Brief Note

Using Stimulus Equivalence Procedures to Teach Receptive Emotional Labeling to a Child With Autistic Disorder

Fumiyuki NORO

The purpose of the present study was to examine the effectiveness of stimulus equivalence procedures for teaching 4 receptive emotional labels (happiness, anger, sadness, and surprise) to a 5-year 9-month-old girl with autistic disorder. Training programs were designed to teach the girl to match schematic expressive faces to printed emotional labels and to match cartoons depicting emotional situations to schematic faces. After both matching tasks met the learning criteria, she showed unreinforced conditional relations between the printed emotional labels and the emotional situation cartoons, indicating the emergence of stimulus equivalence classes. In addition, the results demonstrated expansion of the equivalence classes to photographs of expressive faces and sentences describing emotion-eliciting situations.

Key Words: stimulus equivalence, emotional labels, child with autistic disorder

Matching-to-sample procedures have used to teach a variety of cognitive and language skills to children with developmental disabilities. In the matching-to-sample procedure, a sample stimulus (e.g., a picture card showing an apple) is presented, and then the participant selects a corresponding stimulus from two or more comparison stimuli (e.g., the printed words “apple” and “orange”). Previous studies have found that matching-to-sample procedures are effective for teaching picture-printed words relations (e.g., Mackay, 1985), numerical relations (e.g., Solnick & Baer, 1984), and basic monetary skills (e.g., McDonagh, McIlvane, & Stoddard, 1984).

Previous research has also shown that matching-to-sample procedures not only generate conditional relations that have been directly trained, but also produce equivalence relations among stimuli (Sidman & Tailby, 1982). Equivalence relations are defined by the demonstration of specific properties among stimuli, such as reflexivity, symmetry, and transitivity.

Reflexivity is demonstrated when a participant, without explicit training, matches any stimulus to itself. Symmetry is demonstrated when the roles of the sample and comparison stimulus in the training condition can be reversed without explicit training. For example, when a picture is the sample and a word in hiragana is the comparison stimulus in matching-to-sample training, the hiragana word would...
control selection of the picture on a symmetry test without direct training.

Transitivity is demonstrated when a participant matches stimuli that were never presented together in training, but were linked via a common stimulus. For example, after a participant is trained on picture → hiragana word, and hiragana word → kanji word relations (where the arrows represent connections between the sample and comparison stimuli), transitivity is demonstrated when a new untrained relation emerges in which the participant selects the kanji word corresponding to the picture (picture → kanji word relations). In this example, tests for the kanji word → picture relations evaluate the properties of symmetry and transitivity concurrently. Such tests are called equivalence tests (Sidman, 1990).

Stimulus equivalence procedures have been applied not only to linguistic and academic skills, but also to basic skills for social behavior, such as name-face matching (Cowley, Green, & Braunling-McMorrow, 1992), discriminations between age-appropriate and age-inappropriate items (Haring, Breen, & Laitinen, 1989), and discrimination of emotional facial expressions (Mochizuki, Nozaki, Watanabe, & Yairo, 1989). Mochizuki et al. (1989) used the stimulus equivalence paradigm to teach adults who were deaf and mentally retarded to establish equivalence relations among pictures of facial expressions, printed emotion words, and signs in sign language. Two of the four participants in their study showed the formation of stimulus equivalence relations among stimuli only after sign-picture and word-picture training. In addition, their participants could spontaneously sign manually and write the words corresponding to the pictures of facial expressions and also to photographs. The results of their study demonstrated the application of the stimulus equivalence paradigm to teaching emotional labeling to persons with developmental disabilities.

Persons with autistic disorders (Hobson, 1986a, 1986b), mental retardation (Rojahn, Lederer, & Tassé, 1995), or attention-deficit/hyperactivity disorders (Singh, Ellis, Winton, Singh, Leung, & Oswald, 1998) have been shown to have deficits in the ability to recognize facial expressions of emotion. It is important for these populations that educational programs that teach understanding of facial expression of emotions be developed. The present study systematically replicates and extends the stimulus equivalence paradigm with a child with autistic disorder, in order to demonstrate ways to establish equivalence among groups of facial emotional expressions, typical situations that are causes of emotions, and emotional labels.

