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Can the Emotion Recognition Ability of Deaf Children be Enhanced? A Pilot Study

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Running head: ENHANCING EMOTION RECOGNITION ABILITY

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Abstract

We evaluated the effectiveness of an 11-lesson psychoeducational program designed to enhance the ability of deaf children to understand the emotional experience of themselves and other people. The ‘Funny Faces Program’ was provided to 14 children, aged 9 to 13 years, with moderate to profound hearing impairments. All children were enrolled in an oral education program at a school for the deaf. Alternate forms of the Emotion Recognition Scales (Dyck, Ferguson, & Shochet, 2001) were administered at pretest and posttest. Results indicate significant increases in emotion vocabulary and emotion comprehension, but not in the speed or accuracy of emotion recognition, from pretest to posttest. At posttest, children whose hearing loss is moderate to severe do not differ from hearing children in emotion recognition abilities, but children with profound hearing loss continue to show substantial ability deficits.
Can the Emotion Recognition Ability of Deaf Children be Enhanced? A Pilot Study

When a deaf child is not exposed to a natural language from infancy (Isham & Kamin, 1993), severe prelingual deafness is typically followed by pronounced delays in language acquisition, in academic achievement and verbal intelligence (Bracken & Cato, 1986), in social knowledge and competence (Kusche, Garfield, & Greenberg, 1983; Weisel & Bar-Lev, 1992), and in psychological (Mahapatra, 1974) and social adjustment (Vernon & Greenberg, 1999). During the last decade, research has shown that deaf children are also delayed in acquiring a theory of mind (ToM; Peterson & Siegal, 1995, 1998). This was an important finding for at least two reasons. On the one hand, this finding implied that acquisition of a ToM might itself depend on the acquisition of language (e.g., the syntax of complementation; Tager-Flusberg, 1997). Conversely, it implied that the social problems of deaf children might be mediated by the same cognitive deficits that were thought to account for the social and behavioral problems shown by children with autism (Baron-Cohen, Leslie, & Frith, 1985).

In populations where ToM deficits are observed, deficits in the ability to understand the emotional experience of other people are also typically observed. For example, children with autism or mental retardation have emotion recognition and understanding (ER) deficits that are proportionately greater than their general intellectual deficits (Dyck, Ferguson, & Shochet, 2001; Hobson, Ouston, & Lee, 1988; Loveland, Tunali-Kotski, Chen, et al., 1997). Children with a specific language impairment, who pass 1st order ToM tasks (Leslie & Frith, 1988; Perner, Frith, Leslie & Leekam, 1989) but have difficulty with 2nd order ToM tasks (Patchell, Reed, Coggins, & Hand, 2001), have problems in recognizing nonverbal emotional expressions (Wiig & Harris, 1974), in understanding facial expressions accompanying spoken messages (Larson & McKinley, 1995), and in matching facial expressions with emotional tone of voice (Courtright & Courtright, 1983).
Among deaf children, results have been equivocal. Earlier studies indicated that deaf children make more errors in recognizing facial expressions of emotion than do hearing children, and the number of errors is related to the onset of deafness: people with prelingual hearing loss make more errors than people with postlingual hearing loss (Bachara, Raphael, & Phelan, 1980; Schiff, 1973). However, later studies indicated that deaf children can perform as well as hearing children on a simple ER task when it involves emotion matching rather than emotion recognition (Hosie, Gray, Russell, Scott, & Hunter, 1998; Weisel, 1985). Rieffe and Terwogt (2000) recently reported that deaf 6-year olds and 10-year olds are about as accurate at predicting typical emotional responses and in explaining atypical emotional responses as hearing children, but the deaf participants in their research had been receiving training in emotion labeling and emotional awareness. Finally, Dyck, Farrugia, Shochet and Holmes-Brown (2002) compared deaf children and deaf adolescents with blind children/adolescents and sighted and hearing controls on a battery of emotion recognition and emotion understanding tasks. The results indicated that profoundly deaf children have ER deficits comparable to those of children with autism. Deaf adolescents achieve significantly higher scores than deaf children, but continue to lag both blind adolescents and sighted/hearing adolescents in ER ability.

