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ORIGINAL PAPER

Teaching Emotion Recognition Skills to Children with Autism

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Abstract Autism is associated with difficulty interacting with others and an impaired ability to recognize facial expressions of emotion. Previous teaching programmes have not addressed weak central coherence. Emotion recognition training focused on components of facial expressions. The training was administered in small groups ranging from 4 to 7 children. Improvements were significantly better for the training group ($n = 20$, mean age 9 years, 3 months) than a waiting list control group ($n = 10$, mean age 10 years, 7 months). Pre and post measures revealed an effect size of the training of Cohen's $d = 1.42$. The impact of the training was highly significant. There was evidence of some generalisation of the emotion recognition and improvements at follow-up.

Keywords Autism · Emotion recognition · Facial expressions

The term 'social skills' encompasses a wide range of abilities that includes listening and speaking skills, the recognition and understanding of emotional facial expressions, and the appropriate employment of gesture, posture, and proximity. These skills are essential to relating to other people and deficits in these areas are a key feature of autism. Emotion recognition is one of the most important skills in social interactions and in the development of empathy (Baron-Cohen 2002). It has been suggested that impaired ability in recognising emotions is part of the more general difficulty that individuals with autism have with "theory-of-mind" skills (Baron-Cohen et al. 1985). Many studies have shown that children and adults with autism are impaired in their ability to recognise emotions from facial expressions (Hobson 1986; Macdonald et al. 1989; Ozonoff et al. 1990 (in study 2, but not study 1); Turk and Cornish 1998; Deruelle et al. 2004; Begeer et al. 2006) though some research has failed to replicate these findings (Castelli 2005).

There has been some work to investigate the mechanisms that may cause the deficits in emotion recognition. One line of investigation has been to analyse the visual fixation strategies of individuals with autism, which have been found to differ significantly from non-autistic individuals. Klin et al. (2002) carried out an eye-tracking study of naturalistic social situations and found that participants with autism spent twice as much time looking at the mouth region of faces than on the eyes, whereas non-autistic individuals look at the eye region for three times as long as the mouth region on average. Similarly Speer et al. (2007) also used eye-tracking technology and found that the participants with autism spent significantly less time looking at the eye region of dynamic social stimuli (i.e. video footage) than non-autistic participants. Baron-Cohen et al. (1997) demonstrated that the eyes appear to reveal more information than the mouth region in the presentation of complex emotions. If individuals with autism are focusing more on mouths than eyes, this offers a possible explanation for their poorer performance in emotion recognition tasks.

In addition to this evidence of specific difficulties in processing faces, individuals with autism also show general peculiarities in visual processing; Shah and Frith (1983) demonstrated that people with autism were better on embedded figure tasks than control participants. Happé (1996) has shown that children with autism are less

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susceptible to visual illusions than typically developing children. Happé (1996) has characterised this difference as "weak central coherence"; a cognitive bias that prioritises local information over global information. Deruelle et al. (2004) attempted to assess the impact of weak central coherence on face processing in children with autism and concluded that children with autism process faces like objects, using feature-based strategies. Work by Hobson et al. (1988) and Langdell (1978) indicated that children with autism were not susceptible to the "face inversion effect". This is the finding that stimulus inversion disproportionately impairs recognition of faces relative to other stimuli (e.g. planes, landscapes); which has been taken to be evidence that neuro-typical participants process faces holistically and the poorer performance in the inversion condition is because the inversion disrupts the expected spatial configurations (Joseph and Tanaka 2003). Children with autism's lack of susceptibility to the inversion effect provides further evidence that they may be relying on a feature based strategy in face processing rather than on holistic processing. Tantum et al. (1989) suggested that children with autism may employ abnormal perceptual strategies with gestalt perception being impaired, but feature analysis remaining intact. Miyashita (1988, cited in Davies et al. 1994) has argued that children with autism perceive faces in terms of component parts rather than viewing the face as a whole.

