

A Choreography Memory Task Study with a Music DVD Using fNIRS

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Abstract: We measured brain blood flow using fNIRS for subjects while they did choreography memory task accompanying a music DVD. We found common activated areas at the prefrontal area of four subjects and those were considered to be areas activated by music. The other activated areas could be categorized into two patterns. One of them seemed to be a reflection of memory activities to guess the whole process of the choreography comprehensively, and the other was a reflection of guessing a logical or spatial structure of the choreography. Working memory areas were not activated. Our results suggested a possibility that different strategies of memory showed different patterns at prefrontal areas.

Keywords: choreography memory, strategy of memory, prefrontal area, oxy-hemoglobin, oxyHb, functional near infrared spectroscopy, fNIRS, Perfume

1. Background

There have been many language memory studies on brain blood flow, but there are only a few such choreography memory studies. In the present study, we measured brain blood flow change during a choreography memory task. We used a music DVD of the Japanese techno-pop singer group, Perfume. There are almost no pauses in Perfume's songs, and they continue to sing and dance through to the end. Although their dances alone are difficult as a choreography memory task, the levels of language, music and visual stimuli are almost constant and continuous during a song. For this reason we thought that using a music DVD by Perfume would be suitable for our study.

2. Purpose

We measured oxy-hemoglobin (oxyHb) at the prefrontal area of each subject and compared activated areas between watching the music DVD and carrying out the choreography memory task

3. Methods

3-1. Date, Facility and Subjects

The subjects were 23-71 years old, 3 males and 2

females. The measurements were made at the office of Shimadzu Corporation in Tokyo on May 25, 2009.

A 14 inch computer screen was set in front of a subject at a distance of 60cm away. Speakers were set at a 65 cm distance from the subject. The album "Perfume ~Complete best~" (2007) was used as the test DVD. This music album has four video clips and one of those is "Computer City". In this video clip, the singers wear white clothing and they sing and dance against a black back wall and a black floor. Moreover visual effects, such as computer graphics, are less and the dance can be watched clearly. Therefore, this video clip was considered as suitable for the present study. It was 218 s long.

3-2. Procedure

One trial consisted of 1-min pre-rest, 218-s task (task 1: only seeing), 1-min rest, 218-s task (task 2: choreography memory), and 1-min post-rest (**Fig. 1**). During each rest, the subject looked at a black point on the display of the computer (**Fig. 1 Middle**).

Each subject sat on a chair and did one trial.

3-3. Measurement

Brain blood flow was measured by Foire-3000 (Shimadzu, Japan: this is the same machine as the OMM-3000) which is a functional near infrared spectroscope (fNIRS). The measurement area was the prefrontal area of the subject's brain. Eleven light emitting probes and 10 light receiving probes were arranged alternatively in a 3x7 rectangle (**Fig. 1 Right**).



Fig. 1 Left: During the Task Middle: Resting Right: Wearing the Probes

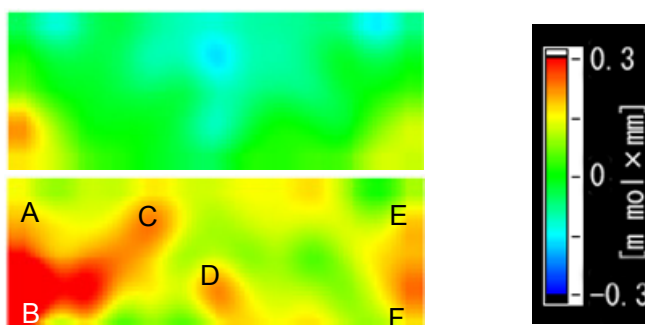


Fig. 2 Up : task 1 (only seeing) and Down : task 2 (choreography memory) oxyHb, subject : K018, f , 39y, SPLN-59-20
task 1 : averaged for 214 s
task 2 : averaged for 215 s

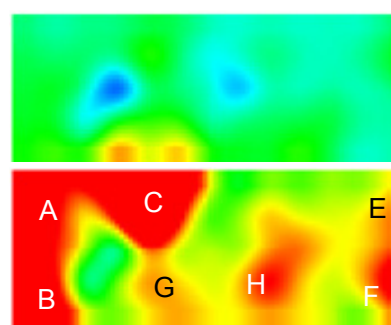


Fig. 3 Up : task 1 (only seeing) and Down : task 2 (choreography memory) oxyHb, subject : A007, m, 25y, SPLN-59-20
task 1 : averaged for 214 s
task 2 : averaged for 220 s

4. Results

Suitable data were obtained for 4 of the 5 subjects. **Figs. 2 and 3** show averaged oxyHb changes of K018 (female, 39 y) and A007 (male, 25 y). When choreography memory task (task 2), was compared with only seeing (task 1), both ventrolateral prefrontal areas (B, F areas in **Figs. 2 and 3**) and the right dorsolateral prefrontal area (C area) were common activated areas of four subjects. Moreover those of two subjects showed increased oxyHb at D area of **Fig. 2**, two others showed increased oxyHb at G and H areas of **Fig. 3**.

5. Discussions

Because areas C, B and F were common among four subjects, these parts are considered as the main activated areas for the choreography memory task. This result is not in conflict with the study of Matsui et

al.¹⁾ in which the task was only to listen to music. Matsui et al. claimed that both ventrolateral prefrontal areas showed the main effect of the music. Both ventrolateral prefrontal areas were activated by the music, and the left ventrolateral prefrontal area was activated by understanding the music structure. Our findings suggest that C area is a specific reflection for the choreography memory task. This area is said to relate to the process unifying information. In other words, area C is activated by song, music, and choreography.

Because of the other activated areas can be categorized into two patterns, we think area D and areas G & H reflect the memory strategy of the subject.

Area D was reported as an activated area during guessing^{2,3)}. Therefore, we consider that subjects memorize the flow of the choreography while supposing it comprehensively.

In Yoshida and Ishii's study⁴⁾ in which the task

was for the subject to clear a maze, activation of areas G and H was related to the degree of belief of the subject's position where he stood in the maze. Through our consideration on their study, the subject's belief was possibly based on the results of guessing his position. In addition, areas G and H were activated during the Kraepelin test⁵⁾. Therefore, we consider that areas G and H relate to logical and spatial guessing.

Areas A and E are said to relate with working memory. Only one subject showed activation of areas A and E.

Many parts were activated at the prefrontal area during the choreography memory task. We suggest that common parts were activated by listening to music and different activated areas in the prefrontal area were reflections of different strategies of memory for choreography. However, hearing each subject's introspection was not enough in the present study. It is necessary to survey the details of memory strategies.

Lastly, the results suggest a possibility that a choreography memory task is effective for brain training.

6. Further Studies

Before experiments, we did not expect to obtain good results because the present study was a preliminary test with a small number of subjects and we did not have much experience with use of choreography memory task. However, the results were relatively clearer than we had expected.

The activated areas could be categorized into two patterns and those were considered to show different strategies of memory for choreography. However, the present study is preliminary and our discussions include speculations. Therefore, further studies are needed with large numbers of subjects and a survey of subject introspections is also needed.

References

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