The presence of ToM and ER deficits across a broad range of clinical populations raises important questions about the processes underlying the observed deficits and about the possibility that these deficits can be effectively treated. For example, ToM deficits in children with autism are often attributed to an impaired ‘theory of mind mechanism’ (Baron-Cohen & Swettenham, 1996), that is, to a neurocognitive structure not responsive to psychological interventions. Observations that ToM deficits in children with autism are stable (Holroyd & Baron-Cohen, 1993; Ozonoff & McEvoy, 1994) and treatment resistant (McGregor, Whiten, & Blackburn, 1998; Swettenham, 1996) are consistent with this hypothesis. Similarly, ER deficits in
autism are attributed to an impaired face processing mechanism (Klin, Sparrow, de Bildt et al., 1999), although it remains unknown whether these deficits are stable or treatment resistant. If ToM/ER deficits are stable and treatment resistant, then any social or behavioral problems that are functionally related to ToM/ER deficits would also be expected to be treatment resistant.

In the case of deaf children, it is more likely that ToM and ER deficits are directly or indirectly related to delays in the acquisition of language than to an impaired neurocognitive structure. There are three lines of evidence supporting this conclusion. First, research indicates that ToM deficits among deaf children are relatively specific to children not exposed to a natural language from infancy. Courtin (2000) and Peterson and Siegal (1999) have demonstrated that the greatest ToM deficits are observed in deaf children with hearing parents, and no ToM deficits are observed in deaf children with deaf parents who were exposed, from infancy, to a sign language-rich environment.

Second, research indicates that ToM deficits are not stable in deaf children. Russell, Hosie, Gray, Hunter, Banks, and Macaulay (1998) observed that among deaf children from hearing families, ToM deficits decreased with age. They argued that increased opportunities for social interaction in older children facilitated the continuing, if delayed, acquisition of ToM ability. Similarly, as already noted, Dyck et al. (2002) observed that the ER abilities of deaf adolescents are significantly greater than those of deaf children. Dyck et al. (2002) also observed that among deaf children and deaf adolescents, ER abilities are directly proportionate to their broader verbal abilities. In comparisons with hearing children and adolescents, group differences in ER ability were consistently eliminated when verbal ability (measured with Wechsler verbal scales) was statistically controlled. As the verbal ability of deaf children increases, so too does their ER ability.
Third, research shows that many of the social problems of deaf children that might be attributed to ToM/ER deficits are responsive to treatment. Suarez (2000) reports that a social skills training program was effective in improving deaf students’ social problem solving skills and assertive behavior, Rasing, Coninx, Duker, and van den Hurk (1996) report the acquisition and generalisation of social behaviors as a result of training in deaf children with severe and less severe language deficits (gains were substantially less in children with greater language deficits), Antia and Kreimeyer (1996) report increased interaction between deaf and hearing children as the result of a social skills intervention, and so on (Curl, Rowbury, & Baer, 1985; Lemanek, Williamson, Gresham, & Jensen, 1986; Toranzo, 1996).

Peterson and Siegal (1995, 1998, 1999) have argued that the ToM deficits of deaf children are due to a lack of ‘conversational opportunities.’ Delays in acquiring a ToM and ER abilities reflect delays in acquiring language (which affects performance on all language-based tasks) and the fact that delays in language make it more difficult for deaf children to participate in the social situations in which hearing children learn to understand the experience of other people. Given research showing that the ToM abilities of deaf children are not stable, the ‘conversation hypothesis’ implies that the ER deficits of deaf children would be reduced if the children received systematic training in how to understand the emotional experience of other people. This research was designed to provide an initial test of this hypothesis by assessing whether the ER abilities of oral deaf children can be enhanced following ER training.