A number of attempts have been made to teach emotion recognition skills to children and adults with autism (Bölte et al. 2006; Attwood 2000; Golan and Baron-Cohen 2006). Many have relied on computer based interventions or the use of passive medium such as television (Baron-Cohen et al. 2007; Silver and Oakes 2001). Swettenham (1996) cites three reasons for the growth of interest in the use of computers with children with autism: (1) it involves no social factors; (2) it is consistent and predictable; and (3) it allows the child to control the work at their own pace. One could argue that for the skills to generalise to the real world, the teaching should (1) involve social factors, (2) be unpredictable (as are social interactions) and (3) the pace be negotiated with other participants (just like in real life). For this reason we designed our teaching program specifically as a small group intervention that would require the children to practice the skills with other children.

Previous teaching has relied on tasks involving the repetitions of whole-face pictures of emotions (Baron-Cohen et al. 2007). However, as children with autism do not develop sufficient proficiency with emotion recognition in naturalistic settings, possibly due to a local processing bias or possible bias towards focussing too much on the mouth region and not on the eyes, it could be argued that further episodes of exposure to whole faces may not be sufficient to teach the skill.

Most of these approaches to teaching emotion recognition have used materials that have not been standardised and without reference to the substantial research done on facial expression of emotion by the Facial Expression Program (Ekman and Friesen 2003) between the early 1970s and the present day, which led to the development of an anatomically based system the facial action coding system (FACS). We included six emotions (angry, sad, disgusted, scared, surprised and happy) based on those that can be most reliably identified by the general population across cultures as demonstrated by the extensive work by Ekman and Friesen (2003). We ensured that all of the materials used both in assessing and teaching the children conformed to the features postulated as central to each of the emotions as described by Ekman and Friesen (2003).

Many previous teaching studies have reported difficulties with skill generalisation (Golan and Baron-Cohen 2006; Silver and Oakes 2001). Though improvements may be made on the teaching materials, the children often do not show any improved ability to recognise emotions on faces not previously seen. Golan and Baron-Cohen (2006) described three levels of generalisation of emotion recognition skills: *Close generalisation* (which involved using stimulus presented during training); *Feature-based distant generalisation* (using stimuli not used in the training) and *Holistic distant generalisation* (using feature films with complex holistic stimuli). In this study we focused on using so called *Feature-based distant generalization* as our test of learning for the children. Without this degree of generalisation, it may be that the children are simply making an association between the correct response and irrelevant features of the stimuli used during training trials.

None of the previous studies of teaching emotion recognition involved the family or home life of the participants. However, a recent study by Palermo et al. (2006) demonstrated that the parents of children with autism showed poorer emotion recognition skills than a group of matched controls. Work by TEACCH researchers (Mesibov et al. 2005) has shown the utility of parental involvement in interventions for children with autism. We hypothesised that a teaching program that stimulates the parents' interest in emotional expressions of the face, would be more likely to support the child's learning and encourage the application of this knowledge in the real world.

Emotion recognition from facial expression research has relied upon a range of experimental procedures such as sorting paradigms, matching tasks, cross-modal methods, free recall tasks and prompted recognition tasks (Hobson 1991). In sorting tasks it may be possible that participants with autism are using configural cues to match photos without being able to recognize the actual emotion displayed. Ozonoff et al. (1990) speculated that in sorting

tasks the children may use perceptual cues to sort faces (such as matching all the faces with high eyebrows) rather than actually understanding the emotion displayed by the facial expression. We favoured a labelling paradigm to counteract these difficulties, despite this being a cognitively more demanding test than the sorting and matching tests.

The aim of this research was to try teaching children though a part-whole process to focus on different elements of faces as part of the training. It was hypothesised that this may enable them to be more efficient in identifying emotions from facial expressions. The children were taught to recognise the individual action units (Ekman and Friesen 2003) that make up each individual emotional expression. For instance, the expression of "surprise" usually involves three different local changes to the face (eyebrow rising, eyes opening wide, jaw dropping/mouth opening). However, the design of the study does not allow a direct comparison with whole face teaching. If teaching to recognise emotions by parts of faces works, further research will be needed to compare the efficiency of this method with the whole face approach.

