# Using Assistive Technology to Teach Emotion Recognition to Students With Asperger Syndrome
*A Pilot Study*

PAUL G. LACAVA, OFER GOLAN, SIMON BARON-COHEN,
AND BRENDA SMITH MYLES

ABSTRACT

Many individuals with autism spectrum conditions (ASC) have difficulty recognizing emotions in themselves and others. The present pilot study explored the use of assistive technology to teach emotion recognition (ER) to eight children with ASC. Participants were between the ages of 8 and 11 years and had a diagnosis of Asperger syndrome (AS). ER testing was conducted using a computer at pre- and postintervention. The intervention consisted of 10 weeks of using the computer software Mind Reading: The Interactive Guide to Emotions™ in either home or school settings. The results indicated that after intervention, participants improved on face and voice ER for basic and complex emotions that were in the software, as well as for complex voice ER for emotions not included in Mind Reading. The implications of these findings are discussed.

Individuals with autism spectrum conditions (ASC) have impairments in social communication (American Psychiatric Association, 2000). Included in this core impairment is a difficulty with social–emotional reciprocity as well as nonverbal communication such as facial expression, gestures, and eye contact (American Psychiatric Association, 2000). Often, individuals with ASC have difficulties recognizing emotions—especially complex emotions that require mentalizing (e.g., embarrassed, jealous, sarcastic) in both themselves and others (Bauminger, 2004; Capps, Yirmiya, & Sigman, 1992; Hillier & Allinson, 2002). All of these difficulties can contribute to challenges in making and keeping friendships and other positive peer relationships.

*Theory of mind* (TOM) is one conceptualization used to describe the social impairment in ASC (Baron-Cohen, 1989, 1995; Baron-Cohen & Swettenham, 1997). According to this theory, individuals with ASC have an inherent disability in terms of putting themselves in someone else's shoes or understanding the psychological perspective of others. That is, they have trouble imputing meaning, emotion, and intent to others. Deficits in this area are critical to effective social interaction, which to a great extent is predicated on understanding what other people are thinking or feeling. By comparison, typically developing children pass simple false belief tests used to test for TOM at around age 4 and are able to understand higher levels of false belief by age 6 or 7 (Baron-Cohen, 2003). A false belief task or test often includes a researcher acting out short vignettes, sometimes with props, and asking the participant questions pertaining to what he or she has seen, heard, and so on, and questions about beliefs of what others or story characters have seen, heard, and so forth. For an example of TOM in real life, see Figure 1. Children with ASC are usually delayed in reaching these developmental milestones.

TOM difficulties in autism have recently been considered from a different perspective—that of empathizing. Whereas TOM includes understanding what others may be thinking or feeling, *empathizing* includes the ability to not only identify the emotions and mental states of others but also


Volume 28, Number 3, May/June 2007, Pages 174–181

use that information to respond to them with an appropriate reaction (Baron-Cohen, 2003; Baron-Cohen, Wheelwright, Lawson, Griffin, & Hill, 2002; Lawson, Baron-Cohen, & Wheelwright, 2004). Individuals with ASC have much greater difficulty in this area than their typically developing peers (Baron-Cohen, 1995, 2003; Baron-Cohen & Swettenham, 1997).

Understanding emotions is one element of the ability to take another's perspective. Several studies have explored interventions to teach individuals with ASC to recognize emotions. These include social skill instruction (Bauminger, 2002; Hadwin, Baron-Cohen, Howlin, & Hill, 1996; Ozonoff & Miller, 1995) and assistive technology (AT) interventions (Golan & Baron-Cohen, 2006a, 2006b; Silver & Oakes, 2001). For example, Bauminger (2002) investigated the use of a behavior-based intervention to facilitate the emotion recognition (ER) skills of 15 high-functioning children with autism, ages 8 to 17. The intervention consisted of lessons from a social skill curriculum used in the school setting for 3 hours per week for 7 months. The lessons included activities such as play and role play with a typically developing peer and practicing the skills learned from each weekly lesson at home with parents. The results showed an improvement in the children's emotional knowledge and ability to give examples of complex emotions. Specifically, at postintervention, the participants with autism were more likely to initiate social interaction with their peers and spent more time displaying positive social behaviors such as eye contact and sharing.