Method

Funny Faces Program

We developed The Funny Faces Program (FFP) to increase deaf children’s understanding of mental state terms, how to apply these terms to one’s own experience and to the experience of other people, how to attend to and interpret non-verbal—and especially facial—emotion cues, and how to understand both how
emotions are elicited and how emotions affect behavior. The FFP is closely modeled on psychoeducational programs that were designed to prevent, and have been shown to be effective in preventing, anxiety or depression in children and adolescents, including children from non-English speaking backgrounds in rural Australia (FRIENDS: Barrett, Sonderegger, & Sonderegger, 2001; Aussie Optimism: Roberts, Ballantyne, van der Klift, & Quan Sing-Rowlands, 2001; R. Roberts, C. Roberts, Cosgrove et al., 2001; Resourceful Adolescent Program: Shochet, Dadds, Holland, et al., 2001; Social Problem Sovling: Spence, 1995). Although these programs aim to increase children’s ability to regulate their own emotions, this aim is achieved, in part, by increasing children’s knowledge of emotions (labeling), the causes of maladaptive emotional experience, and of how emotional experience can be changed. In our view, these programs are likely to enhance the ER ability of children even if this is not their explicit aim.

The FFP is an 11 session program designed to be implemented as part of a school’s curriculum. Materials include a 123 page ‘Facilitator’s Handbook’ and a 19 page ‘Student’s Handbook.’ Sessions are intended to be 45 minutes in length and are organized into 5 modules. The first single-session module introduces children to the program and aims to foster a cooperative and supportive group learning environment. The second module, understanding emotions, consists of 7 sessions which focus on happiness, sadness, fear, hurt (emotional responses to rejection, disappointment, betrayal, etc.), anger, and complex, social, and other emotions (e.g., shame, jealousy, embarrassment, surprise, disgust). A third single-session module links situations with emotions, a fourth single-session module links situations with changing emotions, and the fifth single-session module reviews the program as a whole. Each session is designed to be conducted by a facilitator and an assistant, and incorporates conventional classroom methods and experiential learning.
Participants
Participants were 14 deaf children, 8 boys and 6 girls, aged between 9 and 13 years (mean = 11.84 years; sd = 1.32 years), who were enrolled in an oral education program at a school for the deaf in the Perth, Australia, metropolitan region. Participants constituted the entire population of oral deaf children within this age range who were being educated at the school in question. Nine children were profoundly deaf (hearing loss > 90db), 2 children were severely deaf (hearing loss > 70db), and 3 children were moderately deaf (hearing loss > 50db). Half of the children had received a cochlear implant and the remaining half of the children used hearing aids; severity of hearing loss was based on unassisted and or pre-implant hearing ability. Nine of the children had no comorbid condition, but 5 children had received diagnoses as follow: Attention Deficit Hyperactivity Disorder (ADHD) = 2, ADHD and Oppositional Defiant Disorder = 1, Attention Deficit Disorder = 1, Down Syndrome = 1, and dyspraxia = 1.

Measures
The Emotion Recognition Scales (ERS; Dyck et al., 2001) include measures of the ability to recognize facial and vocal emotion cues, emotion vocabulary, understanding of emotion-context relationships, and the ability to solve emotional puzzles. The ERS have been shown to be valid for use with deaf children and adolescents (Dyck et al., 2002). For this study, we constructed alternate forms of three ERS to be used as pretest and posttest measures of ER. In order to construct these alternate forms, we reanalyzed data from several previous studies. For the Fluid Emotions Test and Emotion Vocabulary Test (see below), we pooled item data from Dyck et al. (2001) and Dyck et al. (2002), which resulted in 337 sets of item scores sampled from children with one of several psychological disorders (i.e., Autistic Disorder, Asperger Disorder, Attention Deficit Hyperactivity Disorder, Mental Retardation, Anxiety Disorder), one of two sensory disabilities (i.e., deafness or
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blindness), or with no psychological disorder or sensory disability. For the Comprehension Test (see below), we reanalyzed unpublished item data obtained from 360 children and adolescents in a series of test development studies. For each test, items were matched for difficulty and item-total correlation and then 1 item from each matched pair was assigned to each of the alternate forms.

**Fluid Emotions Test (FET).** The FET is an individually administered measure of the ability to recognize static and changing/changed facial expressions of emotion. Each FET form consists of 16 items, and each item has two components. In the first component, participants are shown an image, on a computer screen, of a person expressing one of 7 emotions (anger, contempt, disgust, fear, happiness, sadness, surprise) or a neutral expression. The images are taken from the ‘Japanese and Caucasian Facial Expression of Emotions’ and ‘Japanese and Caucasian Neutral Faces’ stimulus sets (Matsumoto & Ekman, 1995). The images are balanced for gender and ethnicity and emotion category. After participants indicate what emotion (if any) has been expressed, the image is slowly changed (over 4 seconds) by morphing software to that of a different person expressing a different emotion. Participants are asked to identify the new emotion as quickly as possible.