Method

Participant and Setting

The participant was a 5-year 9-month-old girl who had been diagnosed with autistic disorder and mild mental retardation, by a child psychiatrist using DSM-IV (American Psychiatric Association, 1994) criteria. On WPPSI (Wechsler Preschool and Primary Scale of Intelligence for Japanese Children), she had a measured verbal IQ of 57, performance IQ of 94, and full-scale IQ of 69. She attended daily programs at a private preschool and came to the university clinical program once a week to
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receive special intervention services for social and academic skills.

The participant could read all the Japanese hiragana characters, and could communicate verbally in two- or three-word sentences, but her communications' functions were limited to requests. She could follow one-step instructions, such as "throw the ball," "bring me (something)," and "return the book to the shelf," during the university clinical program. However, at home or school, she often displayed noncompliant and disruptive behavior that was presumed to be maintained by social attention. In addition, she had several stereotypic behaviors (e.g., smelling another person's hair). Her preschool teacher and parents reported that she could not emit appropriate responses in relation to the other children in the preschool setting. For example, when she saw that other children were angry or crying, she often laughed; she persistently repeated what the other children disliked.

The setting was a therapy room (10 m x 8 m) at the university clinical center. Experiments were conducted at a small table in a room usually used for training. Responses of the trainer and the participant were recorded with a VTR camera.

Materials

The materials used included the following: schematic expressive faces, photographs of expressive faces, emotional situation cartoons, and printed emotion words. Each stimulus was 88 mm x 125 mm, and was laminated.

Schematic expressive faces. Schematic expressive faces used in the present study were drawings of emotional facial expressions selected from Yamada's (1993) set of drawings of average facial expressions of emotional categories, produced with computer graphic software from photographs of 36 adults without disabilities. Each of the schematic faces consisted of four elements: eyes, eyebrows, nose, and mouth.

Photographs of expressive faces. Two types of photographs were used in the present study: photographs of faces from Ekman and Friesen (1975), and photographs of faces of adult Japanese (one man and one woman). The photographs of Japanese were selected based on the criteria for facial element features given in Ekman and Friesen (1975). A set of eight black and white photographs were used for each type, including four emotional expressions (happiness, anger, sadness, and surprise) exhibited by two adults (one man and one woman).

Emotional situation cartoons. Three sets of four cartoons each were developed for use in the present study. Each cartoon in each set depicted an event that could have produced one of the four emotions (happiness, anger, sadness, and surprise). Under each cartoon was a short sentence describing the event. Table 1 lists the 12 situations used in the present study. As an example, the cartoon depicting an anger situation is shown in Fig. 1.

Printed emotion words. Four words in hiragana (よろこんでいる、おこっている、か Ashley had access to several types of emotional labels. Each label corresponded to one of the four target emotions (happy, angry, sad, surprised).
**TABLE 1** The Situations Described in the Emotional Situation Cartoons

