Latest Researches

Paro Found to Improve Brain Function in Patients with Cognition Disorders

(Translation of the AIST press release dated September 16, 2005)

Key Points

- Interacting with Paro found to improve brain function through measuring and analyzing the brain waves of elderly patients with cognition disorders
- Robot therapy through use of Paro can be used to prevent cognition disorders and it can contribute to improvements in long term care

Synopsis

The National Institute of Advanced Industrial Science and Technology (AIST), Kimura Clinic, and Brain Functions Laboratory participated in joint research involving Paro, a therapeutic seal robot, and patients with Alzheimer's disease and other cognition disorders to discover the effect of the robot on improving brain function.

Elderly subjects with cognition disorders were asked to interact with Paro. The subjects' brain waves were measured before and after the interaction for analysis. Out of the 14 people who participated in the study, 7 (50%) experienced an improvement in brain function. Studies in the past have shown that robot therapy involving Paro in domestic and international facilities for the elderly produces expressions and behavior in the patients that is similar to those in healthy people. Interaction with Paro improves brain function in elderly patients with cognition disorders and helps prevent the development of such disorders in healthy people. Furthermore, subjects who expressed a positive attitude towards Paro were found to show a greater response to the therapy.

In Japan, the cost of providing long term care for patients with cognition disorders has risen to 4 million yen per person. This represents an enormous burden for the municipalities that provide long term care insurance. Because of this, it has become increasingly important to find ways to prevent cognition disorders that will require long term care.

People who interact with Paro are expected to improve the quality of their lives and prevent the onset of cognition disorders. In this way, Paro can help decrease the need for long term care.

These results are going to be presented at the Stockholm-Tokyo video conference on Service Robots and the Aging Population on September 22, 2005.

Image 1: Paro, the therapeutic seal robot

Background

Declining birthrates and aging populations are being observed in most industrial countries. In Japan, it is predicted that 26% of the population will be over 65 years of age by 2015 (Statistics Bureau, Ministry of Internal Affairs and Communications). This will result in an increase in the number of people who require long term care. Since many people are already receiving support from the long term care insurance system, this will result in a drastic increase of social costs. By improving the quality of life of elderly people, the onset of cognition disorders is delayed and the symptoms are reduced. This should also serve to minimize the need for long term care and improve the quality of care that elderly patients receive at home and in medical and welfare facilities.

There are several options for treating and preventing cognition disorders. Those include pharmaceutical treatment, dietary measures, art therapy, music therapy, exercise, learning, and animal therapy. But there is room for improvement in all of them.

AIST's Intelligent Systems Research Institute aim to produce subjective quality through touching people's hearts by providing comfort and entertainment. Under this concept, research on and development of Paro, the therapeutic robot seal, started in 1993. The institute especially focus on robot therapy, seeking results seen in animal therapy through a robot shaped like an animal.

History of the Research

AIST's Intelligent Systems Research Institute decided to use a baby seal as the model for its animal robot . This is because unlike dogs or cats, people have less stereo type for seals and can accept smoothly. If the robot was shaped like a dog or a cat, people would be able to tell the difference between the robot and the real animal and might feel that the robot was not real. Implementation of the Paro concept was made possible through Intelligent Systems Company (ISC), a venture business that was created on September 17, 2004 with the support of the AIST Innovation Center for Startups (part of the Ministry of Education, Culture, Sports, Science, and Technology fund for promoting science and technology in order to foster a basis for strategic research). Paro's designs and patents are licensed to ISC in order to commercialize the Paro product. Paro has been available for sale to individuals since March 2005 and 500 units have already been sold.

Robot therapy has been implemented at various facilities for the elderly, such as adult day care facilities and nursing homes, in addition to pediatric units in Japan. Furthermore, domestic studies have noted the effects of robot therapy. (See the AIST press release from September 17, 2004, translated into English and released on December 8, 2004.) Studies have also been done outside of Japan that confirm the mental, physiological, and social effects of robot therapy involving Paro.

Experiments that were done at nursing facilities confirm that it is possible to continue using Paro over a long period of time. Facilities that introduced Paro in August 2003 are still using the robot and find that it is still popular with their clients.

As a result, Paro is being introduced at many elderly care facilities throughout the country. For example, Paro has been used since May 2005 at eight day centers in Nanto City, Toyama Prefecture, in order to prevent cognition disorders in their elderly clients.

Image 2: Patients with cognition disorders interact with Paro
(The nets on the patients' heads are for measuring brain waves.)