The FET yields 4 scales. ‘Accuracy 1’ (ACC1) is the number of premorph faces correctly identified; ‘Accuracy 2’ is the number of postmorph faces correctly identified; ‘Speed’ is the average postmorph response time, measured with a stop watch, regardless of accuracy; ‘Speed given accuracy’ (SGA) is a categorization of response times for accurate responses. Response latencies greater than 12 seconds result in a score of 0 whether or not the response is accurate. Latencies of 9-12 seconds are scored 1, and each subsequent 1 second decrease results in an incremental score of 1. Latencies of less than 4 seconds are scored 7. Thus, the maximum score on the SGA is 102. Because the SGA incorporates information from the Speed and
Accuracy 2 scales, only results for it and the Accuracy 1 scale are reported in this study.

The new alternate forms of the ACC1 scale were internally consistent (Form A, $\alpha = .81$; Form B, $\alpha = .83$) and were strongly related to each other ($r = .85$). The new alternate forms of the SGA were also internally consistent (Form A, $\alpha = .85$; Form B, $\alpha = .85$) and strongly related to each other ($r = .9$).

**Comprehension Test** (CT). The CT is an individually administered measure of the ability to understand the emotional consequences of exposure to emotion-eliciting situations (e.g., “Susan is given a new bicycle for her birthday. What will Susan feel?”). CT items sample the emotions represented in the FET, social variants of the emotions (pride, shame, pity, embarrassment), variations in emotional intensity (fear versus terror), and material (gain or loss), social (rejection), and intrapsychic (failure) causes of emotions. Answers are recorded by the examiner on the test form and are scored on a 3-point scale against conceptual scoring criteria and prototypic answers. Each form of the CT is an 11-item ordinal scale. The two forms are internally consistent (Form A, $\alpha = .84$; Form B, $\alpha = .82$) and are strongly related to each other ($r = .79$).

**Emotion Vocabulary Test** (EVT). The EVT is an individually administered measure of the ability to define emotion words (e.g., “What does the word ‘angry’ mean?”). The EVT was developed because emotion vocabulary represents a limit to individual performance on other ERS, and the words chosen for inclusion in the EVT are taken from the scoring keys of other ERS. The response format of the EVT is open-ended and initial responses may be queried by the examiner to resolve ambiguities in the initial response. Responses are scored on a 3-point scale against conceptual criteria and prototypic answers. Each form of the EVT is a 10-item ordinal
scale. The alternate forms are internally consistent (Form A, $\alpha = .81$; Form B, $\alpha = .82$) and are strongly related to each other ($r = .78$).

**Design and Procedure**

A one-group pretest-posttest design was used to obtain an initial estimate of the effectiveness of the FFP in enhancing the ER ability of deaf children. At pretesting, participants were randomly assigned to a Form A or Form B test order condition. Participants in the Form A condition were individually assessed on Form A of the FET, CT, and EVT (in that order) at pretest; participants in the Form B condition were individually assessed on Form B of the FET, CT, and EVT at pretest. Each test session lasted approximately 20 minutes and all pretesting took place within 3 days of the start of the FFP.

The FFP was conducted over the course of two weeks, and was presented to the entire group of participants; there was no opportunity for participants who missed sessions (due to illness, etc.) to make-up the missed content. The program was facilitated by one of us (ED) with the assistance of two briefed, but not specifically trained, teacher’s aides. The facilitator had spent several hours attending the participants’ regular classes so that she would be familiar to them. Scheduling constraints entailed numerous changes to how the program was delivered. For example, although each session was designed to last 45 minutes, some sessions had to be reduced to 30 minutes and others extended to 90 minutes (leaving the total training delivered at the intended 9 hours). Similarly, although each session was intended to begin by reviewing previous content, some sessions had to be scheduled ‘back-to-back’ which made the review redundant. Program delivery was also disrupted by unforeseen school events (e.g., school photographs), by behavior management problems, by participants’ neglect to bring hearing aids or turn on cochlear implant processors, and by absenteeism.
Posttesting was conducted during the 5 school days immediately following the program’s completion, except for one participant who was ill and was tested 12 days following the program. Participants who had completed Form A at pretest completed Form B at posttest, and vice versa.