In another study, Silver and Oakes (2001) taught children with ASC to predict and recognize emotions in others using a computer-based intervention called the Emotions Trainer. Participants between the ages of 12 and 18, included in either an experimental or a control group, were diagnosed with either autism or Asperger syndrome (AS). The computer intervention was used 10 times over a 2-week period for 30 min each time. The program consisted of five sections that included asking the user to choose the correct emotion out of four choices describing photographed facial expressions, situations or events, and objects and descriptive captions. Compared to the control group, the experimental group improved their ability to identify emotions in story and cartooned situations that triggered an emotional response, but not their recognition of emotion in photographed facial expressions, on which both intervention and control groups showed improvement.

A relatively new multimedia computer program used to address ER is Mind Reading: The Interactive Guide to Emotions™ (Baron-Cohen, Golan, Wheelwright, & Hill, 2004), an interactive software program designed to teach ER in a systematic and comprehensive format. Several recent studies have investigated the use of the Mind Reading software and the ability of individuals with ASC to recognize emotions, both with adults (Golan & Baron-Cohen, 2006a) and with children (Golan & Baron-Cohen, 2006b). The results showed that after 10 to 15 weeks of using Mind Reading, the adult intervention group improved in the recognition of complex emotion and mental states (e.g., intimate, insincere) from both faces and voices, but there were problems with generalization to other tasks that were not covered in Mind Reading (Golan & Baron-Cohen, 2006a). In the children's study (Golan, 2006; Golan & Baron-Cohen, 2006b), after 10 to 15 weeks of using Mind Reading in the home setting, the intervention group improved on complex ER from faces and voices and on the ability to generalize this skill to novel emotional voices and pictures of the eye region (Baron-Cohen, Wheelwright, Spong, Scahill, & Lawson, 2001), suggesting improved generalization compared to adult software users (Golan, 2006).

> The ability to put oneself in another person's shoes, developed at a young age, is essential to empathizing. The following example illustrates this important skill. Jim is an 11-year-old student with Asperger syndrome. He is in the sixth grade at an inclusive public school and receives special education support. Jim has above-average cognitive ability and does well in most subjects. However, getting along with peers is very challenging for him. Often, Jim misinterprets others' emotions or intentions, which leads to arguments. For example, Jim often laughs when other students make mistakes. He has difficulty reading emotions and an inherent difficulty to put himself in his peers' shoes and understand how they feel when he laughs at their errors. Thus, Jim does not understand why his peers are not happy to be his friend.

**FIGURE 1.** Sample application of theory of mind in action.

The present pilot study is an extension of these studies and represents an initial attempt to use Mind Reading in the United States. Specifically, the research investigated the efficacy of using Mind Reading as an instructional method to teach emotion recognition to children with AS.

# Method

## Participants

Two (25%) girls and six (75%) boys, ages 8 through 11 ($M$ = 10.27, $SD$ = 1.24), participated in the study. All participants were European American and had a formal diagnosis of AS. All were diagnosed using criteria from either the *Diagnostic and Statistical Manual of Mental Disorders*, 4th edition (*DSM-IV*; American Psychiatric Association, 1994), or the *DSM-IV* text revision (*DSM-IV-TR*; American Psychiatric Association, 2000), and a licensed psychiatrist or psychologist rendered a diagnosis independently to each participant. Diagnoses were verified using the *Asperger Syndrome Diagnostic Scale* (ASDS; Myles, Bock, & Simpson, 2001), a 50-item survey designed to determine the likelihood of a child between the ages of 5 and 18 having AS. Participants' mean Asperger syndrome quotient (ASQ) score on this parent-completed measure was 111.87 (*SD* = 16.10), confirming the previously given diagnoses of AS. On the ASDS, an ASQ of 90 or above indicates that one is likely to have AS, whereas a score of 110 or higher suggests AS is very likely. Demographic data and other information on participants are presented in Table 1.

