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Empathizing-Systemizing Theory: Past, Present, and Future

David M. Greenberg[1,2,3] and Simon Baron-Cohen[2,4]
[1]Department of Clinical Psychology, City College of New York, New York, USA
[2]Autism Research Centre, Department of Psychiatry, University of Cambridge, Cambridge, UK
[3]Department of Psychology, Cambridge University, Cambridge, UK
[4]CLASS Clinic, Cambridgeshire and Peterborough NHS Foundation Trust (CPFT), Cambridgeshire, UK

Definition

The empathizing-systemizing (E-S) theory (Baron-Cohen 2003, 2009) proposes an account of two important dimensions of individual differences in cognition which has proved useful in explaining psychological sex differences in human cognition and has helped to explain the clinical condition of autism. Recent evidence suggests that E-S brain types are not just a useful psychological description but that these also have a biological basis and can explain individual differences in everyday human behavior.

Empathy is the ability to understand and predict what another person is thinking and feeling and to respond to another person's mental state with an appropriate emotion (Baron-Cohen and Wheelwright 2004). The cognitive component of empathy is the ability to imagine or recognize another's mental state and to put yourself in another person's shoes (also referred to as "theory of mind" or mentalizing), while the affective component of empathy is the emotional reaction a person has in response to the mental state of another. Systemizing is a very different process: the drive to analyze, build, understand, and predict a rule-based system, including those that are categorical (e.g., the rules defining types of rock or fungi), mechanical (e.g., the rules governing the workings of your computer or your car engine), natural (e.g., the rules governing the cardiovascular system or your garden pond), social (e.g., the rules governing a legal system or a corporation), motoric (e.g., the rules governing a golf swing or a particular form of dance), and abstract (such as the rules of mathematics or syntax) (Baron-Cohen et al. 2003). In short, empathy centers on how we make sense of and respond to people or other animate entities in terms of their mental states while systemizing centers on how we make sense of (usually inanimate) objects or events.

Empathy can be measured using the empathy quotient (EQ: Baron-Cohen and Wheelwright 2004), which is a 60-item self-report measure (20 of which are "filler" items so are not scored) that includes items such as "I can pick up quickly if someone says one thing but means another"; "I am good at predicting how someone will feel"; and "Other people tell me I am good at understanding

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how they are feeling and what they are thinking." Those that score high on the EQ typically also score higher on performance tests of empathy including the "Reading the Mind in the Eyes" Test (RMET: Baron-Cohen et al. 2001a). Systemizing can be measured using the systemizing quotient-revised (SQ-R: Wheelwright et al. 2006) which is a 75-item self-report measure that includes items such as "I am fascinated by how machines work"; "In math, I am intrigued by the rules and patterns governing numbers"; "When I look at a mountain, I think about how precisely it was formed"; and "If I were buying a computer, I would want to know exact details about its hard disc drive capacity and processor speed." The EQ and SQ have been translated into multiple languages (available for free to the research community at www.autismresearchcentre.com), and there are short versions of each measure (Wakabayashi et al. 2006; Allison et al. 2015).

Empathy and systemizing are not entirely independent of each other as large-scale studies indicate a small but statistically significant negative correlation, implying that the higher one scores on one dimension and the lower one scores on the other. This has been interpreted as a trade-off perhaps reflecting neural competition. An individual's scores on these two dimensions can be used to calculate their "brain type" or cognitive style. Individuals whose empathizing (E) scores are higher than systemizing (S) scores are categorized as E > S or type E, those with an S > E profile are categorized as type S, and those with relatively equal E and S scores (E = S) are categorized as type B (or balanced). The comparison of EQ and SQ scores also identifies cognitive styles at the extreme ends of this space: those with E > > S scores are described as extreme type E and those with S > > E scores are described as extreme type S. Roughly 30% of the population is estimated as type E, 30% as type S, 30% as type B, 5% as extreme type S, and 5% as extreme type S (Baron-Cohen et al. 2014). Significantly more males (58%) than females (23%) are categorized as type S or extreme type S and more females (47%) than males (13%) are classified as type E or extreme type E (Baron-Cohen et al. 2014), such that type S has also been described as the "male brain" and type E has been described as the "female brain." These terms of course do not mean that all females have one brain type and all males have another, simply that there are statistical trends differentiating groups of males and females. Individuals by definition may be typical or atypical for the sex such that it is not possible (and would be stereotyping) to prejudge a person's brain type on the basis of the sex.

