

CHAPTER 23

Theory of Mind

SIMON BARON-COHEN, SALLY WHEELWRIGHT, JOHN LAWSON, RICHARD GRIFFIN,
CHRIS ASHWIN, JAC BILLINGTON, AND BHISMADEV CHAKRABARTI

Autism is diagnosed when a child or adult has abnormalities in a triad of behavioral domains: social development, communication, and repetitive behavior/obsessive interests (American Psychological Association [APA], 1994; World Health Organization [WHO], 1994). In the 1960s and 1970s, many of the children with autism who were studied by cognitive developmentalists also had comorbid learning difficulties (i.e., below-average intelligence) and language delay (Frith, 1970; Hermelin & O'Connor, 1970; Wing, 1976). An average IQ of 60 was not uncommon in samples studied during that period.

AUTISM SPECTRUM CONDITIONS: LOW, MEDIUM, AND HIGH- FUNCTIONING SUBGROUPS

In the 1980s, cognitive developmentalists began to focus on what was then called *high-functioning autism* (Baron-Cohen, Leslie, & Frith, 1985, 1986). Such children might be better described as *medium-functioning* because although they had IQs within the average range, their IQ fell within two standard deviations from the population mean of 100. Because one standard deviation is 15 points, anyone with an IQ above 70 would still have been included in this band. An IQ of 71 is by statistical definition average but is hardly high functioning.

By the 1990s, interest had shifted to studying the truly high-functioning strata of the autistic spectrum: those whose IQs were close to 100 or above. This strata would have included those with *superior IQ*, that is, those whose IQ was higher than 2 standard deviations above the population mean (Baron-Cohen, Jolliffe, Mortimore, & Robertson, 1997; Frith, 1991; Jolliffe & Baron-Cohen, 1997; Klin, Volkmar, Sparrow, Cicchetti, & Rourke, 1995; Szatmari, Tuff, Finlayson, & Bartolucci, 1990). Since we know that IQ is a strong predictor of outcome in autism (Rutter, 1978), it is important to take IQ into account.

Asperger syndrome (AS) was first described by Asperger (1944). The descriptions of the children he documented overlapped considerably with the accounts of childhood autism (Kanner, 1943). Little was published on AS in English until relatively recently (Frith, 1991; Wing, 1981). Current diagnostic practice recognizes people with AS as meeting the same criteria as for high-functioning autism (HFA) but with no history of language delay and no cognitive delay. That is, as a toddler, the individual was speaking on time (i.e., single words by age 2 and/or phrase speech by 3 years old) and has had a mental age in line with his or her chronological age (i.e., an IQ in the normal range). Although some studies have claimed a distinction between AS and HFA (Klin et al., 1995), the majority of stud-

We are grateful for support from the MRC (United Kingdom), the James S. McDonnell Foundation, and the Isaac Newton Trust during the period of this work. Parts of this chapter are reprinted from elsewhere (Baron-Cohen, Wheelwright, Griffin, Lawson, & Hill, 2002).

ies have not demonstrated many, if any, significant differences.

This background into autism and intelligence is important because it reveals that over the past 40 years, there has been a major shift in research strategy. When studying the cognitive development of autism, one strategy (and one we focus on here) is to identify the deficits or talents that are present in all three subgroups (low, medium, and high functioning). In this way, we can characterize necessary, core characteristics of people on the autism spectrum and test whether a cognitive theory can account for such core features. At the same time, we can clarify those associated characteristics that may occur more frequently than chance but may not lie in this core. The list of *associated* (but not universal) characteristics is very long and includes the following: language delay, learning disability, self-injury, clumsiness, attention deficit/hyperactivity disorder (ADHD), epilepsy, gastrointestinal inflammation, hyperlexia, and nonright-handedness. We suggest that the *core characteristics* comprise two triads:

Triad A: Social difficulties, communication difficulties, and difficulties in imagining other people's minds

Triad B: Strong, narrow obsessional interests, repetitive behavior, and "islets of ability"

This new view builds on the concept of the triad but extends it into two triads (Wing & Gould, 1979). In the next sections, we look at some different cognitive theories to see how well they can account for these two triads of characteristics.

THE MINDBLINDNESS/EMPATHIZING THEORY

The mindblindness theory of autism (Baron-Cohen, 1995) and its extension into empathizing theory (Baron-Cohen, 2002) propose that in autism spectrum conditions, there are deficits in the normal process of empathizing, relative to mental age. These deficits can occur by degrees. The term *empathizing* encompasses the following earlier terms: *theory*

of mind, *mind reading*, and taking the *intentional stance* (Dennett, 1987).

Empathizing involves two major elements: (1) the ability to attribute mental states to self and others as a natural way to understand agents (Baron-Cohen, 1994a; Leslie, 1995; Premack, 1990) and (2) having an emotional reaction that is appropriate to the other person's mental state. In this sense, it includes what is normally meant by the term *theory of mind* (the attributional component), but it goes beyond to include having some affective reaction (e.g., sympathy).

The first of these elements, the mental state attribution component, has been widely discussed in terms of being an evolved ability, given that the universe can be broadly divided into two kinds of entities: those that possess intentionality and those that do not (Brentano, 1970). The mental state attribution component is effectively judging whether this is the sort of entity that might possess intentionality. *Intentionality* is defined as the capacity of something to refer or point to things other than itself. A rock cannot point to anything. It just is. In contrast, a mouse can "look" at a piece of cheese, it can "want" the piece of cheese, it can "think" that this is a piece of cheese, and so on. Essentially, agents have intentionality, whereas nonagents do not.

This means that when we observe agents and nonagents move, we construe their motion as having different causes (Csibra, Gergely, Biro, Koos, & Brockbanck, 1999; Gelman & Hirschfield, 1994). Agents can move by self-propulsion, which we naturally interpret as driven by their goals and desires, while nonagents can reliably be expected not to move unless acted on by another object (e.g., following a collision). Note that mental state attribution is quite broad, because it includes not just attribution of beliefs, desires, intentions, thoughts, and knowledge, but also perceptual or attentional states and all of the emotions (Baron-Cohen, Wheelwright, Hill, & Golan, submitted; Griffin & Baron-Cohen, 2002).