<table>
<thead>
<tr>
<th>Situation</th>
<th>Emotion</th>
<th>Stimulus set</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The boy wins a race. <em>(kyousou-de-itiban-ni-natta-toki)</em></td>
<td>happy</td>
<td>1</td>
</tr>
<tr>
<td>2. The boy gets a present from another child. <em>(purezeno-wo-moratta-toki)</em></td>
<td>happy</td>
<td>2</td>
</tr>
<tr>
<td>3. The boy is praised by his teacher. <em>(homerareta-toki)</em></td>
<td>happy</td>
<td>3</td>
</tr>
<tr>
<td>4. The boy's friend hits him on the shoulder. <em>(otomodachi-ni-tatakareta-toki)</em></td>
<td>angry</td>
<td>1</td>
</tr>
<tr>
<td>5. The boy's turn on the slide is skipped. <em>(junban-wo-nukasareta-toki)</em></td>
<td>angry</td>
<td>2</td>
</tr>
<tr>
<td>6. The boy's friend takes his toy. <em>(omocha-wo-torareta-toki)</em></td>
<td>angry</td>
<td>3</td>
</tr>
<tr>
<td>7. The boy's friends won't let him play with them. <em>(asobi-ni-irete-moraenai-toki)</em></td>
<td>sad</td>
<td>1</td>
</tr>
<tr>
<td>8. The boy's favorite toy is broken. <em>(omocha-ga-kowareta-toki)</em></td>
<td>sad</td>
<td>2</td>
</tr>
<tr>
<td>9. The boy's teacher yells at him. <em>(sensei-ni-okorareta-toki)</em></td>
<td>sad</td>
<td>3</td>
</tr>
<tr>
<td>10. A snake pops out of the box right in front of the boy. <em>(hako-kara-hebi-ga-detekita-toki)</em></td>
<td>surprised</td>
<td>1</td>
</tr>
<tr>
<td>11. A dog suddenly comes out from behind a tree. <em>(kyuu-ni-inu-ga-detekita-toki)</em></td>
<td>surprised</td>
<td>2</td>
</tr>
<tr>
<td>12. A balloon bursts right in front of the boy. <em>(fuusen-ga-wareta-toki)</em></td>
<td>surprised</td>
<td>3</td>
</tr>
</tbody>
</table>

*Note.* The romanized Japanese sentences in parentheses are the short sentences that were included (in Japanese characters) with the cartoons.

![Situational Emotion Cartoon](image)

**FIG. 1** One of the Stimuli Used as a Situational Emotion Cartoon

In this example, the boy's toy has been taken by his friend. To prevent the participant in the present study from discriminating among the emotions on the basis of the facial expressions of the protagonists in the cartoons, the faces in all the cartoons were the same.
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General Procedures (Matching-To-Sample Tasks)

Except for tests involving oral labeling of emotional situation sentences, all testing and training trials were matching-to-sample tasks, in which four comparison stimuli were presented, followed by presentation of one of the four sample stimuli. The girl was requested to select the comparison stimulus corresponding to the sample. The order of trial configurations within a set was unsystematic, with the restriction that the same sample did not appear on more than three consecutive trials. The position of the designated correct comparison varied unsystematically from trial to trial. In any given set of trials, each conditional relation was presented on an equal number of trials. Sessions typically contained two blocks, each consisting of 12 trials.

Pretest

A schematic representation of the stimulus relations in training and testing is shown in Fig. 2.

Pretests had three purposes: to assess the participant’s ability (a) to select printed emotion words corresponding to schematic facial expressions (AB relation tests); (b) to match schematic facial expressions to emotional situation cartoons (CA relation tests); and (c) to select situational cartoons corresponding to printed emotion words (BC relation test). All pretest trials were conducted in the matching-to-sample format. To encourage task engagement by the participant, she was given a seal of her preferred character after every three trials, independently of her matching performance. There were 12 trials per block; in each of the four tasks was presented three times per block.

Training Procedure

The participant was taught AB and CA relations via standard matching-to-sample procedures. After every correct selection, the trainer provided verbal praise, such as “Good!” (“Sou da’ne” in Japanese). In addition, a character seal was given to her on a fixed-ratio 3 schedule as a reinforcer. When she selected an incorrect comparison, the trainer provided negative verbal feedback, such as “Wrong!” (“Chigau yo” in Japanese), and the trial was repeated. The criterion for training was 80% correct responding in two consecutive blocks of trials. When training for both AB and CA relations had met the criterion, the posttest condition began.

