

## 外国語要旨

学位論文題目：「How Preschoolers Solve Problems: Development of Analogical Problem-Solving Skills」

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We usually make inferences about unknown things by using our knowledge of things already known to us. This type of thinking is called analogical reasoning. In the research of analogy, the known domain is “the base” while the unknown is “the target.” To infer correctly, we need to notice the similarities between the base and target. The most important type of similarity is structural similarity, which is focused on the essence; superficial similarity is focused on the appearance.

Previous studies revealed that preschoolers have difficulty focusing on structural similarity; they rather tend to focus on superficial similarity (Chen, 1996; Deahler & Chen, 1993; Gentner & Toupin, 1986; Hosono, 2011). In addition, it has been suggested that the age at which children pick up the ability to focus on structural similarity is past 5 years of age (Rattermann & Gentner, 1998; Hosono, 2006; Halford, 1992; Uchida, 1985; 1996; Ishida, 2011). However, most previous experiments on preschoolers have used simple tasks and not complex ones involving various elements and similar to those experienced in real life. In this study, I examined preschoolers' use of structural similarity for problem-solving tasks from the base analogy story.

In study 1, I conducted two experiments that examined when preschoolers pick up the ability to spontaneously extract the structure of a story. In experiment 1, 5-year-olds( $n=4;6-5;5$ ) and 5-and-1/2-year-olds( $n=5;6-6;5$ ) attempted to solve problems using an analogy. There were four ways of presenting the base stories: ①two stories were presented followed by a prompt to compare the stories, ②two stories were presented, but children were not instructed to compare the stories, ③one story was presented, and ④no stories were presented. In the results, 5-year-olds solved the problem by analogy in conditions when the story was present. This result suggested that young preschoolers could engage in analogical reasoning. In addition, 5-and-1/2-year-olds performed better in problem solving tasks when two stories were presented than when only one story was presented, regardless of whether or not the two stories were compared. These results suggested that 5-year-olds can extract the structure of a story spontaneously; however, both groups tended to rely on partial similarities, and it was difficult to have them use the whole similarity between the story and the problem.

In experiment 2, I examined the differences between of the structure on which preschoolers and adults could focus on. In response to the interview that asked the participant about

similarities between the base story and the target problem, adults noticed more elements of similarity than preschoolers. Therefore, they could solve the problem that seemed far removed from the story. On the other hand, children noticed less elements of similarity. Children older than 5 1/2 years of age began to spontaneously focus on the structure. However, throughout preschool age, children tended to use only a part of the structure.

In study 2, I examined whether preschoolers could solve analogical problems if they received hints of mapping elements of the structure that was common between the base story and the target problem. In experiment 3, I prompted that children map the tool that was to be used to solve the problem. The results suggested that 5-year-olds and 5-and-1/2-year-olds could solve problems better if they were prompted to map an object (which is a tool used to solve the problem). In the mapping an object condition, 5-and-1/2-year-olds were able to notice the similarities of other objects that should be mapped between the base story and the target problem. The effectiveness of prompting the mapping of an element of the structure was shown.

In experiment 4, I examined the kinds of similarities the preschoolers could focus on if I prompted mapping an object. The results revealed that 5-year-olds could explain the point of superficial similarity, but 5-and-1/2-year-olds began to explain the point of the structural similarity. For preschoolers, it seemed that mapping an object was not enough to infer using structural similarity.

Study 3 examined whether preschoolers could focus on structural similarity that include some elements if I present the similarity of attribution, which was information to connect the object with the reference. In experiment 5, I presented preschoolers the attribution of the tool used to solve the problem. Results indicated that 5 and 5 1/2 years old children improved in their problem solving skills by analogy if they were presented the attribution that is common between tools used in the story and the problem. It seemed that the attribution had to connect the base story and the target problem. However, there were still many 5-year-olds who could not notice the whole similarity. In experiment 6, I presented not only attribution of the tool but also reference that was derived by attribution. For example, I instructed children "it is soft and thin (attribution), so it can be rolled (reference) as a tube." Results showed that 5-year-olds could solve the problem using attribution even without reference.

This study indicated that preschoolers could solve an analogical problem; however, it was only after 5 2/1 years of age that children could solve the problem spontaneously based on structural similarity alone. It was difficult for 5-year-olds; they mapped some elements of structure. It seemed that preschoolers started to notice the structure using hints of mapping elements such as attribution. The development of analogical problem solving skills was related to the expansion in the children's cognitive capacity, as indicated by the construction of structures involving many elements.