The second empathizing element, the affective reaction component, is closer to what we ordinarily refer to with the English word *empathy*. Thus, we not only attribute a mental state to the agent in front of us (e.g., the man "thinks" the cake is made of soft, creamy

630 Theoretical Perspectives

chocolate) but also anticipate his or her emotional state (the man will be disappointed when he bites into it and discovers it is hard and stale), and we react to his or her emotional state with an appropriate emotion ourselves (we feel sorry for him). Empathizing thus essentially allows us to make sense of the behavior of other agents we are observing and predict what they might do next and how they might feel. And it allows us to feel connected to other agents' experience and respond appropriately to them.

The Normal Development of Empathizing

Empathizing develops from human infancy (Johnson, 2000). In the infancy period, it includes:

- Being able to judge whether something is an agent (Premack, 1990)
- Being able to judge whether another agent is looking at you (Baron-Cohen, 1994b)
- Being able to judge whether an agent is expressing a basic emotion (Ekman, 1992) and, if so, what type
- Engaging in shared attention, for example, by following gaze or pointing gestures (Mundy & Crowson, 1997; Scaife & Bruner, 1975; Tomasello, 1988)
- Showing concern or basic empathy at another's distress or responding appropriately to another's basic emotional state (Yirmiya, Sigman, Kasari, & Mundy, 1992)
- Being able to judge an agent's goal or basic intention (Premack, 1990)

Empathizing can be identified and studied from at least 12 months of age (Baron-Cohen, 1994a; Premack, 1990). Thus, infants show dishabituation to actions of agents who appear to violate goal directedness (Gergely, Nadasdy, Gergely, & Biro, 1995; Rochat, Morgan, & Carpenter, 1997). They also expect agents to emote (express emotion), and they expect consistency across modalities (between face and voice; Walker, 1982). They are also highly sensitive to where another person is looking and, by 14 months, strive to establish joint attention (Butterworth, 1991; Hood, Willen, & Driver, 1997; Scaife & Bruner,

1975). By 14 months, they also start to produce and understand pretense (Bates, Benigni, Bretherton, Camaioni, & Volterra, 1979; Leslie, 1987). By 18 months, they begin to show concern at the distress of others (Yirmiya et al., 1992). By 2 years old, they begin to use mental state words in their speech (Wellman & Bartsch, 1988).

Empathizing develops beyond early childhood and continues to develop throughout the life span. These later developments include:

- Attribution of the range of mental states to self and others, including pretense, deception, and belief (Leslie & Keeble, 1987)
- Recognizing and responding appropriately to complex emotions, not just basic ones (Harris, Johnson, Hutton, Andrews, & Cooke, 1989)
- Linking mental states to action, including language, and, therefore, understanding and producing pragmatically appropriate language (Tager-Flusberg, 1993)
- Making sense of others' behavior, predicting it, and even manipulating it (Whiten, 1991)
- Judging what is appropriate in different social contexts, based on what others will think of our own behavior
- Communicating an empathic understanding of another mind

Thus, by 3 years old, children can understand relationships between mental states such as "seeing leads to knowing" (Pratt & Bryant, 1990). By 4 years old, they can understand that people can hold false beliefs (Wimmer & Perner, 1983). By 5 to 6 years old, they can understand that people can hold beliefs about beliefs (Perner & Wimmer, 1985). By 7 years old, they begin to understand what *not* to say to avoid offending others (Baron-Cohen, O'Riordan, Jones, Stone, & Plaisted, 1999). With age, mental state attribution becomes increasingly more complex (Baron-Cohen, Jolliffe, et al., 1997; Happe, 1993). The little cross-cultural evidence that exists suggests a similar picture in very different cultures (Avis & Harris, 1991).

These developmental data have been interpreted in terms of an innate module being part of the infant cognitive architecture. This has

been dubbed a theory of mind mechanism (ToMM; Leslie, 1995). But as we have suggested, empathizing also encompasses the skills that are needed for normal reciprocal social relationships (including intimate ones) and in sensitive communication. Empathizing is a narrowly defined domain, namely, *understanding and responding to people's minds*. Deficits in empathizing are referred to as degrees of mindblindness.

Empathizing in Autism Spectrum Conditions

Since the first test of mindblindness in children with autism (Baron-Cohen et al., 1985), there have been more than 30 experimental tests. The vast majority of these have revealed profound impairments in the development of their empathizing ability. These tests are reviewed elsewhere (Baron-Cohen, 1995; Baron-Cohen, Tager-Flusberg, & Cohen, 1993) but include deficits in the following:

- Joint attention (Baron-Cohen, 1989c)
- Use of mental state terms in language (Tager-Flusberg, 1993)
- Production and comprehension of pretense (Baron-Cohen, 1987; Wing & Gould, 1979)
- Understanding that “seeing leads to knowing” (Baron-Cohen & Goodhart, 1994; Leslie & Frith, 1988)
- Distinguishing mental from physical entities (Baron-Cohen, 1989a; Ozonoff, Pennington, & Rogers, 1990)
- Making the appearance-reality distinction (Baron-Cohen, 1989a)
- Understanding false belief (Baron-Cohen et al., 1985)
- Understanding beliefs about beliefs (Baron-Cohen, 1989b)
- Understanding complex emotions (Baron-Cohen, 1991)
- Showing concern at another's pain (Yirmiya et al., 1992)

Some children and adults with AS show their empathizing deficits only on age-appropriate adult tests (Baron-Cohen, Jolliffe, et al., 1997; Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001; Baron-Cohen, Wheelwright, & Jolliffe, 1997) or on age-appropriate screening

instruments such as the Empathy Quotient (EQ; Baron-Cohen, Richler, Bisarya, Guranathan, & Wheelwright, 2003; Baron-Cohen & Wheelwright, 2004) or the Friendship and Relationship Quotient (FQ; Baron-Cohen & Wheelwright, 2003).

