

# Research on Cognitive Inquiry and Interactive Product Design of Alzheimer's Disease

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## Abstract:

**Objective:** According to the investigation and study of elderly patients with Alzheimer's disease, combined with music therapy, following the design principles of the elderly toys, a music rehabilitation toy is designed, which aims to alleviate the elderly's condition. **Methods:** Through literature search to understand the symptoms and cognitive impairment of Alzheimer's disease, and through field research and in-depth interviews, to investigate and summarize the psychological and physiological characteristics of the elderly, to understand their living and behavioral habits and interests, and then Combine the physical characteristics of the elderly, design products and rationalize functions by following the design principles and design methods of the elderly. **Conclusion:** Through the observation and refinement of the elderly's preferences and behavioral habits, combined with the needs of elderly patients with Alzheimer's disease to strengthen their physical fitness, consider a scientific, safe, easy-to-operate, etc., to design a physical exercise and music. A game-based interactive product with a smart app with personalized customization of track selection and motion recording and deep data analysis.

## Keywords:

Alzheimer's Disease, Mild Cognitive Impairment, Music Therapy, The Elderly, Interactive Products

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## 1. Introduction

Chinese society is in a stage of general population aging. Relevant data show's that by 2017, the number of elderly people over 65 years old (including rural and urban) in China has reached about 150 million, accounting for 11.4% of the total [1]. With the increase of the number of elderly people year after year, Alzheimer's disease (hereinafter referred to as AD) has also attracted more attention. A research report has pointed out that there are about 75million new Alzheimer's patients in China, and it is highly likely that the number will continue to increase [2]. In the face of such a large and growing number of Alzheimer's patients, the market reaction is not satisfying. In fact, few products are designed for them in the domestic market.

## **2. Cognitive Behavioral Characteristics**

### ***2.1. Cognitive Behavior***

Cognition refers to the ability that external information is used to indicate and guide daily life learning after being processed by the brain. Cognitive impairment refers to the impairment of perception, logical thinking, memory reasoning, judgment, language action, etc. According to the cognitive situation of patients, Alzheimer's disease can be divided into three periods, namely mild, moderate and severe dementia, and the performance of each period is different.

In the mild dementia stage, the main performance is a sharp decline in short-term memory ability, especially the ability of instantaneous memory, having difficult in distinguishing the direction, emotional abnormalities, language nervous system problems, etc. In the stage of moderate dementia, the main manifestations are the destruction of long-term memory and short-term memory, the deterioration of direction discrimination and self-care ability, the difficulty of calculation, and the impatience of emotion. In the stage of severe dementia, it is difficult to take care of oneself, limb stiffness, coma and infection.

### ***2.2. Research on Mild Cognitive Impairment***

In mild dementia, the most common is memory disorders, such as forgetfulness, getting lost, forgetting names, etc.; logic disorders for unclear calculation; understanding disorders for being unable to understand other people's words, etc.; judgment disorders for being unable to correctly think and understand problems, and make judgments, etc.; executive disorders for wearing clothes inside out; The main performance of ability disorder is discontinuity of speech organization, naming problems and so on.

## **3. Current Status of Treatment of Alzheimer & Apos's Disease**

The cause of Alzheimer's disease has not been determined medically, and there is no way to cure it completely. At present, drug therapy is mainly used to delay the disease, but it is easy to cause side effects [3]. Therefore, on the basis of drug therapy, other ways of adjuvant therapy are generally used to improve the cognitive behavior ability and self-regulated life ability of patients [4]. At present, the adjuvant treatment of Alzheimer's disease mainly includes cognitive behavior training, psychological intervention, physical training, music therapy, etc [5].

### ***3.1. Non Drug Treatment***

#### ***3.1.1. Cognitive Training***

Cognitive training for patients with Alzheimer's disease, that is, the training of cognitive function [6], mainly to develop the brain functions of language, reasoning, logic, calculation and so on. Generally speaking, it is to train the patients to relearn these functions, to interfere with their cognitive abilities of thinking, memory, reaction, emotion and so on, so as to help the trainees improve their cognitive level.