Image 3: A man with a cognition disorder interacts with Paro
(The net on the patient's head is for measuring brain waves.)

Explanation of the Research

Brain waves were measured in patients with cognition disorders such as Alzheimer's disease and senile dementia while they interacted with Paro to determine the effects of this interaction on brain function.

Subjects were cognition disorder patients who come to the Kimura Clinic for art therapy.

The "Dimension" system was used to evaluate brain function in patients with cognition disorders as they interacted with Paro. "Dimension" was developed by the Brain Functions Laboratory for the early detection of cognition disorders. Subjects interacted with Paro for approximately 20 minutes and their brain waves were measured before and after the interaction. Subjects were asked to close their eyes while their brain waves were being measured. Subjects were also asked to evaluate Paro and these results were evaluated with the demonstrated changes in brain function.

There were 29 possible subjects for this test, but there were several subjects who had normal brain function or whose cognition disorders were at too high a level to comply with the instructions to close their eyes. In total, the data from 14 subjects were used. The results are shown in Image 4. Of the 14 subjects with cognition disorders, 7 (50%) showed an improvement in brain function after interacting with Paro. Some subjects even returned to normal levels of brain function.

Image 5 shows the relationship between subjects' evaluations of Paro and improvements in brain function. Subjects who rated Paro highly experienced the most improvement in brain function.

This research was implemented as a part of the Research on Continuous Interaction between Humans and Robots (2004-2008) Basic Research Program of the Japan Science and Technology Agency.