THE EMPATHIZING-SYSTEMIZING THEORY

A deficit in empathizing might account for Triad A—the social and communication abnormalities that are diagnostic of autism—and it could even account for difficulties in *imagining* other people's mental states. However, such a deficit has little if anything to contribute to our understanding of Triad B—repetitive behavior, obsessions, and the islets of ability. Thus, our view of autism is now broader and suggests that alongside empathizing deficits, a different process is *intact or even superior*. This process is what we call *systemizing* (Baron-Cohen et al., 2003).

Systemizing

Whereas we think of empathizing as the drive to identify and respond affectively to agents' mental states to understand and predict the behavior of that agent, we think of systemizing as the drive to analyze and build systems to understand and predict the behavior of nonagentive events. Systems are all around us in our environment and fall into at least six classes:

1. *Technical* (e.g., machines and tools)
2. *Natural* (e.g., biological and geographical phenomena)
3. *Abstract* (e.g., mathematics or computer programs)
4. *Social* (e.g., a business or a football league)
5. *Motoric* (e.g., a juggling technique or a Frisbee throw)
6. *Organizable* (e.g., a collection, a taxonomy, or a list)

The way we make sense of any of these systems is not in terms of mental states, but rather in terms of underlying rules and regularities. Systemizing involves an initial analysis of the system down to its lowest level of detail to identify potentially relevant *parameters* that

632 Theoretical Perspectives

may play a causal role in the behavior of the system. These parameters are then systematically observed or manipulated one by one, and their effects on the whole system are noted. That is, systemizing entails an analysis of input-operation-output relationships. Once the operations on inputs are identified and checked, the output of the system becomes totally predictable.

Systemizing in Autism Spectrum Conditions

Are people with autism intact or even superior at systemizing? We know from clinical descriptions of children with autism that they are typically fascinated by machines (the paragon of nonintentional systems). Parents' accounts (Hart, 1989; Lovell, 1978; Park, 1967) are a rich source of such descriptions. Typical examples include extreme fascinations with electricity pylons, burglar alarms, vacuum cleaners, washing machines, video players, trains, planes, and clocks. Sometimes, the machine that is the object of the child's obsession is quite simple (e.g., the workings of drainpipes or the design of windows). Our survey of obsessions in children with autism substantiated this clinical observation that their preoccupations tend to cluster in the area of systems (Baron-Cohen & Wheelwright, 1999).

Children with an autism spectrum condition who have enough language, such as is seen in children with AS, may be described as holding forth, like a "little professor," on their favorite subject or area of expertise, often failing to detect that their listener may have long since become bored of hearing more on the subject. The apparently precocious systematic understanding, while being relatively oblivious to their listener's level of interest, suggests that their systemizing might be outstripping their empathizing skills in development. The anecdotal evidence includes an obsession with not just machines (technical systems) but also other kinds of systems. Examples of their interest in natural systems include obsessions with the weather (meteorology), the formation of mountains (geography), motion of the planets (astronomy), and classification of lizards (taxonomy).

Experimental studies converge on the same conclusion: Children with autism have not only

an intact intuitive physics but also an accelerated or superior development in this domain (relative to their empathizing and relative to their mental age, both verbal and nonverbal). For example, using a picture-sequencing paradigm, children with autism performed significantly better than mental age-matched controls in sequencing physical-causal stories (Baron-Cohen et al., 1986). Two studies found children with autism showed superior understanding of a camera (Leekam & Perner, 1991; Leslie & Thaiss, 1992). In two direct tests of intuitive physics in children and adults with AS (Baron-Cohen, Wheelwright, Hill, et al., 2001; Lawson, Baron-Cohen, & Wheelwright, 2004), people with AS were found to be functioning at a normal or even superior level relative to controls. Finally, using the Systemizing Quotient (SQ), it was found that adults with AS scored higher than controls (Baron-Cohen et al., 2003).

Family Studies of Empathizing and Systemizing

Family studies add to this picture. Parents of children with AS also show mild but significant deficits on an adult mind-reading task (on the adult version of the Reading the Mind in the Eyes test). This task mirrors the deficit in empathizing seen in patients with autism or AS (Baron-Cohen & Hammer, 1997b; Baron-Cohen, Wheelwright, Hill, et al., 2001). This familial resemblance at the cognitive level is assumed to reflect genetic factors, since autism and AS appear to have a strong heritable component (Bailey et al., 1995; Bolton et al., 1994; Folstein & Rutter, 1977; Le Couteur et al., 1996).

We should also expect that parents of children with autism or AS would be overrepresented in occupations in which possession of superior systemizing is an advantage, while a deficit in empathizing would not necessarily be a disadvantage. A clear occupation for such a cognitive profile is engineering. A study of 1,000 families found that fathers and grandfathers (patri- and matrilineal) of children with autism or AS were more than twice as likely to work in the field of engineering, compared to fathers and grandfathers of children with other disabilities (Baron-Cohen, Wheelwright, Stott, Bolton, & Goodyer, 1997). In-

deed, 28.4% of children with autism or AS had at least one relative (father and/or grandfather) who was an engineer. Related evidence comes from a survey of students at Cambridge University, studying either sciences (physics, engineering, or mathematics) or humanities (English or French literature). When asked about family history of a range of psychiatric conditions (schizophrenia, anorexia, autism, Down syndrome, or manic depression), the students in the science group showed a sixfold increase in the rate of autism in their families, and this increase was specific to autism (Baron-Cohen et al., 1998).

Plotting Empathizing and Systemizing

If empathizing and systemizing are independent dimensions, it is possible to plot on orthogonal axes possible scores from possible tests assessing these two abilities. Figures 23.1 and 23.2 provides a visual representation of this model of the relationship between empathizing and systemizing. It suggests appropriate labels for different possible patterns of scores. The axes show number of standard deviations from the mean. The scale of the diagram is less important than the principle underlying it.