Posttests

Tests for equivalence relations. To evaluate the formation of equivalence relations among printed words, schematic faces, and emotional situation cartoons, the emergence of BC relations, that is, the equivalence test defined by Sidman (1990), was evaluated. In BC relation tests, one of the B stimuli (printed emotion words) was presented as the sample stimulus, and one of the three sets of C stimuli (emotional situation cartoons) was presented as comparison stimuli. To encourage the girl’s task engagement, she was given a seal after every three trials, independently of her matching performances.
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Transfer tests for photograph stimuli. Evaluation of her performance matching photographs of expressive faces and printed words (DB) was conducted to assess transfer of training to the photographs of expressive faces. The two sets of stimuli described above, a standard set and a Japanese set, were used. In phase 1, the black and white photographs of faces (one man and one woman) from Ekman and Friesen (1975), materials commonly used in published studies, were used as the standard stimulus set of photographs of emotional faces. Sessions consisted of two test blocks, 12 trials in each block. Photographs of a man’s and a woman’s face were used in the first and second block of each session, respectively.

After tests with the standard stimulus set, tests with the Japanese stimulus sets were conducted (Phase 2). Testing procedures with the Japanese stimulus sets were the same as for the standard stimuli.

**Fig. 2** Schematic Representation of the Stimulus Relations in Training and Testing

A, B, C, D, and E represents stimuli, in this example, “anger.” F represents the response. Solid arrows represent relations taught to the participant. Broken arrows represent relations tested after training. Arrows point from stimuli used as sample to stimuli used as comparisons in the matching-to-sample tasks.
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**TABLE 2 Sentences Used in the Tests for Sentence-Oral Labeling Relations**

<table>
<thead>
<tr>
<th>Situation</th>
<th>Emotion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.* You (the participant) received a present from your friends on your birthday. (HANAKO-chan (the participant)-wa-otanjoubi-ni-purezento-wo-moraimasita)</td>
<td>happy</td>
</tr>
<tr>
<td>2. Your mother bought you a new dress. (HANAKO-chan-wa-okaasan-ni-atarasi-youfuku-wo-katte-moraimasita)</td>
<td>happy</td>
</tr>
<tr>
<td>3. Your mother took you to see the movie, “Finding Nemo.”. (okaasan-ga-HANAKO-chan-wo-NIMO-no-eiga-ni-tureteitte-kuremasita)</td>
<td>happy</td>
</tr>
<tr>
<td>4.* When you were playing with your friends, they skipped your turn. (HANAKO-chan-ga-otomodachi-ni-keraremasita)</td>
<td>angry</td>
</tr>
<tr>
<td>5. Your friend kicked you. (HANAKO-chan-ga-otomodachi-ni-keraremasita)</td>
<td>angry</td>
</tr>
<tr>
<td>6. Your friend took your textbook. (otomodachi-ga-HANAKO-chan-no-kjyoukasyo-wo-totte-simaimasita)</td>
<td>sad</td>
</tr>
<tr>
<td>7.* Your friends won’t let you play with them. (otomodachi-ga-HANAKO-chan-wo-asobi-ni-irete-kuremasen-desita)</td>
<td>sad</td>
</tr>
<tr>
<td>8. Your favorite dress got torn. (HANAKO-chan-no-okinirii-no-ooyufuku-ga-yaburete-simaimasita)</td>
<td>sad</td>
</tr>
<tr>
<td>9. Your close friends’ family moved out of town. (HANAKO-chan-to-nakayosi-no-otomodachi-ga-tooku-ni-hikkosite-simaimasita)</td>
<td>sad</td>
</tr>
<tr>
<td>10.* A balloon burst close to you, and made a loud noise. (HANAKO-chan-ga-motteita-fuusen-ga-oookinaoto-wo-tate-te-warete-simaimasita)</td>
<td>surprised</td>
</tr>
<tr>
<td>11. When you were walking along, a car suddenly pulled out in front of you. (HANAKO-chan-ga-aruite-iruto-kyuu-ni-mae-kara-kuruma-ga-tobidasimashita)</td>
<td>surprised</td>
</tr>
<tr>
<td>12. A snake came out of the drawer in your desk. (HANAKO-chan-no-tukue-no-naka-kara-hebi-ga-detekimasita)</td>
<td>surprised</td>
</tr>
</tbody>
</table>

**Note.** Asterisks indicate situations that were the same as those in the emotional situation cartoons.

**Tests of Sentence-Oral Labeling Relations**

After the posttests were completed, additional tests were conducted to evaluate whether the participant could orally produce emotional labels corresponding to non-trained situational sentences. Three sets of four sentences (12 total) were developed for use in this test condition, with one sentence in each set describing an event that was said to have produced one of the four target emotions (Table 2).