The study had two hypotheses, that children with autism would perform better on the recognition task after training than before and that children who had the training would show an improvement larger than a waiting-list control group.

Method

Participants

Participants were recruited from 14 mainstream schools, from the database of children referred to North Lee ASD services, and had undergone multidisciplinary assessments by the Regional Autism Service using both the autism diagnostic observation schedule (ADOS, Lord et al. 1989) and diagnostic interview for social and communication disorders (DISCO, Wing et al. 2002) and had been diagnosed with an Childhood Autism (ICD-10). The project was approved by the COPE Foundation Research and Ethics Committee and written informed consent for participation in the study was obtained from all of the parents of the children. The children were all between the ages of 6 years 9 months and 14 years 3 months of age (mean age = 9 years 6 months). The sample was composed of 3 girls and 30 boys. Two exclusion criteria were applied: firstly, performance on the Emotion Recognition Task (ERT) of over 80%, secondly, difficulty with comprehension of the emotion labels (happy, sad, angry, surprised, disgusted and afraid). All the children passed the Emotional Vocabulary Comprehension Test, however three children (all boys) were excluded from training because their performance was greater than 80% on the ERT.

Scores on the Peabody Picture Vocabulary Test-Revised (PPVT-R, Dunn and Dunn 1981) and the Raven Standard Progressive Matrices (SPM; Raven et al. 1977) were available for 25 of the children giving an indication of verbal and non-verbal ability. The raw scores on the PPVT-R were converted to age-referenced standard scores. Raw scores on the SPM were transformed to percentiles and then converted to Performance IQ scores. The participants were assessed for degree of autism using the Childhood Autism Rating Scale (CARS) (Schopler et al. 2002).

Participant details are shown in Table 1. Children were randomly allocated to either the experimental group or the waiting-list control. Four-one-way ANOVAs (with the factor group: training and waiting list) were performed to compare groups on chronological age, non-verbal ability and verbal ability and CARS score to assess how well the groups were matched.

The groups did not differ significantly in chronological age ($F(1, 28) = 3.87$, $p = 0.06$) verbal ability ($F(1, 23) = 0.94$, $p = 0.34$) non-verbal ability ($F(1, 23) = 0.61$, $p = 0.44$) or on their CARS score ($F(1, 28) = 1.58$, $p = 0.22$).

Measures

Emotion Recognition Test (*ERT*) was a measure devised to assess emotion recognition of six core emotions (happy, sad, angry, surprised, fearful and disgusted) using photographs from Ekman's Pictures of Facial Affect (1976). These are highly standardised images that have been used in numerous studies of emotion recognition (e.g. Macdonald et al. 1989). We selected 24 pictures from these materials (4 per emotion). These were laminated and presented in a book format with the photographs measuring 7 cm × 9 cm. The participants were presented with the

Table 1 Participants' mean (SD) chronological age, standardised score of verbal ability, and standardised score of non-verbal ability in the training and waiting list groups

Group	Chronological age (years; months) ($N = 30$)	Verbal ability (PPVT-R) $N = 25$	Non-verbal ability (SPM) $N = 25$
Training ($n = 20$)	9;3 (1;10)	85.60 (12.50)	104.6 (17.40)
Waiting list ($n = 10$)	10;7 (2;1)	90.22 (9.63)	98.60 (20.17)

booklet and a prompt sheet that listed the six possible emotions.

Emotion Vocabulary Comprehension Test was a task to assessment the comprehension of the emotion labels to be used in the emotion recognition task. The children were required to choose from six emotion labels as to how they would most likely feel in response to a particular hypothetical scenario (e.g. a story of loss was assumed to provoke sadness).