We have used the terms *Brain Type B* (*Balanced*), *Brain Type E* (*Empathizing*), *Brain*

Type S (*Systemizing*), to describe the three basic brain types that are generated from this model. These all fall within two standard deviations from the mean on both dimensions. We have also shown on the graph the *extremes* of Brain Types S and E. The terms describe the discrepancy between the empathizing score and the systemizing score. In the Balanced Brain, there is no difference between scores (i.e., $E = S$). In Brain Type E, empathizing is one or two standard deviations higher than systemizing (i.e., $E > S$). In the Extreme Brain Type E, this discrepancy is greater than two standard deviations (i.e., $E \gg S$). In Brain Type S, systemizing is one or two standard deviations higher than empathizing (i.e., $S > E$). For the Extreme Brain Type S, this discrepancy is greater than two standard deviations (i.e., $S \gg E$).

The key point is the discrepancy between the scores rather than the absolute scores themselves. For example, someone could score two standard deviations above the mean on empathizing (a very high score), but if the score was three standard deviations above the mean on systemizing, he or she would be described as having Brain Type S. Thus, the key issue is possible asymmetries of ability.

Evidence from sex difference research (Kimura, 1992) suggests that Brain Type S is more commonly found in males, while Brain

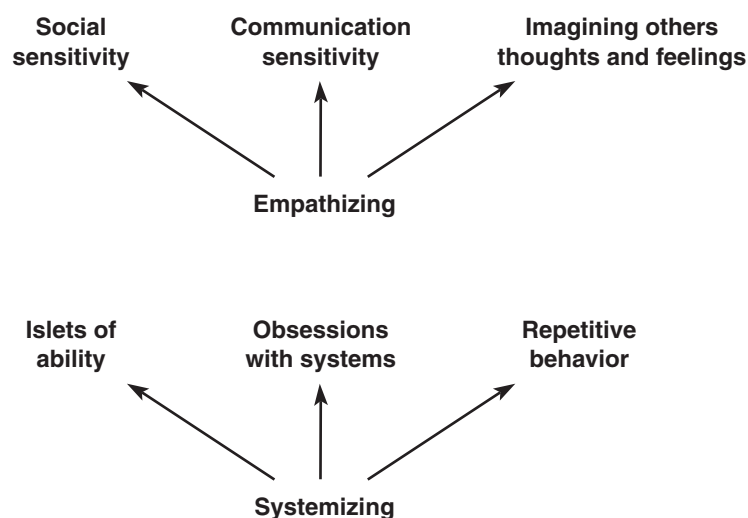


Figure 23.1 Explaining the core characteristics of autism spectrum conditions in terms of empathizing and systemizing.

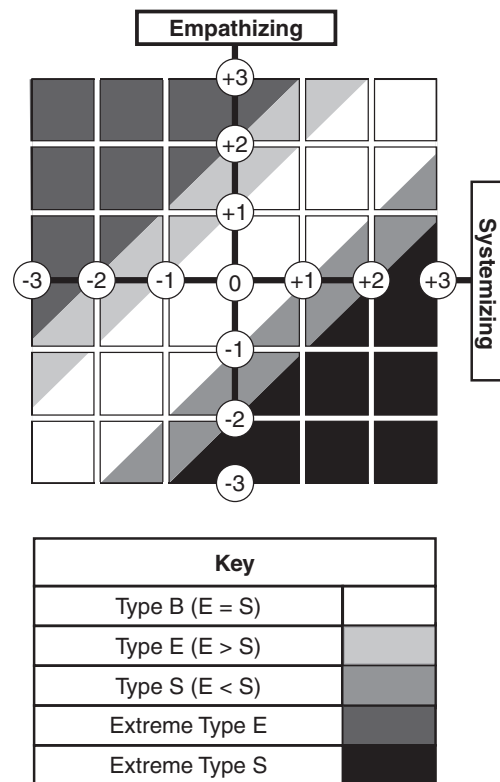


Figure 23.2 Empathizing and systemizing associations. *Note:* Axes show standard deviations from the mean.

Type E is more frequent in females. For this reason, we can also use the terminology *Female Brain* and *Male Brain* types as synonyms for Brain Types E and S, respectively. One result that is consistent with this idea is that human neonates, 1 day old, show a sex difference: Female babies look longer at a human face than a mechanical mobile, while male babies show the opposite pattern of preferences (Connellan, Baron-Cohen, Wheelwright, Ba'tki, & Ahluwalia, 2001).

THE EXTREME MALE BRAIN THEORY

Autism has been described as the extreme of the male brain (Asperger, 1944; Baron-Cohen, 2002; Baron-Cohen & Hammer, 1997a). A number of pieces of evidence are consistent with the extreme male brain (EMB) theory of autism. First, regarding empathizing measures, females score higher than males on tests

of understanding faux pas, and people with AS score even lower than unaffected boys (Baron-Cohen, Wheelwright, Stone, & Rutherford, 1999; Lawson et al., 2004). Second, girls make more eye contact than boys (Lutchmaya, Baron-Cohen, & Raggett, 2002), and children with autism make even less eye contact than unaffected boys (Swettenham et al., 1998). Third, girls tend to pass false belief tests slightly earlier than boys (Happé, 1995), and children with autism are even later to pass false belief tests. Finally, women score slightly higher than men on the Reading the Mind in the Eyes test, and adults with AS or high-functioning autism score even lower than unaffected men (Baron-Cohen, Jolliffe, Mortimore, & Robertson, 1997). There are also established sex differences in systemizing, males tending to score higher on tests of folk physics, map use, and mental rotation, for example (Kimura, 1999), and people with autism being at least intact if not superior on these tasks (Baron-Cohen, Wheelwright, Schill, Lawson, & Spong, 2001; Baron-Cohen et al., 2003; Lawson et al., 2004).

