Mutual Acceptance by Sharing Information through Indirect Biofeedback

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ABSTRACT

This paper proposes a model of mutual acceptance between a patient, his/her family members, and medical staff by sharing information through indirect biofeedback. In Japan, an upcoming so-called super-aging society, it has become a serious problem how to achieve effective and high-quality care support for aged persons. Here we focus on a psychological aspect of this problem and suggest a possible way to tackle it. We propose that an elderly patient, his/her family members, and medical staff could deepen their mutual understanding and mutual acceptance by sharing indirect biofeedback information of the patient. This paper describes and discusses two aspects: indirect biofeedback of a user’s sleep state based on analysis and measurement of his/her sleep data; and sharing information through indirect biofeedback using a plant-type indicator, which can be tested in an experiment.

KEYWORDS

Mutual acceptance, sharing information, indirect biofeedback, quality of sleep, plant-type indicator

1 INTRODUCTION

The number of people with stress and mental health problems suffering also from sleep disorder has been gradually increasing in Japan. However, their situation is often not improved only by consulting with specialists in psychiatry or psychosomatic medicine [1].

There is a view postulating that a patient with schizophrenia and the doctor play the “language game,” a philosophical concept advocated by L. J. Wittgenstein, where the doctor “plays” the role of a doctor rather than understanding the patient, and the patient “plays” the role of patient rather than revealing their true nature to the doctor [2]. In the current state of psychiatric care, a patient might believe that it is sufficient to visit the hospital to get some instructions and prescriptions to alleviate the symptoms, and that the situation can be improved by using the remedy given for the disease. On the other hand, the goal of the doctor might be to just ease the symptoms and pain from which the patient is suffering and not remove the cause of the disease.

A consultation with such a specialist could not be very effective if it is a passive experience for the patient. However, if the patient is asked to approach the symptoms of his/her disease in a voluntary and proactive way, the treatment is more likely to succeed. To elicit proactive behavior, the patient with sleep disorder must be made aware of their current sleep state so they can then act appropriately to maintain self-control [3]. A device or mechanism is needed to externalize the sleep state of the patient, while the patient establishes a sense of unity with the external device.

Here we propose an indirect biofeedback mechanism that can help the patient be aware of his/her sleep quality and condition by monitoring a device with visual features that vary according to their sleep data [4]. We also propose a mechanism through which the patient, his/her family members, and doctors and medical staff can share the information of the indirect biofeedback.
2 INFORMATION SHARING THROUGH INDIRECT BIOFEEDBACK

2.1 Concept

Figure 1 shows our proposed model of information sharing through indirect biofeedback.

A patient’s biological data, such as information related to sleep, heart rate, and respiration, are collected by a mat-type sensor, and sent to and stored in a server every day. Some indicators representing the sleep state and quality are generated by analyzing the data in the server. These indicators, which constitute direct information, are changed and transformed into indirect information. The indirect information is designed to be displayed in a way that anybody can understand and feel. Therefore, this indirect information is not only fed back to the patient but also shared with his/her family members, doctors, and medical staff. The indirect biofeedback information can be used by the patient to be easily aware of his/her sleep state and quality, and to control his/her own self. In addition, since his/her family members, doctors, and medical staff can also easily learn about the patient’s sleep state and quality, the patient will be able to experience other people understanding and accepting his/her biological state. Therefore, sharing some information about the patient’s sleep state and quality influences other people’s attitude towards the patient as well as the interactions and/or communications with him/her. Medical staff can change their care plan for the patient, and the patient can be more relaxed and sleep more effectively [8].

2.2 Information Sharing

Information sharing between people is useful for mutual understanding in general. The case on which we focus here, however, might be different from usual cases, and we need to make some considerations. While medical staff might be in a strong position, a patient is usually in weaker one, in the sense that the patient depends on the medical care given by the staff. On the other hand, the patient pays for the medical care and services given by the staff. Moreover, the information shared by medical staff and family members is the patient’s personal information. Information sharing between a patient and medical staff, thus, should be carefully designed considering the points mentioned above. It might be quite useful, on the other hand, that a patient is aware of being understood and accepted by others through information sharing.

2.3 Indirect Biofeedback

It is crucial that information sharing is designed attentively, as the information to be shared between a patient and medical staff can be extremely personal and usually should not be seen or known by others. In general, the patient does not want others to know this extremely personal information as it could be too direct and close to him/herself. In addition, direct numerical feedback might give the user a negative feeling due to perceiving unfamiliar data that display drastic numerical changes.

In this case, indirect representation, that is, indirect biofeedback can be useful. The
information represented as indirect biofeedback and shared by others is the patient’s personal information, but not too direct or close to the patient that he/she feels that their personal information exposed to others.

In this research, we employ virtual plants and their changes as a representation of indirect biofeedback, as shown in Figure 2. We expect that such a representation will enable not only the externalization and objectification of a patient’s physiological information, but also the patient’s control of their inner state by being aware of it [9].

Figure 2. Plant-Type Avatars

2.4 Related Work

Biofeedback has been used by psychologists to help treat a variety of issues including post-traumatic stress disorder, attention deficit hyperactivity disorder, headache, and hypertension [9][10].