Variable Recoding

Because both Form A and Form B of each ERS was used at pretest, and both forms were also used at posttest, it was necessary to create a common pretest score for each scale and a common posttest score for each scale. These common scores were achieved by creating a single pretest variable for each test and a single posttest variable for each test. Thus, the Emotion Vocabulary Test pretest score was the person’s score on EVT Form A or Form B depending on which form of the test was administered at pretest.

Results

Because three of the alternate forms of the Emotion Recognition Scales constructed for this study have different numbers of items than published versions, comparisons with published group means are not appropriate. Table 1 presents pretest and posttest means and standard deviations on the ERS for this sample as well as recalculated comparison data (based on the same items) obtained from same-aged (approximately; see Table 1 notes) deaf and hearing controls in the Dyck et al. (2002) study. The results suggest that the ER pretest deficits of this sample are comparable to those that have been previously reported for deaf children using different versions of the ERS; one way analyses of variance indicate that the deaf children in this sample do not differ from deaf children in the comparison sample on any scale except the EVT, on which the present sample achieves significantly lower scores \[F(1, 28) = 6.86, p < .05\].

We next assessed whether the severity of deafness is associated with the severity of ER deficits by comparing the performance on the ERS of profoundly deaf
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children (n = 9) with children with less severe impairments (n = 5). One-way analyses of variance indicate that profoundly deaf children obtain significantly lower scores at pretest on the Comprehension Test \( F(1, 13) = 5.82, p < .05 \) and Emotion Vocabulary Test \( F(1, 13) = 7.40, p < .01 \), but not on the two scales of the Fluid Emotions Test [ACC1: \( F(1, 13) = 1.69, \text{ns} \); SGA: \( F(1, 13) = 0.64, \text{ns} \)] (see Table 2).

Table 1 shows that all posttest means are nominally higher than pretest means. We assessed whether ER abilities at posttest were significantly higher by conducting four repeated measures analyses of variance. Because there is a relationship between the severity of deafness and ER ability, we also assessed whether there is an interaction between severity of deafness and response to the program by including our categorical severity variable (profound or not profound deafness) as a between-subjects factor. The results indicate that there is no evidence that the ability to recognize static [ACC1: \( F(1, 12) = 1.14, \text{ns} \); \( \eta^2 = .087 \)] or changing [SGA: \( F(1, 12) = 0.75, \text{ns} \); \( \eta^2 = .059 \)] facial expressions of emotion had increased during training.

Although the interaction with the severity of deafness was not significant, at posttest the profoundly deaf participants obtained significantly lower scores on the ACC1 scale than less severely deaf participants [\( F(1, 12) = 7.22, p < .01 \)]. As for the remaining two scales, both emotion vocabulary [EVT: \( F(1, 12) = 9.24, p < .01 \); \( \eta^2 = .435 \)] and the ability to understand relations between emotions and emotion-eliciting contexts [CT: \( F(1, 12) = 4.72, p < .05 \); \( \eta^2 = .283 \)] were higher at posttest than at pretest. Once again, in neither case was there an interaction with severity of deafness, but at posttest, the profoundly deaf participants obtained significantly lower scores on both the Emotion Vocabulary Test [\( F(1, 12) = 5.01, p < .05 \)] and the Comprehension Test [\( F(1, 12) = 10.89, p < .01 \)]. Comparison of Table 1 and Table 2 shows that at posttest, the achievement of less severely deaf participants is approximately equal to
hearing persons on all measures. However, for profoundly deaf participants, performance at posttest remains substantially lower than that of hearing persons.