## Setting

Preintervention and postintervention assessments were conducted in a staff office located on a suburban campus of a major midwestern university. All participants were tested individually. The intervention took place in either a home (five participants) or a school setting (three participants). Of those who participated in school, two students attended a private school for students with learning disabilities, whereas the third attended a public elementary school. All students used IBM or IBM-compatible computers in their homes or classrooms.

## Pretest

The researchers followed university protocol for human subject research. Upon approval from the university's Human Subjects Committee, announcements to recruit participants were posted in local ASC publications and Web sites. Parents of children with ASC who were interested in the study contacted the researchers via e-mail, whereupon follow-up telephone conversations were set up. All study procedures were fully explained to parents or caregivers, and written informed consent was obtained. Next, a packet of assessment materials was mailed to each family, including a demographic profile for background information (Myles, Hagiwara, & Carlson, 2000) and the ASDS (Myles et al., 2001). After these documents were completed and returned to the researchers, the preintervention assessment was scheduled.

The first author, who conducted all pre- and postintervention assessments, was trained in the study procedures by the second author prior to student participation. Each participant was tested individually. The first author administered all tests; master's students assisted with data collection, interviewing parents, and establishing the testing environment (building rapport with the student, taking the student for a break, etc.). There were no time limitations for completing the testing, and parents were allowed to accompany the child during testing. After the first author explained all procedures to the participants, he asked for verbal assent from each child; all participants agreed to the terms of the testing. All testing took place on an IBM-compatible computer with a 15-inch screen and headphones. Testing was completed using the DMDX experimental software (Forster & Forster, 2003). Preintervention assessment lasted from 45 to 90 min (including breaks), depending on the participant.

## Design

The study used a nonequivalent pretest–posttest experimental group design. Before the students began the intervention phase, they completed the ER pretest. After a 10-week intervention phase, they completed the ER posttest.

## Instruments

The following four instruments were used. The first three were used during testing, the fourth during the intervention.

**TABLE 1. Demographic and Other Information for Participants with Asperger Syndrome**

| Participant | Age (yrs.) | Gender | ASDS | Setting |
|---|---|---|---|---|
| 1 | 11 | M | Very likely | Home |
| 2 | 8 | M | Possibly | Home |
| 3 | 10 | M | Very likely | Home |
| 4 | 9 | M | Very likely | School |
| 5 | 11 | F | Very likely | Home |
| 6 | 11 | F | Likely | Home |
| 7 | 9 | M | Likely | School |
| 8 | 9 | M | Very likely | School |

*Note.* ASDS = *Asperger Syndrome Diagnostic Scale* (Myles et al., 2001); M = male; F = female.

**Cambridge Mindreading Face–Voice Battery for Children.** The *Cambridge Mindreading Face–Voice Battery for Children* (CAM-C; Golan & Baron-Cohen, 2006c) assessed the recognition of 15 emotional concepts from facial expression video clips and speech segment audio clips taken from Mind Reading. After each clip was shown, participants were asked to choose which of four emotion words best described how the person in the clip was feeling. The CAM-C assesses the recognition of six basic emotions (happy, sad, angry, afraid, disgusted, and surprised) and nine complex emotions (loving, embarrassed, undecided, unfriendly, bothered, nervous, disappointed, amused, and jealous). The CAM-C consists of two subtests—Face ER and Voice ER—each involving 45 questions, for a total of 90 items. It provides ER scores for faces and for voices (max = 45 for each) as well as for the number of emotions recognized correctly (max = 15). These are also available separately for basic and complex emotions.

**Child Feature-Based Auditory Task.** The *Child Feature-Based Auditory Task* (C-FAT; Golan, 2006) tested participants' ability to recognize complex emotions using 17 speech segments. As with the CAM-C, participants were asked for each item to choose one of four words that best described how the speaker was feeling. It is a generalization task that tests for voices that were not included in the Mind Reading software (see Note).