Procedure

Pre-teaching measures were carried out the week before training (ERT, Emotion Vocabulary Comprehension Test, CARS, PPVT-R and SPM), post measures in the week following training (ERT) and the follow up measure was conducted 3 months after the completion of the training programme. Post training measures were carried out by a psychologist who did not know any of the children's pre-scores.

Emotion Recognition Training comprised teaching which took place in hour-long sessions, once a week, for four weeks, run by two therapists. The teaching covered the six core emotions (happy, sad, angry, scared, surprised and disgusted). The teaching photographs were taken from the NimStim Set of Facial Expressions (Tottenham et al. 2002). The photographs used were determined by the experimenters to conform to each of the six emotions as standardised by Ekman's Facial Action Coding System (Ekman and Friesen 1978). The component parts of an emotional expression were highlighted to the children by examining an exemplar (e.g. raised eye brows, raised eye lids and open mouth in surprise faces). A verbal label to correspond to each component was identified (e.g. "O" shaped mouth in surprise faces, raised eye brows, raised eye lids). The children were then given many opportunities to identify that emotional expression from a range of expressions and were encouraged to take into account each component part of the expressions in their decision-making. Role-play using emotional expressions, tracing and free drawing of facial expressions, and games such as matching tasks with parts of faces, were used to provide further opportunities for close consideration of and discussion about the component parts of each emotional facial expression. The children also completed workbooks as homework after each of the first three teaching sessions to allow further practice of each emotion. These included matching components by emotion (e.g. happy mouths with other happy mouths in an array including sad, surprised and angry mouths) to more complex tasks such as matching particular emotions in the eye region with a corresponding mouth region from an array. Though parents did not attend the sessions, all were encouraged to help their children with this homework, and an information evening was held for parents to learn more about the teaching methods. The workbooks included exercises identifying the emotions covering in the teaching, from parts of faces (e.g. mouths only, or eyes only or in the case of disgust, distinguishing the "disgust nose") and working with arrays of pictures, matching parts of faces with the same emotions. The children were required to record an example of a facial expression of emotion in real life and make a note of the context in which the expression was seen in the workbooks.

Results

General Characteristics of Participants

Emotion Vocabulary Comprehension Test was passed by all of the participants, showing that they could use emotion labels appropriately, demonstrating that they had a good understanding of what the emotion words, used in the assessment materials, meant and could give examples of what contexts might elicit each emotion.

Emotion Recognition Test Pre Scores of the Training group and Waiting list group did not differ significantly before training ($T = -0.36$, $p = 0.72$).

Experimental Results

Pre and Post Training Scores on the ERT were analysed. A repeated measures ANOVA with pre/post scores treated as a within-subject factor was carried out to assess the effect of the training programme on the whole sample ($n = 30$). There was a significant main effect of Time $F(1, 29) = 54.43$, $p < 0.0001$.

The dependent variable "degree of improvement" was calculated by subtracting the pre-test scores from the post-test scores. An ANOVA was used to compare the degree of improvement in the training group with the waiting list control group. As can be seen in Fig. 1, both groups made some improvement from time 1 to time 2 (pre and post), and this may partially reflect a practice effect on the measure itself, however the improvement made by the training group was much greater than the control group. There was a significant main effect of Group $F(1, 28) = 13.53$, $p = 0.001$.

A further analysis was possible for the effect of training on the waiting list sub-group. These ten children were measured three times on the ERT; a pre score, a post waiting list score and a post training score after they also received the training program. Figure 2 shows that they had a small improvement while on the waiting list, but made more substantial gains following training. An ANOVA with a within-subject factor of Subject was carried out. There was a significant main

