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# Research in Developmental Disabilities



## Stimulus pairing training for Kanji reading skills in students with developmental disabilities

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### ABSTRACT

Japanese students with developmental disabilities often exhibit difficulties in reading, particularly in Kanji (ideogram) reading, and in acquiring the equivalence relations between pictures, written words, and sounds. Previous research suggested that one student with autism could acquire Kanji reading along with equivalence relations through stimulus pairing training. However, maintenance rates tended to be very low, possibly due to the lack of picture stimuli. In this study, we examined the acquisition and maintenance of Kanji reading skills through stimulus pairing training using corresponding pictures for six students with developmental disabilities. We prepared stimulus pairs consisting of picture stimuli that the students could name along with a corresponding Kanji character that they could not read. All students successfully acquired and maintained the Kanji reading skills through this procedure. These findings suggest that the nameability of picture stimuli in stimulus pairing training may facilitate the acquisition and maintenance of equivalence relations for reading.

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## 1. Introduction

### 1.1. Equivalence relations for reading

Students with developmental disabilities such as autism spectrum disorders (ASDs) and attention-deficit/hyperactivity disorder (ADHD) often experience difficulties in reading (Maughan & Carroll, 2006; Nation, Clarke, Wright, & Williams, 2006). In acquiring reading skills, equivalence relations among pictures, written words and spoken sounds are constructed (Omori, Sugasawara, & Yamamoto, 2011; Sidman, 2000; Yamamoto & Shimizu, 2001). However, students with developmental disabilities often have difficulty in acquiring these types of stimulus relationships.

Previous studies have shown that students with developmental disabilities acquired equivalence relations and reading skills through matching-to-sample (MTS) training (Omori et al., 2011; Stromer, Mackay, Howell, McVay, & Flusser, 1996; Stromer, Mackay, McVay, & Fowler, 1998; Yamamoto & Shimizu, 2001). In the MTS training procedure of Yamamoto and Shimizu (2001), when a picture of rock was presented as the sample stimulus, the student was required to choose the corresponding Kanji character (Japanese ideogram), “岩//iwa/(rock)” from comparison words, such as “岩//

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iwa/(rock)", "波/nami/(wave)", and "旗/hata/(flag)". In addition, when the student made a correct response, the spoken sound of the Kanji (e.g. "/iwa/") was presented as a consequence. As a result of daily training with this MTS procedure, a student with developmental disabilities was taught to acquire Kanji reading skills. A previous study also showed that increasing observing behavior toward sample stimuli (Doughty and Hopkins, 2011) and comparison stimuli (Doughty & Saunders, 2009) improved the percentages of correct responding on an MTS assessment for students with developmental disabilities.

### 1.2. Simultaneous stimulus presentation for reading

Individuals with developmental disabilities may have difficulties acquiring equivalence relationships during MTS training, because multiple stimuli are presented at the same time during the training (Dittlinger & Lerman, 2011; Dube et al., 2010; Pilgrim, Jackson, & Galizio, 2000; Saunders & Spradlin, 1989; Serna, Dube, & McIlvane, 1997). Specifically, a sample and multiple comparison stimuli are presented visually at the same time during MTS training. Therefore, the student must attend and focus on each of the stimuli presented on the computer simultaneously before making a selection response. Students with ASD often show the difficulties in attending to multiple visual stimuli, known as stimulus overselectivity (Dube & McIlvane, 1999). Students with ADHD often have the lack of general attentiveness (McGrath et al., 2011), and presenting multiple visual stimuli at the same time may lead to attention difficulties.

Dube et al. (2010) showed that failure to observe or focus on the visual stimuli led to poor performance in an MTS assessment for students with developmental disabilities, including those with ASD and ADHD. If we consider the potential difficulties in stimulus overselectivity and general attention problems of students with developmental disabilities, we should consider presenting the visual stimuli sequentially, one at a time. Such a procedure may help those with developmental disabilities to acquire reading skills by constructing equivalence relations.

### 1.3. Stimulus pairing training for reading

Recent studies have shown that equivalence relations can be acquired through "stimulus pairing training;" i.e., presenting pairs of stimuli sequentially (Clayton & Hayes, 2004; Layng & Chase, 2001; Leader & Barnes-Holmes, 2001; Leader, Barnes, & Smeets, 1996; Smeets, Leader, & Barnes, 1997; Takahashi, Yamamoto, & Noro, 2011; Tonneau & González, 2004). In this training, one stimulus within a stimulus pair is first presented in the middle of the computer display. Then, the second stimulus of the pair follows in succession at the same position. However, while there are some studies showing that students with developmental disabilities acquired reading skills through MTS training (e.g. Stromer et al., 1996), there are few studies that have used stimulus pairing training (Takahashi et al., 2011). In one study, Takahashi et al. (2011) reported that one student with ASD acquired Kanji reading through stimulus pairing training. In this training, the Kanji character was presented on the computer first. After clicking the Kanji stimulus, the spoken sound of Kanji character was immediately presented. Following this training, the student was able to read twelve Kanji characters and other equivalence relations among pictures, Kanji, and spoken sounds. However, during a one week follow-up session, he could only read two of the twelve Kanji characters, and could only choose seven of the twelve Kanji characters according to their corresponding pictures.

One of the limitations of the study in Takahashi et al. (2011) was that they did not present the nameable or inferable pictures during the stimulus pairing training. This may help explain why the student exhibited difficulties maintaining the acquired equivalence relations after only one week. The results of a previous study suggest that the acquisition of equivalence relations through stimulus pairing training may be facilitated when the visual stimulus meanings were either namable or inferable (Clayton & Hayes, 2004). Therefore, we used corresponding nameable picture stimuli during the training in the present study. We also examined whether students with ADHD could also acquire Kanji reading skills through stimulus pairing training, like students with ASD.

### 1.4. Objectives

In this study, we presented three types of stimuli, Kanji, spoken sounds of those Kanji, and corresponding pictures, presented by a computer in a stimulus pairing training procedure. We presented the each Kanji and corresponded picture one after the other. The present study had two main goals. First, by using stimulus pairing training, we examined the acquisition of equivalence relations between pictures, Kanji characters, and spoken sounds through Kanji reading, picture naming, and Kanji-picture comprehension assessments with three students with ASD and three students with ADHD. A previous study (Takahashi et al., 2011) has shown that the student with ASD could construct the equivalence relations by stimulus pairing training. However, previous research has not examined whether or not stimulus pairing training is effective for the students with ADHD to acquire equivalence relations. Second, we examined whether the participants were able to maintain the acquired Kanji reading skills and other equivalence relations in a follow-up assessment one week and two weeks after training, following the use of nameable picture stimuli during the training procedure. We made stimulus pairs of pictures, which students could name, and Kanji characters, which students could not read before the training.

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