For one of the three sets (marked with asterisks in Table 2), the situations described in the sentences were the same as those in the emotional situation cartoons, with the exception that the subject of each sentence was changed from a boy (as depicted in the cartoons) to the girl’s name. For the other two stimulus sets (8 sentences), new situations likely to trigger the target emotions were used.

A sentence written in a white card was presented by the trainer, and the participant read it orally. After reading the sentence, the participant was asked, “How would you feel in this situation?” She was required to answer this question orally. No
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differential feedback was delivered for any response to this question. Testing was conducted in three sessions, with 12 trials per session, in which each of the 12 test sentences was presented once.

**Interobserver Agreement**

On 30% of the sessions, a second observer separately recorded the accuracy of the participant's matching responses and labeling. Interobserver agreement was calculated on a trial-by-trial basis by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100%. Interobserver agreement was 98%.

**Results**

On the pretests, all relations were below 50% (range 8%-50%). Matching-to-sample training for AB training was conducted for eight training blocks (12 trials per block) until criterion performance was demonstrated. In the AB probes, her accuracy score was 91.1%. CA training was conducted for 14 blocks, after which probe scores in two blocks were both 83.3%. On the equivalence tests (BC), her initial score was low (33.3%), but her subsequent scores improved to a high level (91.7%, 91.7%, 100%, and 100%), despite the fact that test-trial performances received no differential feedback (see Fig. 3).

When the standard stimulus sets were used, the percentage correct in the first block of woman-photo conditions was 75%. Subsequent performance in the standard set phase, however, was below 50%. Table 3 shows the total number of errors in each type of sample-comparison for the first three sessions of tests of transfer to photographs of expressive faces (see Fig. 4).

With photographs of a woman's face (the data to the left of the colon in Table 3), the typical error pattern was that the participant matched photographs of sad
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TABLE 3 Total Number of Errors in Each Sample-Comparison Combination for the First Three Sessions of Transfer Tests With Photographs of Expressive Faces

<table>
<thead>
<tr>
<th>sample (face photo)</th>
<th>comparison (emotional word)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Happiness</td>
<td></td>
</tr>
<tr>
<td>Anger</td>
<td></td>
</tr>
<tr>
<td>Sadness</td>
<td></td>
</tr>
<tr>
<td>Surprise</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Happiness</th>
<th>Anger</th>
<th>Sadness</th>
<th>Surprise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Happiness</td>
<td>—</td>
<td>0 : 0</td>
<td>4 : 0</td>
<td>1 : 5</td>
</tr>
<tr>
<td>Anger</td>
<td>0 : 0</td>
<td>—</td>
<td>0 : 2</td>
<td>0 : 1</td>
</tr>
<tr>
<td>Sadness</td>
<td>0 : 0</td>
<td>1 : 1</td>
<td>—</td>
<td>6 : 2</td>
</tr>
<tr>
<td>Surprise</td>
<td>6 : 8</td>
<td>0 : 0</td>
<td>1 : 1</td>
<td>—</td>
</tr>
</tbody>
</table>

Notes. Dashes indicate correct selections (data are not shown). Total number of trials during three test sessions was 36 : 9 each of 4 samples. Data are presented as the number of errors in tasks with photographs of women (on the left of the colon) and of men (on the right).

faces to surprised words, photographs of surprised faces to happy words, and photographs of happy faces to sad words. With photographs of a man’s face (the data to the right of the colon), trends in the error data were that the participant matched photographs of happy faces to surprised words and photographs of surprised faces to happy words.