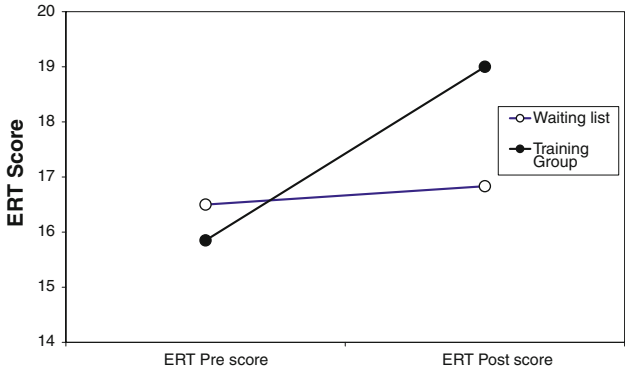

Fig. 1 The scores on the ERT measure before and after the 4 week period for both the training group and the waiting list control group

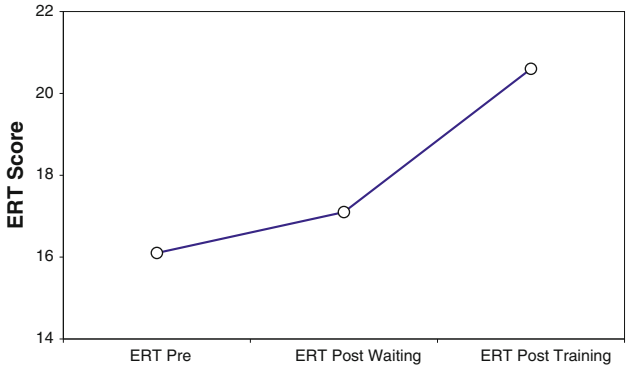

Fig. 2 Scores on the ERT for the pre, post-waiting and post-training period for control group $n = 10$

effect for Condition (pre, post-waiting, post-training) $F(2, 9) = 29.85$, $p < 0.001$. Pairwise comparisons were carried out using T tests, which showed a significant difference between pre and post-training $t_{(9)} = -4.52, p < 0.001$. There was also a significant difference between the post-waiting and post-training scores $t_{(9)} = -3.09$, $p = 0.007$. However, the difference between the pre and post-waiting scores was not significant; $t_{(9)} = -1.06, p = 0.30$.

Effect size was calculated for the training program using data from all 30 children which returned a value for Cohen's $d = 1.42$, which is significantly higher than the value of 0.8 which Cohen cites as the level that constitutes a large effect size (Cohen 1988).

Follow up data was available for 25 children (Average Age = 8 years 10 months, PPVT-R mean = 101.5, SPM mean = 87.7) 3 months after the training ended. Figure 3 shows the data for pre-training, post-training and at 3-month-follow-up. As can be seen, there appears to be a continued increase in ERT scores over the 3 months, from the post training scores, though this did not reach statistical significance.

Therefore the gains made during training, in emotion recognition skills were maintained over time.

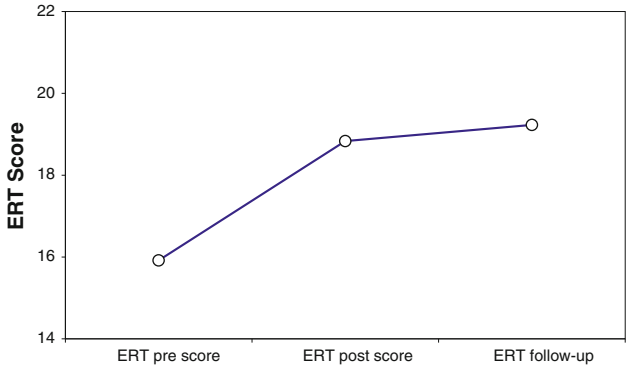

Fig. 3 Pre, post and follow-up scores on the ERT ($n = 25$)

Discussion

This study evaluated a 4-week teaching programme that utilized individual components of emotional expressions, highly standardised source materials and both group work and homework to teach emotion recognition skills to children with autism. The experimental group's post-training scores demonstrated a significant improvement on their pre-training scores and the effect size for the degree of improvement was large. The nature of this improvement was "feature-based distant generalization" as described by Golan and Baron-Cohen (2006). The children also showed significant improvement when compared with the waiting-list control group.