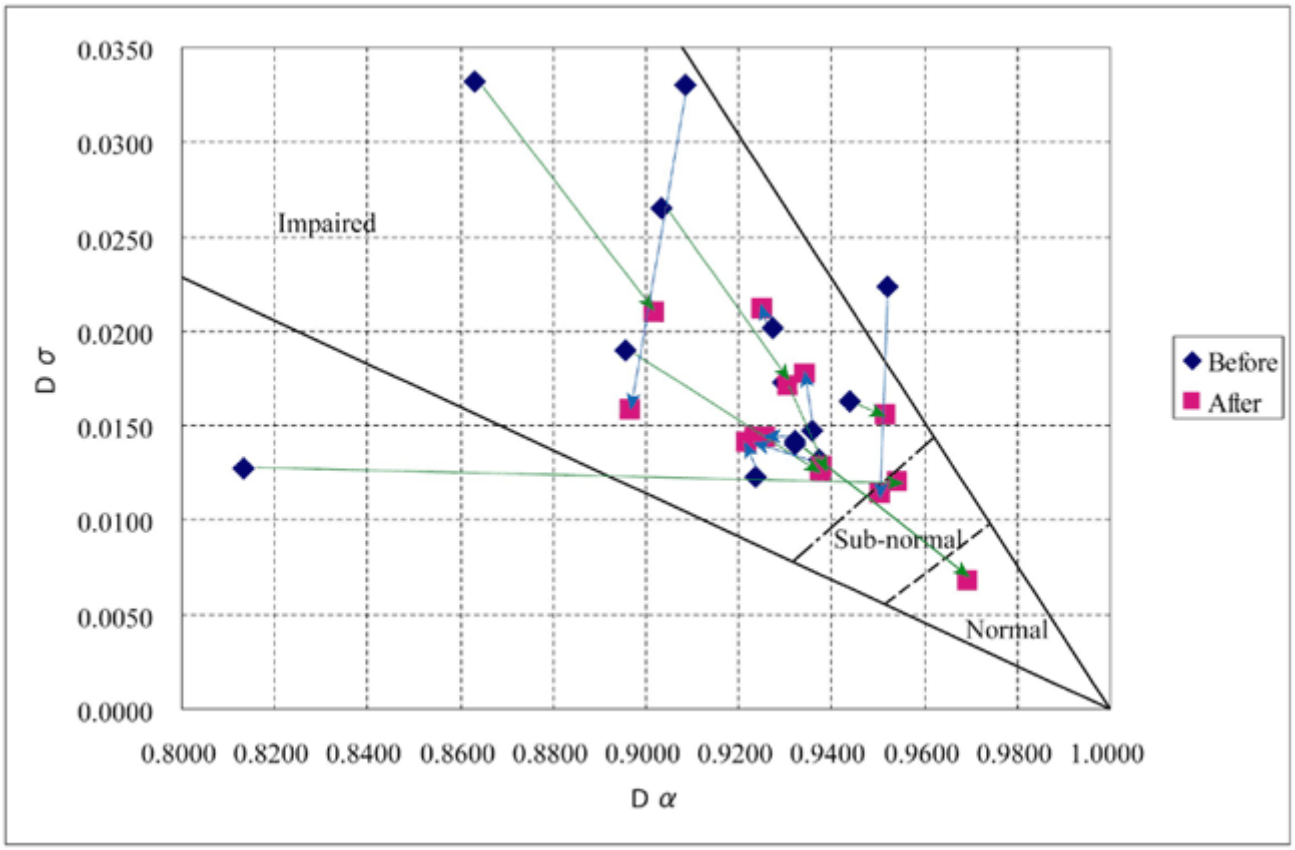


Image 4: Results of the analysis of brain function by "Dimension". The x-axis (Dα) represents positional smoothness in scalp electrical potential distribution. The y-axis (Dσ) represents fluctuations over time (instability). People with normal brain function (see images 6 (1)) have greater amounts of positional smoothness and a small amount of fluctuation over time. However, people with cognition disorders (see image 6 (2)) lose the positional smoothness in the α-waves of their scalp electrical potential distribution and the fluctuations over time become greater. This creates the three distinct areas of impaired function (top left), sub-normal function (middle), and normal function (bottom right). In this study, 50% of the subjects with cognition disorders experienced improvements in the condition of their disorder, and some even returned to normal levels.