In addition to pre/post group contrasts, we also observed changes in individual performance between pretest and posttest. Table 3 reports the difference scores obtained by subtracting pretest from posttest performance on each variable for each participant; positive values indicate an enhancement effect. The results (see Table 3) indicate that on the emotion recognition tasks, participants are about as likely to show diminished achievement as enhanced achievement at posttest. One possible explanation for this pattern of results is measurement error, in particular, test unreliability. We reassessed the internal consistency of our measures by calculating Cronbach’s alpha for each form of each scale. The resulting coefficients were within acceptable limits for the two forms of the CT (.68 and .77) and EVT (.75 and .67), were low for the SGA (.50 and .61), and were clearly unacceptable for the ACC1 (.39 and -.41).

For the more reliable emotion understanding tasks, Table 3 illustrates how the severity of deafness may affect what a child is able to learn. Profoundly deaf children show consistent improvements in emotion vocabulary, a task on which they had almost no measurable ability at pretest. Children with moderate to severe deafness showed most improvement on understanding relationships between emotions and emotion-eliciting contexts; they appear to have had sufficient emotion vocabulary at pretest to be able to use this knowledge effectively to enhance other learning.

Discussion

The results of this study are consistent with other research indicating that deaf children benefit from structured programs designed to enhance their social skills (Suarez, 2000) and social interactions (Antia & Kreimeyer, 1996). The results of this study also provide direct support for the suggestion by Rieffe and Terwogt (2000) that the social cognition of deaf children can be enhanced by training. They had not
assessed this hypothesis themselves, but had shown that their deaf subjects, who were receiving training in emotion labeling and emotion awareness, did not differ from hearing controls on simple emotion understanding tasks.

The enhancement of ER was not evident across all dependent measures, but where enhancement effects were observed, they were relatively large. Increases in performance on both the emotion comprehension and emotion vocabulary tasks were three quarters of one standard deviation (pretest), and posttest performance on the emotion comprehension task is clearly equivalent to that of hearing persons. Nonetheless, there are three reasons why treatment effects are likely to have been underestimated. First, because two of our dependent measures were unreliable in this study, it is not possible to make any valid observations about possible increases in the ability to recognize facial expressions of emotion. Second, effect sizes may have been reduced as a result of the heterogeneity of program participants. Our sample was too small to detect any but large effects, but there is some evidence that profoundly deaf participants learned different things than did less severely deaf participants. If some effects are relatively specific to sub-groups within the sample, then comparisons based on the sample as a whole will tend to obscure them. Third, because this was the first application of the FFP, there were numerous practical contingencies, which could be controlled in subsequent administrations, that appeared negatively to affect the program.

The fact that there was no control group in this pilot study means that we must be cautious in attributing any enhancement effect to the Funny Faces Program; the fact that there was no follow-up means that we cannot be certain whether any of the apparent effects persist. Nonetheless, the results do suggest that the emotion understanding abilities of deaf children can be significantly enhanced as a result of nine hours of structured training. If replicated under more controlled conditions, these results would provide strong evidence that the ER deficits of deaf children are a direct
effect of delays in language acquisition and/or the opportunity to converse about the experience of other people (Peterson & Siegal, 1995, 1998).
Author Notes

We wish to thank Clare Roberts for her advice on how to structure the Funny Faces Program and for her suggestions concerning program content, Tull Ashard for his original illustrations, Mara Blosfelds and two anonymous reviewers for their comments on earlier versions of this report, and the anonymous teachers, parents, and children whose cooperation made this study possible.
References


Enhancing Emotion Recognition Ability


Table 1
Achievement on the Emotion Recognition Scales at Pretest and Posttest Compared with Independent Samples of Deaf Children and Hearing Children

<table>
<thead>
<tr>
<th>Scale</th>
<th>Deaf 1 Pre</th>
<th>Deaf 1 Post</th>
<th>Deaf 2</th>
<th>Hearing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (sd)</td>
<td>Mean (sd)</td>
<td>Mean (sd)</td>
<td>Mean (sd)</td>
</tr>
<tr>
<td>ACC-1</td>
<td>7.42 (1.69)</td>
<td>7.85 (2.14)</td>
<td>7.22 (2.44)</td>
<td>8.83 (1.92)</td>
</tr>
<tr>
<td>SGA</td>
<td>34.28 (16.15)</td>
<td>38.35 (10.72)</td>
<td>36.47 (13.44)</td>
<td>48.27 (13.50)</td>
</tr>
<tr>
<td>CT</td>
<td>6.78 (2.45)</td>
<td>8.57 (4.21)</td>
<td>6.44 (2.68)</td>
<td>8.97 (4.01)</td>
</tr>
<tr>
<td>EVT</td>
<td>1.35 (2.30)</td>
<td>3.28 (2.64)</td>
<td>3.82 (2.92)</td>
<td>4.85 (3.46)</td>
</tr>
</tbody>
</table>