**Reading the Mind in Films Test–Children's Version.** The *Reading the Mind in Films Test–Children's Version* (RMF-C; Golan, Baron-Cohen, & Golan, 2006) tested participants' ability to recognize emotions in characters in short social scenes taken from four children's movies. This task consisted of 22 examples. Each scene includes visual, vocal, and some contextual information, and participants are asked to choose one out of four emotion words that best describes the way the target character feels at the end of the scene.

**Mind Reading.** The Mind Reading software, which served as the independent variable, consists of several components, including emotions library, learning center, and games zone. The emotions library is a catalogue of over 400 different emotions for viewing and interacting. Emotions are presented separately in photographs, short movie clips, and audio clips and are also demonstrated through contextual examples. In the learning center, users can access emotions in groups, lessons, and quizzes, matching faces, voices, and labels for the different emotions. Users can also access the "beginners' 20" or "top 100" selection of the most common emotions, of which lessons and quizzes are available through the learning center. A system of rewards (e.g., trains, birds, musical instruments) serves as an incentive throughout lessons and quizzes. Finally, the games zone is a motivating area with five different choices of interactive games that involve skills such as guessing the emotions on a partially uncovered face, matching emotions, and assessing real-world faces. The software has six levels of difficulty, and a character assistant helps the user along the way. Users may create a scrapbook of emotions that they can access to further study emotions.

## Procedure

The CAM-C and C-FAT were administered in random order, and students were allowed to take as many breaks as they needed. Most participants took at least two short breaks to get a drink of water or take a short walk. One student did not take any breaks, and two needed more than 10 short breaks to complete testing.

The CAM-C face recognition subtest presented items randomly, so only one version was needed. The CAM-C voice recognition subtest and the C-FAT task had two versions; one was used at preintervention and the other at postintervention. The version used at pre- and postintervention was randomized across participants. The RMF-C task had just one version, which was only presented at postintervention to avoid improvement due to familiarity with the scenes.

At some point during the assessment, either a master's student or the first author interviewed parents, using an informal survey that asked questions about their child's ability to recognize emotions. After all three tests were completed, the first author gave a demonstration of the Mind Reading software to students and their parents, showing them how to install the program and use the various components. This demonstration was also given to school staff working with students using the software in a school. The parameters for its use were also explained. Parents and teachers were also shown how to use the Mind Reading manager, which allows the parent or teacher to monitor the child's work and to change different settings, such as difficulty levels, to screen out emotions intended for adults (e.g., from the "romantic" emotion group), and so forth. Finally, parents were told how to send usage data, recorded by the software, back to the researchers after the 10 weeks of training.

The Mind Reading computer software was used by each participant during the intervention for at least 10 weeks. Students were directed to use the games zone for no more than 33% of the total time that they were using the software (to ensure that lessons and quizzes were taken). Other than these restrictions, students were permitted to freely navigate and use the program that best fit their learning style and preferences.

During the 10-week intervention, researchers called on the participants in the home setting to (a) check on their progress, (b) answer questions, and (c) help solve any problems. A researcher visited the school participants in their classrooms every 2 weeks to conduct the same type of check-in.

After each participant had used the software for 10 weeks, a postintervention assessment was scheduled. The procedure and setting for posttest were identical to those of preintervention assessment, except that another test, the RMF-C, was used as well. After testing, each child and his or her parent were interviewed using social validity and product reviews. Finally, they received the software to keep, as well as a small token of appreciation from project staff. Parents of children in the home setting e-mailed all data logs containing student performance on the computer software to the researchers. For the participants in the school settings, the researcher downloaded and saved all their data logs directly from the school computers.

### Dependent Variables

Preintervention and postintervention assessments yielded four dependent variables: two CAM-C scores (Face and Voice subtest scores), C-FAT, and RMF-C scores. Task scores were defined as the percentage of correct responses on a task.