This model of the independence of empathizing and systemizing also predicts the existence of very high-functioning individuals with AS, who may be extreme high achievers in domains such as mathematics and physics—equivalent to Nobel Prize winners even—but who have deficits in empathizing. Some case studies are beginning to identify such very high-functioning individuals (Baron-Cohen, Wheelwright, et al., 1999).

OTHER MODELS OF COGNITIVE DEVELOPMENT IN AUTISM

In this final section, we briefly summarize some other cognitive developmental theories of autism because they are important alternatives against which to consider the empathizing-systemizing theory.

Executive Function Theory

People with autism spectrum conditions show repetitive behavior, a strong desire for routines, and a need for sameness. The only cognitive account that has attempted to explain this aspect of the syndrome is the executive dysfunction theory (Ozonoff, Rogers, Farnham, &

Pennington, 1994; Pennington et al., 1997; Russell, 1997b). This theory paints an essentially negative view of this repetitive behavior, assuming that it is a form of frontal lobe perseveration or inability to shift attention.

We recognize that some forms of repetitive behavior in autism such as *stereotypies* (e.g., twiddling the fingers rapidly in peripheral vision) are likely to be due to executive deficits. Moreover, we recognize that, as people with autism who have additional learning disabilities are tested, executive deficits are more likely to be found (Russell, 1997a). But the fact that it is possible for people with AS to have no demonstrable executive dysfunction while still having deficits in empathizing and talents in systemizing suggests that executive dysfunction cannot be a core feature of autism spectrum conditions.

The executive account has also traditionally ignored the *content* of repetitive behavior. The emphasizing-systemizing (E-S) theory, in contrast, draws attention to the fact that much repetitive behavior involves the child's obsessional or strong interests with mechanical systems (e.g., light switches or water faucets) or other systems that can be understood in terms of rules and regularities. Rather than these behaviors being a sign of executive dysfunction, they may reflect the child's intact or even superior development of his or her systemizing. The child's obsession with machines and systems and what is often described as his or her "need for sameness" in attempting to hold the environment constant might be signs that the child is a superior systemizer. The child might be conducting mini-experiments in his or her surroundings in an attempt to identify physical-causal or other systematic principles underlying events.

One possibility is that the strong drive to systemize seen in autism spectrum conditions may underlie the Triad B features (repetitive behavior, obsessional or narrow interests, and the islets of ability).

Central Coherence Theory

It could be argued that good systemizing skills are simply an expression of an anomaly previously documented, namely, weak central coherence (Frith, 1989; Happe, 1996). *Weak central coherence* refers to the individual's

preference for local detail over global processing. This has been demonstrated in terms of an autistic superiority on the Embedded Figures Task (EFT) and the Block Design Subtest (Jolliffe & Baron-Cohen, 1997; Shah & Frith, 1983, 1993). It has also been demonstrated in terms of an autistic deficit in integrating fragments of objects and integrating sentences within a paragraph (Jolliffe & Baron-Cohen, 2001a; Jolliffe & Baron-Cohen, 2001b). The faster and more accurate performance on the EFT and Block Design subtest has been interpreted as evidence of good segmentation skills and superior attention to detail. The latter has also been demonstrated on visual search tasks (Plaisted, O'Riordan, & Baron-Cohen, 1998a, 1998b).

Our view of systemizing certainly embraces aspects of the central coherence (CC) theory. For example, systemizing requires as a first stage an excellent attention to detail, identifying parameters that may then be tested for their role in the behavior of the system under examination. So, both the E-S theory and the CC theory predict excellent attention to detail. However, the E-S and CC theories also make opposite predictions when it comes to an individual with autism being able to understand a whole system. The E-S theory predicts that people with autism, faced with a new system to learn, will learn it faster than someone without autism, as long as there are underlying rules and regularities that can be discovered. Moreover, they will readily grasp that a change of one parameter in one part of the system may have distant effects on another part of the system. Thus, if the task is a constructional one (e.g., building a model plane), they will be able to grasp that changing the thickness of the wings may cause the plane to land at a steeper angle. This kind of reasoning clearly involves good central coherence of the system. What is being understood is the *relationship* between one parameter and one distal outcome. In contrast, the CC theory should predict that they should fail to understand whole (global) systems or the relationships between parts of a system. This has not been tested.

SUMMARY

This chapter has reviewed both the early mind-blindness theory of autism and the more recent

636 Theoretical Perspectives

extensions of the empathizing-systemizing theory and the extreme male brain theory of autism. The first of these extensions addresses a problem that the early theory had, namely, the need to also account for the obsessional features of autism. The second of these may help explain the marked sex ratio in autism and throw light on the biological basis of autism (Lutchmaya & Baron-Cohen, 2002). Both of these extensions lead to new predictions when contrasted with other cognitive developmental theories of this condition and illustrate some of the progress that is being made in this part of the field of developmental psychopathology.

Cross-References

Aspects of social development are discussed in Chapters 11 and 26; attention and perception are discussed in Chapter 13. Issues of emotional developmental are discussed in Chapter 15.