Deaf 1 = This Study
Deaf 2 = Deaf children from Dyck et al., 2002: n = 16, female = 8, mean age = 9.29 years (sd = 1.14 years)
Hearing = Hearing children from Dyck et al., 2002: n = 30, female = 16, mean age = 8.77 years (sd = 1.70 years)

ACC-1 = Accuracy of Emotion Recognition; SGA = Speed Given Accuracy of Emotion Recognition; CT = Comprehension Test; EVT = Emotion Vocabulary Test
Table 2

Emotion Recognition Abilities at Pretest and Posttest for Profoundly Deaf and Moderately to Severely Deaf Participants

<table>
<thead>
<tr>
<th></th>
<th>ACC1-Pre</th>
<th>ACC1-Post</th>
<th>SGA-Pre</th>
<th>SGA-Post</th>
<th>CT-Pre</th>
<th>CT-Post</th>
<th>EVT-Pre</th>
<th>EVT-Post</th>
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<tr>
<td></td>
<td>Mean (sd)</td>
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<tr>
<td>ACC1-Pre</td>
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<td></td>
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<tr>
<td>Less Profound</td>
<td>8.20 (1.92)</td>
<td>9.60 (1.67)</td>
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<tr>
<td>Profound</td>
<td>7.00 (1.50)</td>
<td>6.88 (1.76)</td>
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<tr>
<td>SGA-Pre</td>
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<td></td>
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</tr>
<tr>
<td>Less Profound</td>
<td>39.00 (18.50)</td>
<td>42.40 (11.39)</td>
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<tr>
<td>Profound</td>
<td>31.66 (15.20)</td>
<td>36.11 (10.30)</td>
<td></td>
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<tr>
<td>CT-Pre</td>
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<tr>
<td>Less Profound</td>
<td>8.60 (2.88)</td>
<td>12.00 (2.54)</td>
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<tr>
<td>Profound</td>
<td>5.77 (1.56)</td>
<td>6.66 (3.77)</td>
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<td></td>
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<tr>
<td>EVT-Pre</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less Profound</td>
<td>3.20 (2.94)</td>
<td>4.60 (3.50)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Profound</td>
<td>0.33 (1.00)</td>
<td>2.55 (1.87)</td>
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</table>
Table 3

Differences Between Performance at Posttest and Pretest for Each Participant

<table>
<thead>
<tr>
<th>Subject #</th>
<th>ACC1</th>
<th>SGA</th>
<th>CT</th>
<th>EVT</th>
</tr>
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<tbody>
<tr>
<td>Profound</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>2</td>
<td>-4</td>
<td>-31</td>
<td>-3</td>
<td>1</td>
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<td>1</td>
<td>14</td>
<td>2</td>
<td>4</td>
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<td>2</td>
<td>20</td>
<td>5</td>
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<td>-1</td>
<td>9</td>
<td>5</td>
<td>5</td>
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<tr>
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<td>0</td>
<td>-11</td>
<td>1</td>
<td>4</td>
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<td>17</td>
<td>-3</td>
<td>0</td>
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<td>13</td>
<td>6</td>
<td>3</td>
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<td>3</td>
<td>7</td>
<td>-2</td>
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<td>0</td>
<td>2</td>
<td>-3</td>
<td>0</td>
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<td>Less Profound</td>
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<td>7</td>
<td>3</td>
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</tbody>
</table>

Note: Positive values indicate an enhancement effect (posttest minus pretest)

ACC1 = Accuracy of emotion recognition; SGA = Speed given accuracy of emotion recognition; CT = Comprehension Test; EVT = Emotion Vocabulary Test