## Results

The mean raw scores (number of correct responses) of ER measures for all participants for pre- and postintervention are summarized in Table 2. Nonparametric statistical analyses were conducted on the difference scores for all participants on the CAM-C Face and Voice subtests and the C-FAT. Wilcoxon signed-rank tests were carried out to determine any statistically significant differences on participants' performance on the three pre- and posttest measures. The differences between the pre- and posttest performances on all three measures were statistically significant for all tasks, with mean posttest scores higher than pretest scores. This was found for the CAM-C Faces subtest, $z = -2.366$, $p < .05$; the CAM-C Voices subtest, $z = -2.24$, $p < .05$; and the C-FAT, $z = -2.028$, $p < .05$. Participants' mean scores, standard deviations, and range scores on these measures appear in Table 2.

Participants' performance on the RMF-C task resulted in a mean score of 13.375 ($SD = 4.172$). While this average score appears lower than that of Golan's (2006) groups of children with ASC who received no intervention ($M = 14.52$, $SD = 3.61$), and the group of children with ASC who used Mind Reading ($M = 15.48$, $SD = 2.54$), these differences were not statistically significant. Participants' means, standard deviations, and range scores on the RMF-C appear in Table 2.

### Treatment Integrity

Data from the computer software provided information on the participants' use of the software, highlighting the students' use or non-use of the intervention. Participants used the software for an average of 10.5 hours during the intervention phase. As the parameters of the intervention allowed participants to use the software with only one limitation (maximum of 33% time in the game zone), participants clearly used the software in a variety of ways. Some used the emotions library area almost exclusively, whereas others preferred the learning center. Some took quizzes daily, others less frequently, and all used the games zone areas.

### Social Validity

A checklist was created and given to the participants, their teachers, and their parents both at pre- and postintervention in order to monitor social validity. This subjective evaluation is based on the Council for Exceptional Children's *Quality Indicators for Single Subject Research Design* (Horner et al., 2005). All parents agreed that ER abilities were important skills to have. After using the software for some time, one participant began to ask teachers, "What's my face saying?" Another began to make statements to others such as, "Don't get frustrated." One parent commented that her child felt more confident about distinguishing emotions, which helped with her anxiety. Several parents mentioned that after using the program, their child looked at other people's faces for clues on how they might be feeling. Six of the eight participants liked the game zone best, although several said that the games became boring after a time. Several others mentioned that the repetition was boring. Most said that they had no

**TABLE 2. Means, Standard Deviations, and Score Ranges on Measures of Emotion Recognition at Pre- and Posttest**

| Measure | Pretest | Posttest |
|---|---|---|
| CAM-C Faces | | |
| *M* | 28.375 | 33.750 |
| *SD* | 7.090 | 4.979 |
| Range | 19–37 | 25–40 |
| CAM-C Voices | | |
| *M* | 29.875 | 32.750 |
| *SD* | 5.167 | 4.559 |
| Range | 23–38 | 24–39 |
| C-FAT | | |
| *M* | 9.00 | 11.25 |
| *SD* | 2.673 | 3.151 |
| Range | 6–15 | 7–15 |
| RMIF-C | | |
| *M* | n/a | 13.375 |
| *SD* | n/a | 4.172 |
| Range | n/a | 8–19 |

*Note.* CAM-C Faces = *Cambridge Mindreading Face–Voice Battery for Children,* Faces subtest (Golan & Baron-Cohen, 2006c); CAM-C Voices = *Cambridge Mindreading Face–Voice Battery for Children,* Voices subtest; C-FAT = *Child Feature-Based Auditory Task* (Golan, 2006); RMF = *Reading the Mind in Films Test–Children's Version* (Golan, Baron-Cohen, & Golan, 2006); n/a = not applicable.

problems installing the software and that using the software was easy.

