motivation rather than simple external motivation [5]. It is an excellent and important way of motivating people to achieve their stated goals, and continuous improving work efficiency.

In modern rehabilitation medicine, the rehabilitation exercise therapy based on central nervous system restoration has been proved to be the most basic and active rehabilitation therapy for stroke by clinical rehabilitation medicine. It is also the most widely used treatment in rehabilitation medicine at present. The stimulation mechanism can achieve better rehabilitation effect by strengthening the central nervous system.

The basic process and mode of the Motivation Mechanism are driven simultaneously by several factors, namely, need, internal driving force, inducement and purpose. Incentive mechanism reflects the interaction between incentive subject and incentive object through a set of rational system.

2.2   Analysis of Treatment and Rehabilitation Process

2.2.1   Rehabilitation Process of Elderly Stroke Patients

Generally, the rehabilitation process can be divided into five stages: early stroke, stroke palsy, stroke spasm, relative recovery and sequelae. Wheelchair, orthodontic appliance, etc. will be needed during the sequelae stage 6 months after the rehabilitation. Therefore, the main rehabilitation recovery training focuses on the early three stages. During early stroke period, retarded body position and simple passive or active training should be applied. During the stroke spasm period, basic control training, coordinated training, muscle strength and endurance training should be applied. During the recovery period, limb control, exercise training, speed and refinement are required.

2.3   Analysis of Product Requirements for Elderly Stroke Patients

In September 2015 and October 2017, the research group investigated the rehabilitation departments of three Shanghai general hospitals, a rehabilitation department of a community hospital, a rehabilitation center and some elderly people from communities in Shanghai. In total, 380 questionnaires were distributed, and 354 valid questionnaires were collected. In this survey, the ratio of men to women are roughly equal, with 53% men. 10% of the respondents are over 80, 47% are over 70, and 43% are between 60 to 69 years old. Because some elderly patients with stroke have limited ability in movement and language, some of the questionnaires were completed by family members or rehabilitation doctors. The relevant findings are as follows.

2.3.1   Treatment Methods for Elderly Stroke Patients
The data shows that only 22% elderly stroke patients use the instruments, 32% uses comprehensive treatment. The rehabilitation treatment is mainly hospital counseling. The proportion of patients with continuous rehabilitation training is very low, while the workload of medical staffs is very large.

2.3.2   Evaluation of Rehabilitation Products
36.5% Rehabilitation users believe that variety of products cannot meet the needs of the rehabilitation, 54% believe that the rehabilitation products are not effective, 57% believe that the products are too heavy, 42% believe that the products are inconvenient in operation, 20% believe that the function is too simple, 56% believe that the products look like unfriendly machines. In majority, the elderly stroke patients believe the existing rehabilitation products lack variety and cannot meet the demand, with unsatisfactory effect, inflexibility, complex operation and there is a sense of panic, and dislike the appearance of the product. Some believe that the price is too expensive.

2.3.3   Expectations of the Elderly Stroke Patients
50.4% of the patients expect products to have timely feedback function. 58% expect illness records, 72% expect to use at home, 50% expect to have timely alarm or notification, 52% expect to promote family feelings and entertainment, 58% expect to receive instructions in the usage process. 38% expect the price to be not too expensive, 42% expect to improve loneliness and have more communication.

2.4   User Characteristics of Stroke Rehabilitation Products

2.4.1   Physiological Characteristics of Elderly Stroke Patients
The elderly patients in tardy period (that is, the early stage of stroke and the period of palsy) have features like loosen muscle, low muscle tension, weakened sensory functions, decreased intelligence, mental disorder and impaired autonomic nerve function, etc.

The elderly patients in spastic period begins to recover muscle strength. Part of the limbs can start to move, can drive the whole range of joint movement under the condition

of weight loss, can complete the motion like turning around and sitting up in bed. The main purpose of rehabilitation treatment at this stage is to reduce and suppress spasms.

The elderly stroke patients in recovery period have less spasms, separated movements can be achieved by limbs. The patients can could walk, while there might be abnormal gait, namely cognitive ability obstacle, causing perception difficulty to live independently.