#### ***3.1.2. Psychological Behavior Intervention***

Behavior intervention is to help the patients mitigate illness and improve their condition through psychological expression of care and assistance for patients, such as

the attitude and language of family members towards patients, and the familiarity and suitability of environment and light, so as to achieve the purpose of behavior intervention.

### ***3.1.3. Physical Training***

Physical training, that is, exercise therapy, as the name suggests, is a training method that can help patients to use some equipments, cooperating with some exercise methods, and rely on their own strength to regain the body movement function and restore the consciousness function. Aerobic training is one of the most simple training methods, such as walking, aerobics, running in situ, rope skipping and so on, which can improve the cardiopulmonary and body metabolic function; improve the patient's emotional and psychological conditions; to delay the development of the disease as a whole (including attention, physical flexibility, executive ability cognition, etc.).

### ***3.1.4. Music Therapy***

It is widely accepted that, music is an art that reflects the real emotion. The reason why we can perceive and process music works is that we have the ability of memorizing music. Research shows that music memory has the most complex neuroscience basis [7]. For the elderly patients with AD, although they will lose short-term memory in the early stage of the disease, some studies show that the long-term music memory ability of patients with Alzheimer's disease is relatively well preserved, especially the deepest memories of patients' popular resonance in their young songs. Because of the reaction ability of patients with dementia to music retention, people concerned began to carry out human intervention through music therapy. Music therapy in the treatment of Alzheimer's disease is expect to achieve the following goals: a. enhance the ability of vocabulary organization; b. extend long-term memory; c. enhance transient memory; d. strengthen social interaction; e. improve the ability of direction discrimination; f. relieve tension; g. improve mood and so on [8].

## **4. Product Design Specification for the Elderly**

Due to the physiological problems of the elderly, such as the decline of vision, hearing, memory and reaction ability, when designing products for the elderly, we should not only meet the functional needs, but also care about the physiological and psychological characteristics of the elderly.

### ***4.1. Product Design Principles for the Elderly***

For the design of products for the elderly, we should comply with the following design principles: a. ease of use: take the physical condition of the elderly into account, make it easier to learn and remember, even learn without guidance and training, while maintaining the most important functions. b. Safety: safe green materials are needed. In terms of product design function and operation, there will be no potential threat to the body of the elderly. c. Product semantics: when designing products, fully consider the self-esteem of the elderly and avoid the negative and bad psychological effects of the products. d. Interesting: product design should be based on the preferences of the elderly, so as to improve the utilization rate and participation enthusiasm of the product.

## ***4.2. Design Specification of Intelligent App for the Elderly***

With the rapid development of the Internet, the design of intelligent app based on the special users of the elderly should not only meet the needs of the elderly, but also conform to the design specifications when designing the app interface: a. Categories division: put the similar functions on a page for easy identification. b. Simple structure: the content to be expressed on the interface is simplified, so that the interface content is simple, and the level is reduced, so as to help the elderly make a quick choice. c. Intuitive: the interface should be more intuitive, Reduce the hidden function, which makes it direct, quick and effective to identify the corresponding key function. [9]

## **5. Product Design Examples**

### ***5.1. Product Overview***

According to the previous research results and literature search methods, this product is an interactive product designed for the elderly over 65 years old with mild dementia, with the main functional features of physical exercise, music memory enhancement and emotional relief. Its functions include: a. Take music game as the main function, provide a safer and more convenient way of exercise, as well as mental exercise and physical exercise. b. through data analysis, recommend interested personal tracks to achieve better treatment effect. c. App collects personal game data and feedback to patients' families and doctors in the form of charts, more intuitively see the product effect, in order to timely intervention and treatment.

### ***5.2. Product Design Analysis***

This design is called "pebble music game blanket", which mainly includes a physical product and an intelligent app.