E-S theory has proven to be a useful framework for characterizing those with autism. Individuals on the autism spectrum are typically classified as type S or extreme type S, with higher systemizing scores than empathy scores (Goldenfeld et al. 2005). A proportion of those with autism may even show hyper-systemizing (Baron-Cohen et al. 2009). This may explain the remarkable talents often documented in autism, including autistic savants, given that savant skills often center on the understanding of a particular system (e.g., music or mathematics or calendrical calculation). E-S scores also predict autistic traits as measured by the autism-spectrum quotient (AQ: Baron-Cohen et al. 2001b) in both autism and control populations.

Some have misinterpreted E-S theory to indicate that people with autism do not have the ability to empathize. In fact, the evidence shows that people with autism only score lower on the cognitive components of empathy, but their affective empathy typically remains intact (Dziobek et al. 2008). That is, they are able to react emotionally to the suffering of others and respond with an appropriate emotion; however, they have difficulty recognizing the mental states of others and using these to predict their behavior. This can explain why social situations can be confusing for them and why people with autism can be taken advantage of. The mirror opposite of autism is the profile of psychopaths (or those with antisocial personality disorder) who have high cognitive empathy and low affective empathy, which enables them to manipulate others without being caring about their victim (Baron-Cohen 2011).

There is emerging evidence that E-S theory has implications for other clinical diagnoses. For example, extreme empathizing was found to correlate with psychosis (paranoia and mania) in

females (Brosnan et al. 2010), and a recent study has also shown that individuals with autism who have had a comorbidity of psychosis have higher empathy scores than those without psychosis (Larson et al. 2015). In separate studies, systemizing has also been found to link to schizotypy (Russell-Smith et al. 2013) and anorexia nervosa (Hambrook et al. 2008).

E-S theory is not just an explanation of observed psychological sex differences and clinical diagnosis but also of everyday human behavior and interests. For example, E-S scores predict what subject a person will study at a university: on average, those with E > S profiles are more likely to study humanities, and those with S > E profiles are more likely to study the exact sciences (Billington et al. 2007). Indeed, E-S scores are better predictors than sex of an individual's choice of whether to study science or humanities among college students. Greenberg et al. (2015b) applied E-S theory to the psychology of music. In one study, Greenberg et al. (2015a) found that on average, individuals classified as type E preferred music with low energy, negative emotions, and emotional depth, while individuals classified as type S preferred music with high energy, positive emotions, and intellectual depth. Future research should continue to investigate how E-S theory predicts behavior in different facets of everyday life, including occupational choice, relationship style, parenting style, moral values, or even voting behavior.

Research shows that there is a biological basis underlying differences in cognitive styles. For example, amniotic fluid hormones measured in the second trimester of pregnancy show increased levels of fetal testosterone in those with higher autistic traits and autism (Auyeung et al. 2009; Baron-Cohen et al. 2015) and in those with stronger SQ scores, better attention to detail (Auyeung et al. 2006) and narrower interests (Knickmeyer et al. 2005). Lower levels of fetal testosterone are associated with higher scores on the EQ and the RMET (Chapman et al. 2006) and better quality of social relationships and communication (Knickmeyer et al. 2005). Using fMRI, type S and type E cognitive brain types in males are associated with differences in hypothalamic and ventral basal ganglia regions in the brain (Lai et al. 2012). In several large genetic studies, Warrier et al. (2016) showed that heritability of both empathy and systemizing is associated with variation in single nucleotide polymorphisms (SNPs).

Conclusion

Though in the initial years of its development, E-S theory was predominantly used to explain psychological sex differences and autism, it has proven to be far more wide reaching. Indeed, it is linked to a range of everyday behaviors and clinical diagnoses, even after controlling for sex differences. Future research should investigate E-S theory as a framework in which to understand individual differences in a range of human behavior and development. Importantly, it may provide alternative insights to widely used personality models such as the Big Five.

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