REFERENCES

- American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.
- Asperger, H. (1944). Die "Autistischen Psychopathen" im Kindesalter. *Archiv für Psychiatrie und Nervenkrankheiten*, 117, 76–136.
- Avis, J., & Harris, P. (1991). Belief-desire reasoning among Baka children: Evidence for a universal conception of mind. *Child Development*, 62, 460–467.
- Bailey, A., Le Couteur, A., Gottesman, I., Bolton, P., Simmonoff, E., Yuzda, E., et al. (1995). Autism as a strongly genetic disorder: Evidence from a British twin study. *Psychological Medicine*, 25, 63–77.
- Baron-Cohen, S. (1987). Perception in autistic children. In D. Cohen (Ed.), *Handbook of autism and pervasive developmental disorders*. New York: Wiley.
- Baron-Cohen, S. (1989a). Are autistic children behaviourists? An examination of their mental-physical and appearance-reality distinctions. *Journal of Autism and Developmental Disorders*, 19, 579–600.
- Baron-Cohen, S. (1989b). The autistic child's theory of mind: A case of specific developmental delay. *Journal of Child Psychology and Psychiatry*, 30, 285–298.
- Baron-Cohen, S. (1989c). Perceptual role-taking and protodeclarative pointing in autism. *British Journal of Developmental Psychology*, 7, 113–127.
- Baron-Cohen, S. (1991). Do people with autism understand what causes emotion? *Child Development*, 62, 385–395.
- Baron-Cohen, S. (1994a). How to build a baby that can read minds: Cognitive mechanisms in mindreading. *Cahiers de Psychologie Cognitive/Current Psychology of Cognition*, 13, 513–552.
- Baron-Cohen, S. (1994b). The mindreading system: New directions for research. *Current Psychology of Cognition*, 13, 724–750.
- Baron-Cohen, S. (1995). *Mindblindness: An essay on autism and theory of mind*. Boston: MIT Press/Bradford Books.
- Baron-Cohen, S. (2002). The extreme male brain theory of autism. *Trends in Cognitive Sciences*, 6, 248–254.
- Baron-Cohen, S., Bolton, P., Wheelwright, S., Short, L., Mead, G., Smith, A., et al. (1998). Does autism occur more often in families of physicists, engineers, and mathematicians? *Autism*, 2, 296–301.
- Baron-Cohen, S., & Goodhart, F. (1994). The "seeing leads to knowing" deficit in autism: The Pratt and Bryant probe. *British Journal of Developmental Psychology*, 12, 397–402.
- Baron-Cohen, S., & Hammer, J. (1997a). Is autism an extreme form of the male brain? *Advances in Infancy Research*, 11, 193–217.
- Baron-Cohen, S., & Hammer, J. (1997b). Parents of children with Asperger syndrome: What is the cognitive phenotype? *Journal of Cognitive Neuroscience*, 9, 548–554.
- Baron-Cohen, S., Jolliffe, T., Mortimore, C., & Robertson, M. (1997). Another advanced test of theory of mind: Evidence from very high functioning adults with autism or Asperger Syndrome. *Journal of Child Psychology and Psychiatry*, 38, 813–822.
- Baron-Cohen, S., Leslie, A. M., & Frith, U. (1985). Does the autistic child have a "theory of mind"? *Cognition*, 21, 37–46.
- Baron-Cohen, S., Leslie, A. M., & Frith, U. (1986). Mechanical, behavioural and intentional understanding of picture stories in autistic children. *British Journal of Developmental Psychology*, 4, 113–125.
- Baron-Cohen, S., O'Riordan, M., Jones, R., Stone, V., & Plaisted, K. (1999). A new test of social sensitivity: Detection of faux pas in normal children and children with Asperger syndrome. *Journal of Autism and Developmental Disorders*, 29, 407–418.

- Baron-Cohen, S., Richler, J., Bisarya, D., Guranathan, N., & Wheelwright, S. (2003). The Systemising Quotient (SQ): An investigation of adults with Asperger Syndrome or High Functioning Autism and normal sex differences. *Philosophical Transactions of the Royal Society, Series B [Special issue]*, 358, 361–374.
- Baron-Cohen, S., Tager-Flusberg, H., & Cohen, D. (Eds.). (1993). *Understanding other minds: Perspectives from autism*. Oxford University Press.
- Baron-Cohen, S., & Wheelwright, S. (1999). Obsessions in children with autism or Asperger syndrome: A content analysis in terms of core domains of cognition. *British Journal of Psychiatry*, 175, 484–490.
- Baron-Cohen, S., & Wheelwright, S. (2003). The Friendship Questionnaire (FQ): An investigation of adults with Asperger Syndrome or High Functioning Autism, and normal sex differences. *Journal of Autism and Developmental Disorders*, 33, 509–517.
- Baron-Cohen, S., & Wheelwright, S. (2004). The Empathy Quotient (EQ). An investigation of adults with Asperger Syndrome or High Functioning Autism, and normal sex differences. *Journal of Autism and Developmental Disorders*, 34, 163–175.
- Baron-Cohen, S., Wheelwright, S., Griffin, R., Lawson, J., & Hill, J. (2002). The exact mind: Empathising and systemising in autism spectrum conditions. In U. Goswami (Ed.), *Handbook of cognitive development*. Blackwells.
- Baron-Cohen, S., Wheelwright, S., Hill, J., & Golan, O. (submitted). A Taxonomy of Human Emotions.
- Baron-Cohen, S., Wheelwright, S., Hill, J., Raste, Y., & Plumb, I. (2001). The "Reading the Mind in the Eyes" test revised version: A study with normal adults, and adults with Asperger Syndrome or High-Functioning autism. *Journal of Child Psychology and Psychiatry*, 42, 241–252.
- Baron-Cohen, S., Wheelwright, S., & Jolliffe, T. (1997). Is there a "language of the eyes"? Evidence from normal adults and adults with autism or Asperger syndrome. *Visual Cognition*, 4, 311–331.
- Baron-Cohen, S., Wheelwright, S., Scahill, V., Lawson, J., & Spong, A. (2001). Are intuitive physics and intuitive psychology independent? *Journal of Developmental and Learning Disorders*, 5, 47–78.
- Baron-Cohen, S., Wheelwright, S., Stone, V., & Rutherford, M. (1999). A mathematician, a physicist, and a computer scientist with Asperger syndrome: Performance on folk psychology and folk physics test. *Neurocase*, 5, 475–483.
- Baron-Cohen, S., Wheelwright, S., Stott, C., Bolton, P., & Goodyer, I. (1997). Is there a link between engineering and autism? *Autism: An International Journal of Research and Practice*, 1, 153–163.
- Bates, E., Benigni, L., Bretherton, I., Camaioni, L., & Volterra, V. (1979). Cognition and communication from 9–13 months: Correlational findings. In E. Bates (Ed.), *The emergence of symbols: Cognition and communication in infancy*. New York: Academic Press.
- Bolton, P., MacDonald, H., Pickles, A., Rios, P., Goode, S., Crowson, M., et al. (1994). A case-control family history study of autism. *Journal of Child Psychology and Psychiatry*, 35, 877–900.
- Brentano, F. (1970). *Psychology from an empirical standpoint*. London: Routledge, and Kegan Paul.
- Butterworth, G. (1991). The ontogeny and phylogeny of joint visual attention. In A. Whalen (Ed.), *Natural theories of mind*. Oxford, England.
- Connellan, J., Baron-Cohen, S., Wheelwright, S., Ba'tki, A., & Ahluwalia, J. (2001). Sex differences in human neonatal social perception. *Infant Behavior and Development*, 23, 113–118.
- Csibra, G., Gergely, G., Biro, S., Koos, O., & Brockbanck, M. (1999). Goal attribution without agency cues: The perception of "pure reason" in infancy. *Cognition*, 72, 253–284.
- Dennett, D. (1987). *The intentional stance*. Cambridge, MA: MIT Press/Bradford Books.
- Ekman, P. (1992). Facial expression of emotion: An old controversy and new findings. In V. Bruce (Ed.), *The face*. Royal Society. Oxford University Press.
- Folstein, S., & Rutter, M. (1977). Infantile autism: A genetic study of 21 twin pairs. *Journal of Child Psychology and Psychiatry*, 18, 297–321.
- Frith, U. (1970). Studies in pattern detection in normal and autistic children: I. Immediate recall of auditory sequences. *Journal of Abnormal Psychology*, 76, 413–420.
- Frith, U. (1989). *Autism: Explaining the enigma*. Oxford, England: Basil Blackwell.
- Frith, U. (1991). *Autism and Asperger's syndrome*. Cambridge: Cambridge University Press.
- Gelman, S., & Hirschfield, L. (1994). *Mapping the mind*. Cambridge: Press Syndicate, University of Cambridge.
- Gergely, G., Nadasdy, Z., Gergely, C., & Biro, S. (1995). Taking the intentional stance at 12 months of age. *Cognition*, 56, 165–193.
- Griffin, R., & Baron-Cohen, S. (2002). The intentional stance: Developmental and neurocognitive