Nishino and his team suggested that we spend a significant part of our lives sleeping, which is essential for our physical and psychological well-being. However, sleep can be easily impaired by psychological and physical disease [11][12]. Professor Shimamoto and his team suggested that a decline in the quality and total duration of sleep decreases physical activity levels and increases daytime sleepiness as well as the risk of lifestyle-related disease and depression [13].

In recent years, Japan has developed a “super-aging” society and care support for elderly people is essential. Takadama and his team focused on this problem and proposed a concierge-based care support system to provide a comfortable and healthy life for elderly people. The system estimates a user’s daily sleep stage, and stores this personal data as big data. By doing so, care workers and doctors can design personal care plans for specific users more effectively. The system has the following characteristics:

1) Estimating sleep stage without connecting any devices to the human body.
2) Designing home care support that supports elderly people living in their home, facility, or hospital.
3) Exploring the lifestyle improvement technology [13][14][15][16].

3 INFORMATION SHARING SYSTEM THROUGH INDIRECT BIOFEEDBACK

Figure 3 shows the configuration of the proposed information sharing system through indirect biofeedback.

We use the mat sensor developed by TANITA to get a patient’s sleep data, and an i-Pad as a device for display. The data are sent to a server through Wi-Fi, stored in a database, and analyzed into quality of sleep. The result is transformed and visualized as a virtual plant, which is not only provided as feedback to the patient but also shared by medical staff and family members.
### 3.1 Data on Quality of Sleep

Sleep disorder increases the risk of lifestyle-related diseases and depression. This association has been observed in the Japanese population due to changes in lifestyle. Moreover, the quality and duration of sleep vary greatly with age. Previous studies have shown that sleep disorder commonly occurs in the elderly. The quality and duration of sleep are determined by numerous factors. The following are the factors that we obtain with a mat sensor and use in the proposed system [11][12]:

- Sleep score
- Sleep efficiency
- Depth of sleep score
- Time of sleep score
- Rhythm of sleep score
- Nocturnal awaking score

A patient’s sleep state and/or quality are evaluated based on the data above. Additionally, we use these data as objective indicators to judge the effect of indirect biofeedback and information sharing with other people.

In addition, we record a patient’s daily events, such as taking a walk and/or bath, having a visitor, singing songs, playing a game, and so on, as well as data on his/her sleep state. Such accumulated data will allow the system to show daily, weekly, monthly, and/or yearly changes of a patient’s sleep state as morphing images of virtual plants. Additionally, we can conduct correlation analyses between the above-mentioned events and quality of sleep, and identify an indicator of a causal relationship between a specific event and sleep.

### 3.2 Representation as Indirect Biofeedback

Based on the data on quality of sleep acquired by the mat sensor, the proposed system calculates the daily average sleep score and compares its change day by day. We can know a patient’s quality of sleep directly by observing the changes as well as the daily average score of the sleep factors.

As mentioned above, however, we do not employ direct feedback but indirect biofeedback with virtual plants. Thus, depending on the changes and the daily average sleep score and sleep efficiency, we employ a representation mimicking the growth of the plants, for example, using the number of flowers and leaves, as shown in Figure 4.

![Figure 4. Mapping of Sleep Score onto Visual Plant](image)

### 3.3 Design of Information Sharing

Since we can obtain sleep patterns by evaluating overall factors of sleep, we can prepare four types of virtual plants according to the sleep patterns; thus, the type of plant displayed would change depending on the sleep patterns. These patterns change daily according to a patient’s state of sleep. We will explain the types to a patient, medical staff, and family members in advance, so they can recognize the patient’s sleep state by looking at the types of virtual plants. We think this information will be useful for the staff and family members to be able to talk to the patient more effectively. Additionally, by having this information, the patient might be able to change his/her own inner state and actions.

Figure 5 shows an example of a display of the system and Figure 6 an example of a display showing a relationship between sleep and an event.
4 EXPERIMENT

We will be conducting an experiment in a senior care home, where five senior residents, their family members, and medical staff will participate. The aims of this experiment are to verify the usefulness of indirect biofeedback in improving a patient’s sleep and to investigate whether participants, including patients, can deepen their mutual understanding and acceptance by sharing indirect biofeedback information. In this experiment, we will focus on the changes in the sleep score as an objective evaluation, and will ask participants to answer questionnaires as a subjective evaluation.

5 CONCLUSION

We have proposed an indirect biofeedback mechanism that helps a patient be aware of his/her sleep quality and condition by monitoring a device showing virtual plants that vary according to his/her sleep data. We have also proposed a mechanism through which the patient, his/her family members, and doctors and medical staff can share the information of the indirect biofeedback.

We will be conducting an experiment in a senior care home with five residents, their family members, and medical staff. Through this experiment, we expect to clarify the usefulness of indirect biofeedback in improving a patient’s sleep, and to confirm that patients, their family members, and medical staff can deepen their mutual understanding and acceptance by sharing indirect biofeedback information [17].

REFERENCES