2.4.2   Psychological Characteristics of Elderly Stroke Patients

Stroke patients will be nervous, panic, depression at the early stage of rehabilitation. When the progress of rehabilitation is not obvious, they will be impatient and constantly complain as their willpower decline, and their dependence will increase. They will abandon themselves and refuse to participate in rehabilitation training. When the patient can gradually face up to reality, admit their physical defects and understand the rehabilitation process, there will be less negative emotion and psychological disorder. The patient will begin to cooperate with rehabilitation treatment actively, with active idea of striving for self-caring.

Stroke patients need more care and positive support from doctors, family members and society to help them recover soon. But it is not enough to guide and adjust patients' the negative psychology. It is also necessary to keep the elderly stroke patients in a positive environment in order to promote their optimism.

3   Analysis on Incentive Factors in the Rehabilitation of the Elderly Stroke Patients

The incentive factors of stroke rehabilitation for elderly patients are mainly divided into three aspects: elderly patients themselves, rehabilitation products, and rehabilitation medical staffs and family members (it will not discuss in this paper due to the limited words).The incentive factors of the elderly patients themselves are the center of the interaction between the product and the user. The incentive factors of the rehabilitative medical staff and the family members, and the incentive elements of the rehabilitation products are the external. They will stimulate internal factors based the cooperation between the two. Only the combination of internal and external incentive elements can promote the effective advancement of the complete rehabilitation process of the elderly stroke patient.

The qualitative research on users in interactive design generally includes five aspects: Activities, Attitudes, Aptitudes, Motivation and Skills. According to the inspiration of incentive mechanism, the use of stimulating rehabilitation products is a persistent reinforcement of rehabilitation in terms of Activities, Attitudes and Motivation for the elderly stroke patients. According to the incentive theory and the particularity of the elderly stroke patients, the interactive design should adopt both the means of positive reinforcement and negative reinforcement, and map them to the incentive elements in design.

3.1   Internal Incentive Elements for Elderly Stroke Patients

The internal incentive elements mainly include: expectations and confidence, recognition, rights, attribution and inclusion, attention, satisfaction, sense of achievement.

Elderly patients hope to return to normal life and society through rehabilitation. In the rehabilitation process, they hope to understand the progress of rehabilitation. After completing the rehabilitation task, they hope to get the affirmation and guidance of the medical staff. Timely feedback and guidance will encourage them to be more confident and concentrate on rehabilitation training, and get a sense of satisfaction and achievement. It will help them to restore the confidence of surviving and overcoming the disease.

### 3.2   External Incentive Factors Based on Rehabilitation Products

The external incentive factors mainly include: physical characteristics,control, fault-tolerant and feedback. The appearance, color, texture and other external physical manifestations of rehabilitation products make it easy for elderly patients to accept and adapt. The operation should be simple and easy to use. The controllability is strong, and timely feedback of rehabilitation information can be corrected for misoperation without friendly measures. There will be failures, letting them feel that they are respected. All these can weaken or even eliminate their fear and conflict of rehabilitation to a certain extent, trigger their interest, and increase their expectations for rehabilitation.

4   Application of Incentive Mechanism in Interactive Design of Rehabilitation Products for Elderly Stroke Patients

4.1   The Implementation Framework of Incentive Mechanism in the Interactive Design of Rehabilitation Products for Elderly Stroke Patients

On the basis of clarifying the elements of rehabilitation motivation for the elderly stroke patients, the author divides each rehabilitation training process into three stages: initial, development and end, and analyze along the timeline. The framework is separated into internal and external motivational factors, and the factors influencing the rehabilitation effect on elderly stroke patients. These correspond to the three levels of initiation, maintenance and strengthening of the incentive mechanism. The model of the rehabilitation incentive mechanism for the elderly stroke is put forward in Fig. 1.