## Discussion

Overall, these results suggest that Mind Reading is a promising new tool for teaching emotion recognition to individuals with AS. That is, children with AS improved their recognition of basic and complex emotions in faces and voices following a time-limited, computer-based intervention. This was found not only on face and voice ER tasks presenting faces and voices included in the software but also on voices that were not included in the software, suggesting that participants could generalize their ER skills. These findings are similar to those of the previous line of research from the United Kingdom (Golan, 2006; Golan & Baron-Cohen 2006a, 2006b). This replication suggests that Mind Reading works as effectively with American users as it does with British ones. However, the lack of difference on the integrative RMF-C task between software users in the current study and participants with ASC who received no intervention in the UK study suggests that the use of Mind Reading, at least for this period of time, only contributed to the ER abilities in faces and voices separately, not to integrative ER. Therefore, further intervention may be needed to facilitate the integration of facial and vocal expressions in context. However, such comparisons must be reviewed with caution given cultural differences between the UK and the United States as well as the use of unmatched groups and the small sample size.

Students found the software interesting, the games fun, and the structure of the program helpful. Individuals with ASC show good, and sometimes superior, skills in "systemizing" (Baron-Cohen, 2003; Baron-Cohen et al., 2002)—that is, in the drive to analyze or build systems to understand and predict behavior and underlying rules. Many children with ASC enjoy technology such as computers, and their relative ease in using clear, rule-based systems make AT an ideal way to support individuals with ASC in various areas of functioning, including the social domain (Golan, LaCava, & Baron-Cohen, 2007). Thus, the use of these predictable, routine, systems-oriented visual technologies can help support the students' learning.

Most students and their families and teachers made positive comments about the software, saying that it was easy to use. Many students found the games fun for at least some period of time, and the software was used by students with the support of parents and teachers in natural settings (home and school). The inclusion of a reward system in the software was motivating, and most students had favorites. For any new intervention for students with special needs, the degree to which treatments are easy to use and can be used by typical persons in natural settings is paramount. In this regard, Mind Reading appears to be appropriate. On the other hand, although all parents and teachers agreed that ER was an important social goal to increase, the findings suggested only limited increases in ER.

### Limitations

The limitations of this study include the use of a small sample size and the exclusion of an ASC or a typically developing control group. There were only eight participants, which required the use of nonparametric tests, limiting the power of the study. Therefore, the results must be considered with caution, as other reasons for the increases in student mean scores are conceivable, including the effects of pretesting, maturation, or statistical regression to the mean. Of note, on the RMF-C task, the mean score of 13.375 was less than Golan's (2006) ASC control group mean score of 14.52, ASC intervention group mean of 15.48, and the typically developing control group mean of 17.73.

### Implications

Along with this initial research support, recommendations for the practical day-to-day use of Mind Reading are warranted. The following suggestions are based on the characteristics and learning preferences of individuals with ASC as well as the components of Mind Reading:

- Mind Reading can be used individually by high-functioning students to learn ER skills.
- Mind Reading can be used by students in multiple settings (e.g., classroom or home setting).
- Mind Reading can be used by students with ASC and with typically developing peers as a way to foster relationships. For example, students can play the games together or learn about emotions together.
- Mind Reading can be used by students in therapies (e.g., speech–language or counseling) or in individual or group social skills.
- Mind Reading can be used with counselors and mentors to address specific issues. For example, if a student misinterprets a peer's emotional reaction to something he or she did, Mind Reading could be used to specifically teach the student the given emotion and the range and use of it.
- Mind Reading can be used by students to augment what they learn using more traditional formats. Even for students who have cognitive impairments, Mind Reading can be used to assist in social skill instruction. For

example, the student could be taught one emotion at a time using applied behavior analysis techniques. Next, the student could use Mind Reading (with adult assistance) to access that emotion on the software and practice using it, and so forth. Because Mind Reading allows users to create their own collection of emotions (using the scrapbook utility), this could be done for each student. The software could also be used as a generalization tool to track emotions on quizzes and to gain reinforcement for success.

- Mind Reading can be used along with other systems of reinforcement to support students who need more motivation.
- Mind Reading can be used along with other interventions such as Social Stories™ (Gray, 2004) and *Comic Strip Conversations*™ (Gray, 1994) to help students learn more about other people and what they are thinking and feeling, along with the basic emotion recognition.
- Mind Reading offers diverse choices for games and ways to learn ER. The software also gives students the opportunity to make choices and give input on how best to learn.
- For students who have difficulty with organization, keeping time, and following a routine, teachers and parents can develop a structured routine around the use of Mind Reading. For example, a schedule could be created to show the student when she may use the computer, and timers can be used to show how much time is left. Furthermore, a visual mini-schedule can be used to show the student which parts of the software she or he must use (e.g., 10 min of learning center, 5 min of quizzes, 5 min of games, and 5 min for rewards).