#### ***5.2.1. Product Design***

Taking music as the starting point, combined with the dance blanket and other game toys popular among young people nowadays, the traditional impression of the elderly products is changed. While considering the safety of use, a positive, healthy, energetic, colorful and fashionable atmosphere is created to make the products more attractive, so as to attract the eyes of the elderly. At the same time, the songs selected should conform to the long-term music memory of patients. This product in: a. shape, it looks like a dance blanket, and has nine pieces of pebbles that can make notes sound, which can be played by one person or by family, as is shown in Figure 1. It has a note memory mode, which can focus on training the memory ability of the elderly. To a certain extent, it plays the role of training memory and reaction ability, so as to improve the cognitive ability of the elderly. b. In terms of operation, the specific operation of the object is to select a song you like, and then, within the specified time, remember the position where the melody of a song sounds, and step on the corresponding position where the light is on in turn, and the music blanket will make notes at the same time, until the end of a song. Or choose the teaching mode, when the music sounds, LED lights on, users only need to see which light is on, step on the cobblestone area of the corresponding position. In order to improve the patient's reaction ability, vision, hearing, touch and other cognitive ability, and exercise and strengthen the overall coordination ability of the body [10], see Figure 2.



**Figure 1.** Cobblestone music blanket appearance.



**Figure 2.** Product use scene diagram.

C. In terms of experience, while the elderly actively participate in music playing, they can also enjoy the effect of exercise, because the pebbles on the music blanket have the function of foot massage. Regular foot massage can promote the blood circulation of the body, stimulate cell vitality, accelerate metabolism, and coordinate between organ systems. Therefore, the product not only contributes to the cognitive behavior training of patients, but also achieves the purpose of physical exercise.

D. Considering the principle of product design for the elderly, the product is easy to use, simplified in appearance and learning needed in operation. In terms of safety, the size of the product conforms to ergonomics, and there is no sharp part, and the material is soft and anti-skid. In terms of semantics, natural pebbles are used as the main material to create a natural and relaxing atmosphere for the game. The color matching and mechanism mainly refer to the effect of the stone road in the park to convey a healthy and positive attitude towards life. In the aspect of interest, it combines the comprehensive experience of vision, hearing and touch. Through the cooperation of feet, eyes and brain, the close interaction between products and people can improve the interest of products. See Table 1.

**Table 1.** Comparison of product design principles.

<b>Design principles</b> <b>Product function</b>	<b>Ease of use</b>	<b>Security</b>	<b>Semantics</b>	<b>Interest</b>
In modeling	a. It looks like a blanket b. Foldable storage, no space	a. Sleek shape b. Soft material c. The product has anti-skid function	a. Product design atmosphere simple, simple color, in line with the elderly aesthetic	a. Soft material with great affinity b. Pebbles are arranged randomly to increase the natural feeling
In operation	a. The operation is simple and the learning mode is almost zero b. Step on exercise, the mode is simple	a. Simple operation, reduce misoperation	a. Exercise the activity ability and reaction ability of the elderly	a. Step on your feet to make a sound and cooperate closely with the song
Experience	Product interactive feedback is intuitive and timely	a. The music is soothing and in line with the preferences and long-term memory experience of the elderly.	a. Music experience and massage experience, return to nature, create a positive state of life	a. With the melody of music or songs, step on the music blanket to dance, interact closely with

				the product, and increase the use of fun
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Product in a form: product shape is simple and natural, simple modeling, in line with the psychological needs of the elderly. b. In terms of material, soft material is selected, which is similar to cotton, hemp and other textile fabrics. Stepping on it is soft and has anti-skid function, which is safe and reliable. c. Color: in the selection of color, choose simple and elegant, low lightness color, reasonable collocation.

Combined with the principles of product design for the elderly and music therapy, this interactive product is designed, which makes a beneficial attempt in strengthening and enriching the memory exercise and physical health care of the elderly. In order to wake up the music memory and recall situation to stimulate the brain memory cognition, the elderly can try to use this music interactive game with their relatives or friends at home, to achieve better effect of delaying the disease while entertaining.