638 Theoretical Perspectives

- perspectives. In A. Brook & D. Ross (Eds.), *Dennett beyond philosophy*: Cambridge University Press.
- Happe, F. (1993). Communicative competence and theory of mind in autism: A test of Relevance Theory. *Cognition*, 48, 101–119.
- Happe, F. (1995). The role of age and verbal ability in the theory of mind task performance of subjects with autism. *Child Development*, 66, 843–855.
- Happe, F. (1996). Studying weak central coherence at low levels: Children with autism do not succumb to visual illusions: A research note. *Journal of Child Psychology and Psychiatry*, 37, 873–877.
- Harris, P., Johnson, C. N., Hutton, D., Andrews, G., & Cooke, T. (1989). Young children's theory of mind and emotion. *Cognition and Emotion*, 3, 379–400.
- Hart, C. (1989). *Without reason*. New York: Harper & Row.
- Hermelin, B., & O'Connor, N. (1970). *Psychological experiments with autistic children*. London: Pergamon Press.
- Hood, B., Willen, J., & Driver, J. (1997). *An eye-direction detector triggers shifts of visual attention in human infants*. Unpublished manuscript, Harvard University.
- Johnson, S. (2000). The recognition of mentalistic agents in infancy. *Trends in Cognitive Sciences*, 4, 22–28.
- Jolliffe, T., & Baron-Cohen, S. (1997). Are people with autism or Asperger's syndrome faster than normal on the Embedded Figures Task? *Journal of Child Psychology and Psychiatry*, 38, 527–534.
- Jolliffe, T., & Baron-Cohen, S. (2001a). A test of central coherence theory: Can adults with high-functioning autism or Asperger Syndrome integrate fragments of an object. *Cognitive Neuropsychiatry*, 6, 193–216.
- Jolliffe, T., & Baron-Cohen, S. (2001b). A test of central coherence theory: Can adults with high-functioning autism or Asperger syndrome integrate objects in context? *Visual Cognition*, 8, 67–101.
- Kanner, L. (1943). Autistic disturbance of affective contact. *Nervous Child*, 2, 217–250.
- Kimura, D. (1992, September). Sex differences in the brain. *Scientific American*, 119–125.
- Kimura, D. (1999). *Sex and cognition*. Cambridge, MA: MIT Press.
- Klin, A., Volkmar, F., Sparrow, S., Cicchetti, D., & Rourke, B. (1995). Validity and neuropsychological characterization of Asperger syndrome: Convergence with nonverbal learning disabilities syndrome. *Journal of Child Psychology and Psychiatry*, 36, 1127–1140.
- Lawson, J., Baron-Cohen, S., & Wheelwright, S. (2004). Empathising and systemising in adults with and without Asperger Syndrome. *Journal of Autism and Developmental Disorders*, 34, 301–310.
- Le Couteur, A., Bailey, A., Goode, S., Pickles, A., Robertson, S., Gottesman, I., et al. (1996). A broader phenotype of autism: The clinical spectrum in twins. *Journal of Child Psychology and Psychiatry*, 37, 785–801.
- Leekam, S., & Perner, J. (1991). Does the autistic child have a metarepresentational deficit? *Cognition*, 40, 203–218.
- Leslie, A. (1987). Pretence and representation: The origins of "theory of mind." *Psychological Review*, 94, 412–426.
- Leslie, A. (1995). ToMM, ToBy, and agency: Core architecture and domain specificity. In L. Hirschfeld & S. Gelman (Eds.), *Domain specificity in cognition and culture*. New York: Cambridge University Press.
- Leslie, A., & Frith, U. (1988). Autistic children's understanding of seeing, knowing, and believing. *British Journal of Developmental Psychology*, 6, 315–324.
- Leslie, A., & Keeble, S. (1987). Do six-month old infants perceive causality? *Cognition*, 25, 265–288.
- Leslie, A., & Thaiss, L. (1992). Domain specificity in conceptual development: Evidence from autism. *Cognition*, 43, 225–251.
- Lovell, A. (1978). *In a summer garment*. London: Secker and Warburg.
- Lutchmaya, S., & Baron-Cohen, S. (2002). Human sex differences in social and non-social looking preferences at 12 months of age. *Infant Behaviour and Development*, 25, 319–325.
- Lutchmaya, S., Baron-Cohen, S., & Raggett, P. (2002). Foetal testosterone and eye contact in 12 month old infants. *Infant Behavior and Development*, 25, 327–335.
- Mundy, P., & Crowson, M. (1997). Joint attention and early social communication. *Journal of Autism and Developmental Disorders*, 27, 653–676.
- Ozonoff, S., Pennington, B., & Rogers, S. (1990). Are there emotion perception deficits in young autistic children? *Journal of Child Psychology and Psychiatry*, 31, 343–363.
- Ozonoff, S., Rogers, S., Farnham, J., & Pennington, B. (1994). Can standard measures identify subclinical markers of autism? *Journal of Autism and Developmental Disorders*.
- Park, C. (1967). *The siege*. London: Hutchinson.