## Future Research

Given the positive results to date, exploring how Mind Reading may be used with students with ASC in social skill training or other treatment groups is warranted. Other areas of interest include studying how teachers can assist students who use the program and how students with more cognitive challenges can successfully use high-tech applications such as Mind Reading. Furthermore, whereas we found generalization in one task (C-FAT), more research is needed to study the generalization of these skills to natural settings and to explore if the use of this software collaterally helps other social skills. Finally, continued rigorous group interventions are needed to investigate Mind Reading with other populations, larger sample sizes, and control groups.

In conclusion, this line of research is important in suggesting that ER growth by those with ASC is possible with appropriate teaching methods. Based on the TOM and empathizing models described earlier, better understanding of others' emotions and mental states may reduce the uncertainty that individuals with ASC experience in the social domain and improve their social integration in school and in the community, leading to increased lifelong success and well-being. ■

---

**PAUL G. LACAVA,** MEd, is a doctoral student at the University of Kansas and special education consultant. His current interests include autism and related disabilities, social–emotional skills and interventions, and historical and current issues and trends. **OFER GOLAN,** MA, PhD, is a child psychologist and lecturer at the Department of Psychology, Bar-Ilan University, Israel. He conducted his doctoral project at the Autism Research Centre, University of Cambridge, UK. His current interests include socioemotional understanding in autism spectrum conditions and the effectiveness of interventions aiming to enhance it. **SIMON BARON-COHEN,** MPhil, PhD, is Professor of Developmental Psychopathology at the University of Cambridge, and director of the Autism Research Centre there. He conducts research into the cognitive neuroscience of autism spectrum conditions and into diagnosis of and intervention for these conditions. **BRENDA SMITH MYLES,** PhD, is Chief of Programs and Development at the Ohio Center for Autism and Low Incidence Disabilities and is employed in the Special Education Department at the University of Kansas. Her research interests are in autism and Asperger syndrome. Address: Paul G. LaCava, University of Kansas, Department of Special Education, Joseph R. Pearson Hall, 1122 West Campus Road, Room 521, Lawrence, KS, 66045; e-mail:plack@ku.edu

## NOTE

The voice clips included in the C-FAT were originally recorded for Mind Reading but were not included in the software. Hence, although the actors' voices are the same as those in Mind Reading, the content of the speech segments is different from what appears in the software.

## REFERENCES

American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed., text rev.). Washington, DC: Author.

Baron-Cohen, S. (1989). The autistic child's theory of mind: A case of specific developmental delay. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, *30*, 285–297.

Baron-Cohen, S. (1995). *Mindblindness: An essay on autism and theory of mind*. Cambridge, MA: MIT Press.

Baron-Cohen, S. (2003). *The essential difference: The truth about the male and female brain*. New York: Basic Books.

Baron-Cohen, S., & Swettenham, J. (1997). Theory of mind in autism: Its relationship to executive function and central coherence. In D. J. Cohen & F. R. Volkmar (Eds.), *Handbook of autism and pervasive developmental disorders* (pp. 880–893). New York: Wiley.

Baron-Cohen, S., Golan, O., Wheelwright, S., & Hill, J. J. (2004). Mind reading: The interactive guide to emotions [Computer software]. London: Kingsley.

Baron-Cohen, S., Wheelwright, S., Lawson, J., Griffin, R., & Hill, J. J. (2002). The exact mind: Empathizing and systemizing in autism spectrum conditions. In U. Goswami (Ed.), *Handbook of childhood cognitive development* (pp. 491–508). Malden, MA: Blackwell.