Differential consequences were introduced in the fourth session to improve the matching of photographs of expressive faces and printed emotion words. In the first block of the training phase (woman), her matching score was 58.3%. In the second block (man), her matching score was 81.1%. During the fourth session, the participant spontaneously began to imitate the facial expressions in sample photographs without any explicit intervention to increase such responses. Table 4 shows the number of occurrences of facial imitation responses during the fourth to sixth sessions.

FIG. 4 Results in Transfer Tests for the DB Relations (matching facial photo to emotional labels)
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**Table 4** Occurrence of Facial Imitation Responses in Sessions 4–6

<table>
<thead>
<tr>
<th>sample (facial photo)</th>
<th>Session 4 (Training)</th>
<th>Session 5 (Test)</th>
<th>Session 6 (Test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Woman</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Happiness</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Surprise</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Man</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Happiness</td>
<td>1</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Surprise</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

*Note.* Each session contained 12 trials, 3 of each sample type; therefore, the maximum score was 3.

She emitted facial imitation responses only when shown happy and surprised facial photos as sample stimuli. During the fifth session, in which Japanese facial photos were introduced as new testing stimuli, the participant did not imitate the facial expression of any sample stimulus. On the other hand, during the sixth session, she again produced imitation responses. In the training phase with standard stimuli and in the second transfer test phase, the participant emitted facial imitation responses to two kinds of photographs of expressive faces (happiness and surprise), ones that had been difficult for her to discriminate in the first transfer phase.

In the first block (woman task) of the first session in which the Japanese stimulus set was used, the participant scored 16.7%, but her accuracy rose to 83.3%, 83.3%, and finally to 100%.

During the tests for sentence-oral labeling, the percentage of correct responding was 83.3%, 91.7%, and 100% for each block, respectively.

**Discussion**

The results of the pretests and the course of acquisition during AB/CA training indicated that the girl had not showed equivalence relations among the schematic expressive faces (A), printed emotion words (B), and emotional situation cartoons (C) prior to AB/CA training. After training for AB/CA relations, BC relations were generated without direct training. The results of BC tests indicated that training on AB/CA generated stimulus equivalence classes among schematic expressive faces, printed emotion words, and emotional situation cartoons. Previous research (Mochizuki et al., 1989) showed the utility of the stimulus equivalence paradigm for teaching receptive emotional labels to adolescents who were deaf and mentally retarded. The results of the present study replicated and extended the Mochizuki et al. (1989) findings with a child with autistic disorders.

The present study evaluated whether the discriminative control of printed emotion words transferred from schematic expressive faces to photographs of expressive faces. The results of the first transfer phase using the standard facial photo-
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graphs as test stimuli were at chance level. After that, direct training was introduced. Following training with the standard stimuli, the second transfer phase with Japanese facial photographs was conducted. The girl then showed a gradual emergence of matching between the Japanese facial photographs and the printed emotion words.

Why did the discriminative function not transfer from the schematic expressive faces to the standard stimuli in the first transfer tests? In previous studies (e.g., Barnes & Keenan, 1993; Fields & Reeve, 2001), a sharing of common physical features among stimuli was considered to be one of the major contributing factors to the transformation of stimulus functions. One possible explanation for the results in the present study is that the physical similarity of stimulus features between the schematic and photographed expressive faces was not enough to result in the transfer of the discriminative functions. A possible explanation is that the participant failed to attend to critical relevant features of the emotional expressions. In order to have positive outcomes on the transfer tests, the participant had to discriminate among four categories of photographed facial expressions on the basis of each perceptual feature. The photographed faces had more complex stimulus features than the schematic expressive faces. Especially, the photographed faces had features irrelevant to emotional discriminations, such as hair and ears. These irrelevant cues might have interfered with the participant's observation of the relevant cues.

The reason why the outcome of the transfer tests with photographs of Japanese expressive faces were positive after direct training on the standard stimuli was the differential consequences in the direct training functioned as instructional control over the participant's observing responses to relevant stimulus features. This was shown by the fact that the participant emitted facial imitation responses to two kinds of emotional face photographs (happy and surprised), ones that had been difficult for her to discriminate in the transfer tests with the standard stimuli. During the transfer tests with the Japanese facial photographs, the facial imitation responses functioned as differential observing responses among the stimulus features relating to emotional expression, and facilitated discrimination among the Japanese facial expressions.