Since stroke rehabilitation for the elderly is a long period of treatment, rehabilitation training also needs to be carried out continuously, from passive treatment to active movement. Therefore, the three stages of rehabilitation training in this model are continuous circulated until the patient is fully recovered. Only when the internal and external motivating factors work together can they bring stronger incentive effect, so that the elderly patients can recover their mental and physical functions happier and faster.
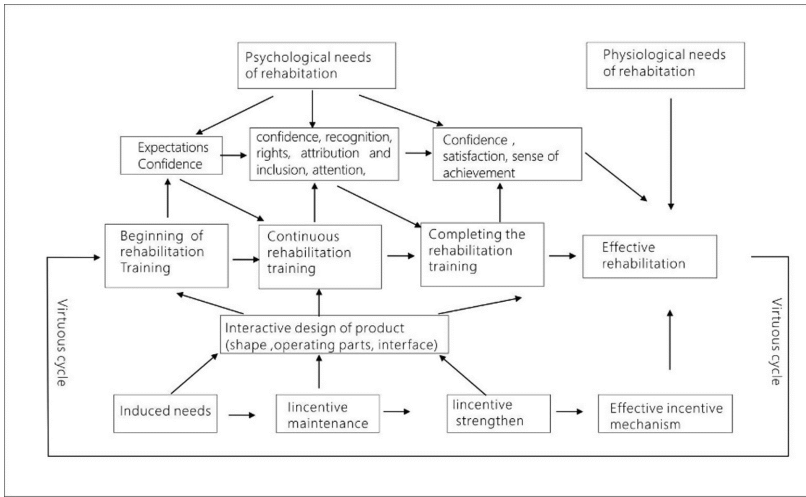
Fig. 1. The model of incentive mechanism of rehabilitation products for elderly stroke patients (Source: author)

4.2 Interactive Design Measures of Rehabilitation Products for Elderly Stroke Patients Based on Incentive Mechanism

The design measures mainly follow the incentive mechanism and revolve around the goal of creating a virtuous circle, from analyzing users' demand to strengthening their self-rehabilitation consciousness and behavior.

4.2.1 Meet Individual Rehabilitation Needs with Scientific Orientation

Reasonable rehabilitation orientation can make the patients accept it quickly, and can recover their mental and physical functions more effectively. It can be reflected in two aspects:

Firstly, rehabilitation doctors can provide users with personality rehabilitation training goals according to the elderly stroke patients at different stages of rehabilitation, specific symptoms, impaired function or limbs, so to deliver professional rehabilitation guidance to patients.

Secondly, rehabilitation doctors can provide the patients with functional- and environmental-matching rehabilitation products according to the rehabilitation plan for elderly stroke patients.

4.2.2 Stimulate Rehabilitation Needs with Reasonable Semantics and Safe Functional Structure

According to the psychological characteristics of the rehabilitation phase of stroke patients, the shape of the product,as an external incentive element at the demand-inducing stage in the model of incentive mechanism should reflect as far as possible the sense of affinity, trust, science and technology, and security. For example, the shape

should be round and concise, with warm or clean color. The materials should let the users feel the warmth and caring. In the design of functional components and operating methods, it should be clear, concise, accurate, so that patients benefit from receiving information and trust the product, and their need for rehabilitation can be simulated. Safety is an important feature of medical products. The stability of the hardware and the software interface should be ensured to avoid unnecessary shock or other negative effects on patients.

4.2.3 The Rehabilitation Behavior Guided by a Hierarchical Rehabilitation Model

Rehabilitation treatment is a long-term, continuous process, following the incentive mechanism from initiation, maintenance to reinforcement. Correspondingly, the settings of rehabilitation product function and interaction design should follow the steps from simplicity to complexity, from completely passive, assisted-active, to completely active anti-resistance exercise, so to prevent elderly patients from falling self-confidence, inferiority and abandonment of the rehabilitation due to difficulties and failure in operation. Therefore, the design of rehabilitation products should be based on the rehabilitation plans and rehabilitation needs of different patients, and set the multi-level functions, order, duration, frequency and intensity of the products. This can keep the patient in the virtuous cycle of taking the challenge, proof of competency, taking further challenge, thus enhance the difficulty of training, as well as maintain and strengthen patients' confidence in rehabilitation. Based on the types and means of rehabilitation, a variety of functional models can be set up in the product design of rehabilitation products. Even for the same rehabilitation condition, multiple types of detailed training models can be set up for selection and setting, so to improve the pertinence and practicability of the rehabilitation program.