The pre-training scores demonstrated that children with autism have considerable difficulty with recognizing some of the basic emotions (confirming the previous research e.g. Hobson 1986; Macdonald et al. 1989). This was particularly the case with the emotions Surprise, Disgust and Fear. Baron-Cohen et al. (1993) point out that children with autism have a selective difficulty with recognising emotions that involve belief states, such as surprise, but perform close to average with simple emotions, such as happy and sad. The current research confirmed this suggestion.

By examining the component parts of each facial expression and emphasizing which components were most relevant to determining each emotion (e.g. when comparing surprise and fear, the mouth is the most relevant component), the participants were encouraged to take all components into account before making a judgment about the emotion being displayed. The visuo-spatial processing differences of children with autism were generally not addressed by previous teaching programmes. This study attempted to address this, however though the effect size reported for the degree of improvement in emotion recognition is considerably greater than reported for any previous training programme, as the study did not directly compare holistic face teaching with component based teaching, conclusions cannot be drawn about the degree of

significance of this aspect of the training. Progress in developing ways to teach children theory of mind skills has been slow. However, the results of this and previous studies do suggest that it is possible, though time-consuming. There is also a considerable gap between developing these skills of emotion recognition and enacting this knowledge through better social skills.

Previous research has highlighted the difficulty of achieving skill generalization in emotion recognition teaching (Silver and Oakes 2001; Golan and Baron-Cohen 2006). It is possible that, as has been suggested with the lack of pretend play (Carruthers 2006) that children with autism may have the capacity for emotion recognition, but choose not to engage in it. However, Golan and Baron-Cohen (2006) have suggested that the problem is in part due to the difficulty of systemizing the "socioemotional world". Our approach has been to rely on the most comprehensive and systematic research into facial expressions and their associated emotions, carried out by Ekman and Friesen (2003) that has achieved very high levels of agreement for the basic emotions. The improvements in emotion recognition tasks by the children with autism in this study, generalized to materials not used during the training sessions (so called feature-based distant generalization). During role plays, the children in the groups we ran frequently demonstrated that they had generalized some of these recognition skills to "real life", however further work is require to assess this quantitatively.

The Emotion Recognition Task had 24 items. The relatively short length of the measure was designed to optimize levels of attention and motivation. However, the number of happy and sad items could have been reduced as they were identified with 98% accuracy by the children, creating a ceiling effect. Eliminating them would have allowed the measure to be more sensitive to the other four emotions, or given scope for a number of other emotions to be included.

Some differences between the current teaching and previous studies were the use of small group teaching and parental involvement. We think that attending the group, a normalizing learning environment, was a motivating factor for the children. Many parents reported that their children had enjoyed being with other children in the groups. The completed homework books were reviewed in the group session each week with the trainers and the other children, which encouraged the children to complete them. The homework itself was also interactive, requiring the input of parents to discuss episodes of emotion expression that occurred during the week which had to be recorded in the workbook, as one of the homework tasks. We think this may have increased attention to facial expression in general and acted as further practice episodes for identifying emotional expressions. Using the current experimental design it is not possible to identify the degree to which group work and parental involvement may have contributed to the improvement.

While encouraging the systematizing ability of children with autism to enable them to recognize emotions, this teaching does not directly address the emotional reaction to others' emotional expressions or appropriate behavioural responses. Some parents noted that though their children seemed to attend more to faces and commented on the parents' expressions, they did not necessarily react in an emotionally appropriate way. For instance, when the parent displayed an angry face, they correctly identify it (e.g. saying "that is a cross face") but laughed at the same time. Both the lack of "in-feeling" with the other person and the inappropriate behavioural response was present in a few examples given by parents. As far as we are aware, none of the previous teaching programmes have attempted to address this issue of how children progress from recognizing the emotion to responding appropriately, but it would appear to be a crucial further step in theory of mind training.

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