Other interpretations of the results of the transfer tests are possible. Regardless of whether or not direct training was conducted with the standard stimuli, it would be easier to transfer discriminative function to Japanese facial photographs than to the stimuli from Ekman and Friesen (1975). The participant, during her daily routine, had had experience with exposure to the facial expressions of Japanese, but had never met people from other racial groups. In her daily routine, although she could not understand the relation between facial expressions and emotions, she was able to respond differentially to others' facial expressions. For example, when the participant saw that other children were angry or crying, she often laughed, and when she saw that another child was laughing, she often slapped that child on the back. That is, for the participant, Japanese facial expressions might already have become functional stimulus classes, that is, sets of discriminative stimuli that controlled the same response. In other words, she could already discriminate Japanese facial expressions prior to participating in the present study, and that would make it easier to transfer.
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discriminative functions from the schematic expressive faces to the Japanese facial photographs.

The results in the tests of sentence-oral labeling relations showed that without direct training, the participant could give emotional labels orally that corresponded to the text-based emotional sentences. However, these results must be interpreted cautiously, because this relation was not assessed during the pretests. Nevertheless, because the results of pretests for other relations were low scores, it seems unlikely that she had acquired relations between sentence-oral emotional labeling without any training. It seems much more likely that the training on the relation between the emotional situation cartoons and the printed emotion words led to the oral labeling of the emotional situation sentences.

How did she come to emit correct emotional labels to the untrained situational sentences? I speculate that the captions presented with the cartoons may have played a mediating function for this transfer. Each cartoon had a caption referring to a situation that was likely to trigger an emotion. That is, each C stimulus was actually not simply a cartoon, but rather a two-element stimulus involving a cartoon and a caption. According to previous studies (e.g., Stromer & Stromer, 1990a, 1990b), when a stimulus consisting of two-elements is used as a sample in matching-to-sample training, each element can be expected to exert independent control over the selection of comparisons. CA training in the present study might have generated not only relations between the emotional situation cartoons and the schematic expressive faces but also between the captions of the cartoons and the faces. In other words, the captions that had been paired with cartoons could become a member of the stimulus equivalence class.

In addition, many of the sentences used in the tests of sentence-oral labeling relations had the same keywords for the corresponding target emotions as had the captions of the cartoons. For example, both the captions and the sentences for happiness had the word “receive”; and both of those for angry had the word “taken away.” One possible explanation of why the participant succeeded in showing new labeling skills could be that the keyword in each test sentence was a useful cue to link the sentence with the appropriate emotional categories.

The results of the present study suggest that the formation of equivalence relations between emotional categories and keywords referring to typical emotional situations may be an important training step for children with autistic disorders in order to facilitate understanding of the emotions triggered by situations. However, one limitation of this is that the key word does not always have an equivalent relation to a specific emotion. For example, the key word “receive” is not equivalent to happiness. When people receive something that they do not like, they may feel sad or angry. Thus, which emotion (e.g., happiness, anger, sadness, or surprise) is equivalent to a key word (e.g., “receive”) depends on the context (e.g., what is received). Several researchers have demonstrated that word-meaning relations are contextually controlled by several environmental factors (Kohlenberg, Hayes, & Hayes, 1991; Mochizuki & Nozaki, 1993). Based on these findings, future research
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should demonstrate contextual control of relations between key words and emotional labels in children with autistic disorders.

In the present study, generalization to the child’s everyday life situations (e.g., in her home and at preschool) was not formally assessed. Anecdotal information suggested that generalization had occurred. Her preschool teacher reported that the participant expressed emotional labels orally to protagonist’s faces in picture-card-shows and picture books after the present training.

Given the limitations described above, the current study should be considered as a preliminary study. Further research should be directed toward evaluating the generalization of the teaching program used in the present study.

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F. Noro


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