- Pennington, B., Rogers, S., Bennetto, L., Griffith, E., Reed, D., & Shyu, V. (1997). Validity test of the executive dysfunction hypothesis of autism. In J. Russell (Ed.), *Executive functioning in autism*. Oxford, England: Oxford University Press.
- Perner, J., & Wimmer, H. (1985). "John thinks that Mary thinks that . . ." Attribution of second-order beliefs by 5–10 year old children. *Journal of Experimental Child Psychology*, 39, 437–471.
- Plaisted, K., O'Riordan, M., & Baron-Cohen, S. (1998a). Enhanced discrimination of novel, highly similar stimuli by adults with autism during a perceptual learning task. *Journal of Child Psychology and Psychiatry*, 39, 765–775.
- Plaisted, K., O'Riordan, M., & Baron-Cohen, S. (1998b). Enhanced visual search for a conjunctive target in autism: A research note. *Journal of Child Psychology and Psychiatry*, 39, 777–783.
- Pratt, C., & Bryant, P. (1990). Young children understand that looking leads to knowing (so long as they are looking into a single barrel). *Child Development*, 61, 973–983.
- Premack, D. (1990). The infant's theory of self-propelled objects. *Cognition*, 36, 1–16.
- Rochat, P., Morgan, R., & Carpenter, M. (1997). Young infants' sensitivity to movement information specifying social causality. *Cognitive Development*, 12, 537–561.
- Russell, J. (Ed.). (1997a). *Autism as an executive disorder*. Oxford, England: Oxford University Press.
- Russell, J. (1997b). How executive disorders can bring about an inadequate theory of mind. In J. Russell (Ed.), *Autism as an executive disorder*. Oxford, England: Oxford University Press.
- Rutter, M. (1978). Language disorder and infantile autism. In M. Rutter & E. Schopler (Eds.), *Autism: A reappraisal of concepts and treatment*. New York: Plenum Press.
- Scaife, M., & Bruner, J. (1975). The capacity for joint visual attention in the infant. *Nature*, 253, 265–266.
- Shah, A., & Frith, U. (1983). An islet of ability in autism: A research note. *Journal of Child Psychology and Psychiatry*, 24, 613–620.
- Shah, A., & Frith, U. (1993). Why do autistic individuals show superior performance on the block design test? *Journal of Child Psychology and Psychiatry*, 34, 1351–1364.
- Swettenham, J., Baron-Cohen, S., Charman, T., Cox, A., Baird, G., Drew, A., et al. (1998). The frequency and distribution of spontaneous attention shifts between social and non-social stimuli in autistic, typically developing, and non-autistic developmentally delayed infants. *Journal of Child Psychology and Psychiatry*, 9, 747–753.
- Szatmari, P., Tuff, L., Finlayson, M., & Bartolucci, G. (1990). Asperger's syndrome and autism: Neurocognitive aspects. *Journal of the American Academy of Child and Adolescent Psychiatry*, 29, 130–136.
- Tager-Flusberg, H. (1993). What language reveals about the understanding of minds in children with autism. In S. Baron-Cohen, H. Tager-Flusberg, & D. J. Cohen (Eds.), *Understanding other minds: Perspectives from autism*. Oxford, England: Oxford University Press.
- Tomasello, M. (1988). The role of joint-attentional processes in early language acquisition. *Language Sciences*, 10, 69–88.
- Walker, A. S. (1982). Intermodal perception of expressive behaviours by human infants. *Journal of Experimental Child Psychology*, 33, 514–535.
- Wellman, H., & Bartsch, K. (1988). Young children's reasoning about beliefs. *Cognition*, 30, 239–277.
- Whiten, A. (1991). *Natural theories of mind*. Oxford, England: Basil Blackwell.
- Wimmer, H., & Perner, J. (1983). Beliefs about beliefs: Representation and constraining function of wrong beliefs in young children's understanding of deception. *Cognition*, 13, 103–128.
- Wing, L. (1976). *Early childhood autism*. Oxford: Pergamon Press.
- Wing, L. (1981). Asperger syndrome: A clinical account. *Psychological Medicine*, 11, 115–130.
- Wing, L., & Gould, J. (1979). Severe impairments of social interaction and associated abnormalities in children: Epidemiology and classification. *Journal of Autism and Developmental Disorders*, 9, 11–29.
- World Health Organization. (1992). *The ICD-10 classification of mental and behavioral disorders: Clinical descriptions and diagnostic guidelines*. Geneva, Switzerland: Author.
- Yirmiya, N., Sigman, M., Kasari, C., & Mundy, P. (1992). Empathy and cognition in high functioning children with autism. *Child Development*, 63, 150–160.