### 5.2.2. Product Aided App Design

This design follows the interface design principle of the elderly, unifies the functions, facilitates the operation, reduces the dispersion of hidden functions, puts the common functions in the obvious interface position, and reduces misoperation. According to the principles of ease of use and interest, the software product reduces the option settings and levels on the interface, and sets the novice mode, ordinary mode, veteran mode, advanced ranking and reward in the game, so as to increase the sociality of the product and increase the user stickiness. In addition, in color, follow the simple, elegant, atmospheric design principles, with green, white, blue as its three main colours. Green is quiet, full of hope; white is simple; blue gives a calm and comfortable feeling.

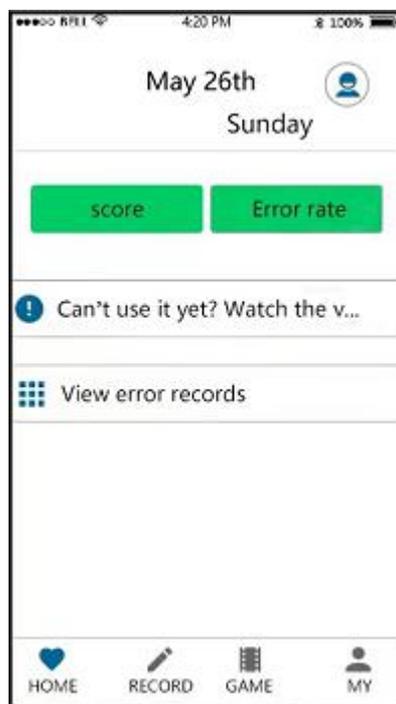


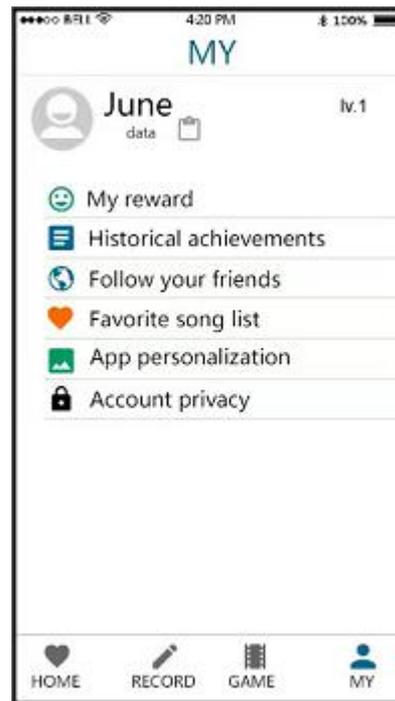
Figure 3. Home page.



Figure 4. Record interface.



*Figure 5. Game interface.*



*Figure 6. My interface.*

According to the function of the product and the corresponding research results, the main functions of app are defined as follows: a. home page: according to the results of the game experience of patients, the corresponding score and error rate records are obtained, and the home page interface is shown in Figure 3; b. record: record the movement of patients, such as the number of times and duration of movement, summarize the user's habits of using the product, and the record interface is shown in Figure 4; c. game: According to the user's usage, recommend the song list that the user may be interested in. At the same time, they can choose the game mode and difficulty level, etc. the game interface is shown in Figure 5. d. mine: users can view their own level and receive rewards and keep up with their friends, see friends game records, etc., as shown in Figure 6.

## 6. Conclusions

Based on music therapy and long-term memory, this music interactive product is designed based on the product design principles for the elderly. To a certain extent, it makes up for the vacancy in the market and makes a beneficial attempt in practical and theoretical research. At the same time, the irreversibility of Alzheimer's disease increases the psychological burden of patients and their families, and the public know little about the disease, which aggravates the illness panic of the elderly. Combined with music therapy, this interactive product is not only a way of delaying the illness by combining mental exercise and physical exercise, but also a way of promoting the elderly with an optimistic and peaceful attitude and a healthy and positive lifestyle. In addition, with the development of brain science, the scientific verification of cognitive ability of Alzheimer's patients at different stages and the construction and verification of EEG experimental paradigm of the therapeutic effectiveness of the product are the focus of further research.

## Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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