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## Construction of a Language Network at Prefrontal Lobe while Listening and Evaluation of Language Proficiency

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### ABSTRACT

Activities of the working memory that site at several areas in the brain are essential for information transmission in language processing. Here, we assume that a network structure of information transmission corresponds to the language proficiency. In this paper, we propose a method to construct a language network by measuring the blood volume at the prefrontal lobe, one of the areas where the working memory is sited. Further, to quantify the language proficiency, we defined a score  $S_y$  that can be calculated from the language network. To validate the usefulness of the proposed method, we conducted an experiment with ten Japanese students who were asked to listen to the news in three languages: Japanese, English, and Vietnamese. Among the subjects, the proficiency in Japanese was the highest, English was intermediate, and Vietnamese was the lowest because all of them were native Japanese students; they had been learning English as a second language, and had never heard Vietnamese. Their respective blood volumes were measured by near-infrared spectroscopy (NIRS) while listening to the news. To obtain the network structure, the dynamic Bayesian network was applied to the data obtained by NIRS, and  $S_y$  was calculated for each language. The  $S_y$  scores for Japanese, English, and Vietnamese were  $-1430$ ,  $-1443$ , and  $-1455$ , respectively. Therefore, the proposed method can represent the language proficiency because  $S_y$  for Japanese was the highest, English was intermediate, and Vietnamese was the lowest.

Keywords: language proficiency; blood volume; NIRS; dynamic Bayesian network; working memory