4.2.4 Maintaining the Incentive Process in a Multi-channel Interactive Manner

By utilizing multiple sensation channels and movement channels, it allows the users to implement rehabilitation training be convenient, quick and accurate. For example, interaction ways like easily-identified pictures, comfortable lighting and material, or friendly and clear sound can communicate information clearly. These methods are designed and used to coordination with the patient's operating behavior and psychology as much as possible, to avoid users' tension, anxiety and lack of concentration. Feedback content is reinforced by a variety of interactive means and forms. This can offset the elderly stroke patients' deficiency in the body and perception ability, and fully mobilize and balance the patient's 'physiological resources'. When the patient is at a loss, light, sound and other information reminders to guide the patient to solve the problem. When the motion slows down, or when the patient is at a low exercise speed due to the low muscle strength, the motor can provide driving force to assist the patient to complete the training. Rehabilitation product design needs to express humanistic care and respect for elderly stroke patients and fully meet their special needs in order to maintain the use.

4.2.5 Simplified Interaction of the Operating System and Increased User Motivation

The muscle strength, body coordination and cognitive ability of the elderly stroke patients in rehabilitation stage decreased significantly, so the response speed of the product system of rehabilitation in the elderly stroke should be coordinated with the response speed of the nervous system of the elderly. The reaction speed should not be too fast; the operation interaction should conform to the life experience and thinking mode of the elderly patients, try to be concise and clear, intuitionistic and clear, reduce the part that patients need to think when using the product, Take instinctive action or habitual behavior, easier to master the operation. Keys and forms of operation semantic precision; operating parts controllable, easy to control; high product fault tolerance; data rendering graphical are all to give users a sense of accomplishment. Stimulate continued use of possible effective means.

4.2.6 Introduction of Entertainment and Fun Interaction to Increase Incentives

The elderly stroke patients lack patience for long-term rehabilitation training. This is unfavorable for them to return to social life later. The integration of entertainment and training meets the emotional need, and can temporarily divert patients' attention. This can improve the relationship between doctors and patients and the rehabilitation status effectively. In the design, games can be adopted to combine the rehabilitation process and actions with the scene, process and operation behavior, to encourage the patients to participate in the rehabilitation and thus improve recovery efficiency. It also has a good effect on post-stroke depression. It can also be set up as multiplayer games or entertainment, such as music activities, sports competitions, art shows, etc. The form needs to be decided based on patient's psychological needs.

(1) Task-oriented entertainment games

Among the many rehabilitation training forms, game is the most popular and attractive one. It also meets the needs of the elderly patients for the fun and quantification of rehabilitation goals. The variety of interaction and communication forms in games can reduce the learning cost and enhance the participation of the elderly stroke patients. These meet the requirements of the incentive mechanism model.

For example, simple rehabilitation games can be set up according to the flexion and extension of the patients' lower limbs. The plasticity and the brain function can be stimulated by the combination of interactive training and exercise. A wide range of types and content with regular updates can maintain patient's freshness and sustained attention.

(2) Participatory and collaborative

The characteristics of the elderly determine the fact that they love to participate in mass and cooperative activities. There is such a need among the elderly stroke patients, and they hope for the care. The rehabilitation games can adopt the double player training mode, so that the patients and patients' families can get involved, especially the young generation. This can not only improve patients' social communication and language

ability, but also bring comfort psychologically, enhance the kinship communication and stimulate the recovery enthusiasm.

4.2.7 Providing Evidence for Sustained Rehabilitation Through Systematic Data Monitoring and Evaluation

Elderly stroke patients have longer treatment and rehabilitation cycles, and may also suffer from many other related chronic diseases, which require long periods of observation and recording. Intelligent rehabilitation products can track and record patients' actual rehabilitation data. After storage and analysis, more concise and accurate expressions such as curves and histograms are fed back to patients intuitively to let them understand the progress of rehabilitation. At the same time, these data are fed back to rehabilitative medical staffs, so that they have a better basis to develop a follow-up rehabilitation plan for the patients.

5 Conclusion

With the progress of economy and technology in China, the improvement of living standard and humanistic accomplishment, the rehabilitation medicine and aging industry will certainly develop rapidly, and the rehabilitation medical system will be more complete. As the link of interaction among the elderly stroke patients, their families, the rehabilitation institution and the medical staffs, the rehabilitation products for elderly stroke patient will be optimize in terms of its functional system, feedback mechanism and interaction mode, to bring relaxed and happy recovery experience. For the product design of the elderly, cooperation in design, medicine, psychology and other fields are needed to achieve real humanistic care, so to make the life better for the elderly.

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