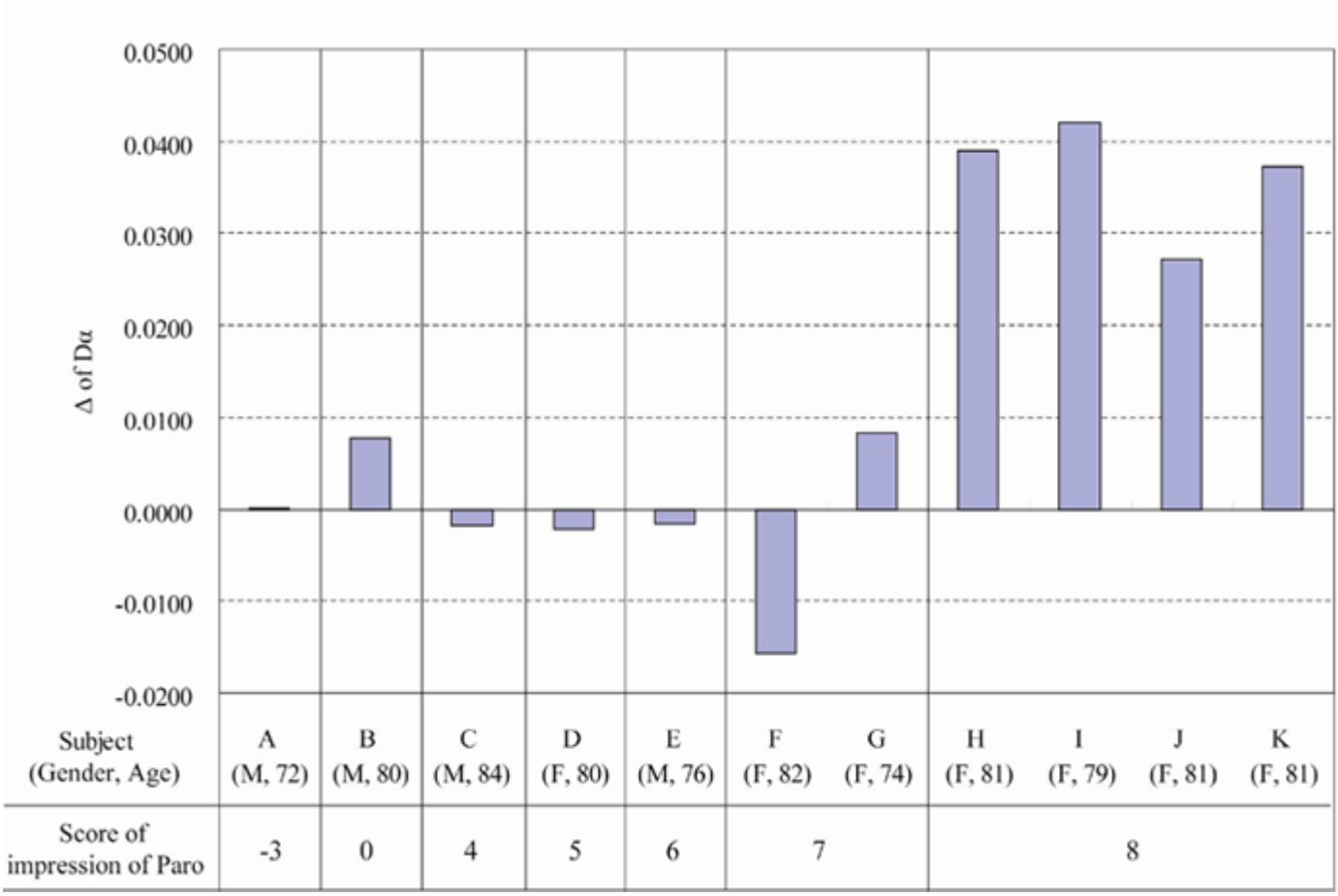
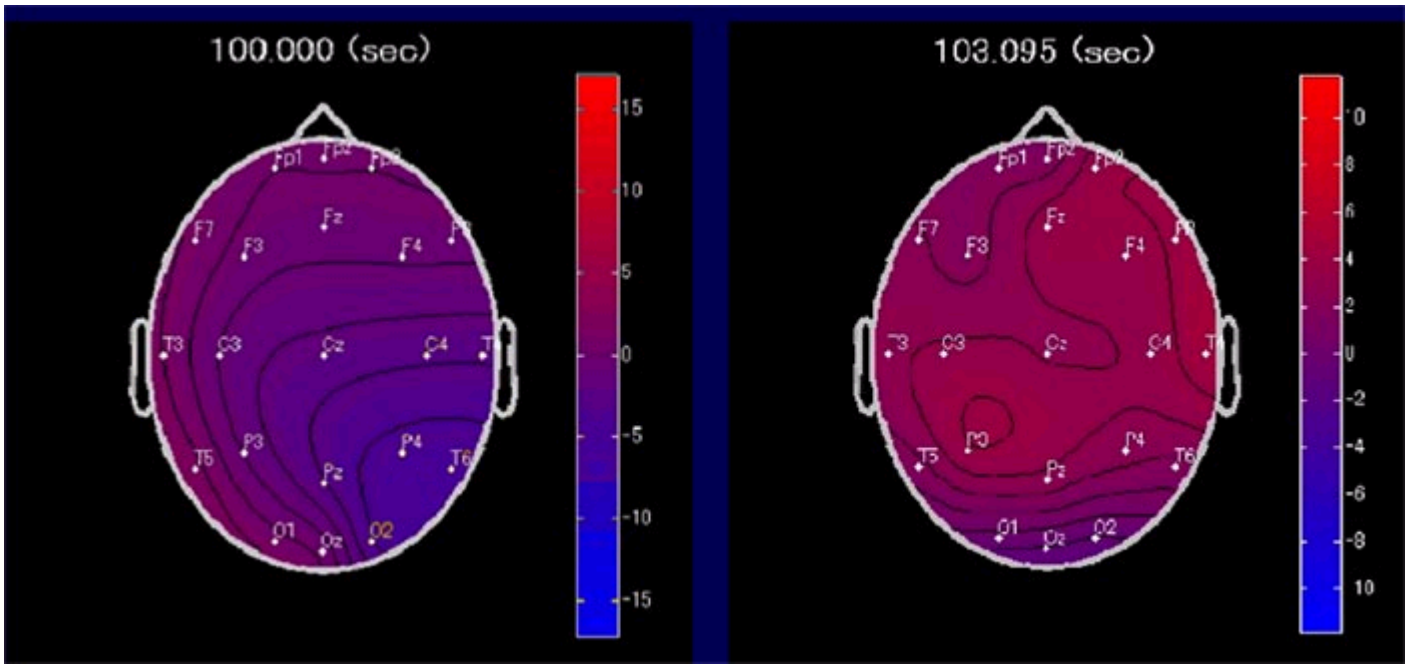


Image 5: The relationship between subjects' evaluations of Paro and improvements in brain function as recorded by the "Dimension" system. The y-axis shows the differences in the α-waves of the scalp electrical potential distribution before and after subjects interacted with Paro. Positive values indicate an improvement in cognition disorder. The x-axis shows the subjects' evaluation of Paro. Valid data was collected from 11 subjects and analyzed. Subjects who rated Paro highly experienced the most improvement in brain function.



(1) Subject with normal brain function (2) Subject with cognition disorder (e.g. Alzheimer's)

Image 6: α-waves of the scalp electrical potential distribution. In patients with cognition disorders, nerve cell activity becomes uneven. This shows up as disruptions in the scalp electrical potential distribution. By quantifying the method of disruption, we can demonstrate the level of degradation in brain function.

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