Baron-Cohen, S., Wheelwright, S., Spong, A., Scahill, V. L., & Lawson, J. (2001). Are intuitive physics and intuitive psychology independent? A test with children with Asperger syndrome. *Journal of Developmental and Learning Disorders*, *5,* 47–78.

Bauminger, N. (2002). The facilitation of social–emotional understanding and social interaction in high-functioning children with autism: Intervention outcomes. *Journal of Autism and Developmental Disorders*, *32*, 283–298.

Bauminger, N. (2004). The expression and understanding of jealousy in children with autism. *Development and Psychopathology, 16*, 157–177.

Capps, L., Yirmiya, N., & Sigman, M. (1992). Understanding of simple and complex emotions in non-retarded children with autism. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 33,* 1169–1182.

Forster, K. L., & Forster, J. C. (2003). DMDX: A Windows display program with millisecond accuracy. *Behavior Research Methods, Instruments, & Computers, 35,* 116–124.

Golan, O. (2006). *Systemising emotions: Teaching emotion recognition to people with autism using interactive multimedia.* Unpublished doctoral dissertation, University of Cambridge, Cambridge, UK.

Golan, O., & Baron-Cohen, S. (2006a). Systemizing empathy: Teaching adults with Asperger syndrome or high functioning autism to recognize complex emotions using interactive media. *Development and Psychopathology, 18,* 591–617.

Golan, O., & Baron-Cohen, S. (2006b). *Teaching children with Asperger syndrome and high functioning autism to recognize emotions using interactive multimedia.* Unpublished manuscript. University of Cambridge, UK.

Golan, O., & Baron-Cohen, S. (2006c). *The Cambridge Mindreading Face–Voice Battery for Children (CAM-C): Basic and complex emotion recognition in children with and without autism spectrum conditions.* Manuscript submitted for publication.

Golan, O., Baron-Cohen, S., & Golan, Y. (2006). *Reading the mind in films (Child version): Testing recognition of complex emotion and mental states in children with and without autism spectrum conditions.* Manuscript submitted for publication.

Golan, O., LaCava, P. G., & Baron-Cohen, S. (2007). Assistive technology as an aid in reducing social impairments in autism spectrum conditions. In R. L. Gabriels & D. E. Hill (Eds.), Working with school-age children and adolescents (pp. 124–142). New York: Guilford Press.

Gray, C. (1994). *Comic strip conversations.* Jenison, MI: Jenison Public Schools.

Gray, C. A. (2004). Social stories, 10.0 [Computer software]. Jenison, MI: Jenison Public Schools.

Hadwin, J., Baron-Cohen, S., Howlin, P., & Hill, K. (1996). Can we teach children with autism to understand emotions, belief, or pretence? *Development and Psychopathology, 8,* 345–365.

Hillier, A., & Allinson, L. (2002). Understanding embarrassment among those with autism: Breaking down the complex emotion of embarrassment among those with autism. *Journal of Autism and Developmental Disorders, 32,* 583–592.

Horner, R. H., Carr, E. G., Halle, J., McGee, G., Odom, S., & Wolery, M. (2005). The use of single-subject research to identify evidence-based practice in special education. *Exceptional Children, 71,* 165–179.

Lawson, W., Baron-Cohen, S., & Wheelwright, S. (2004). Empathizing and systemizing in adults with and without Asperger syndrome. *Journal of Autism and Developmental Disorders, 34,* 301–310.

Myles, B. S., Bock, S. J., & Simpson, R. L. (2001). *Asperger syndrome diagnostic scale.* Austin, TX: PRO-ED.

Myles, B. S., Hagiwara, T., & Carlson, J. K. (2000). *Demographic profile.* Unpublished manuscript. University of Kansas.

Ozonoff, S., & Miller, J. (1995). Teaching theory of mind: A new approach to social skills training for individuals with autism. *Journal of Autism and Developmental Disorders, 25,* 415–433.

Silver, M., & Oakes, P. (2001). Evaluation of a new computer intervention to teach people with autism or Asperger syndrome to recognize and predict emotions in others. *Autism, 5,* 299–316.