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A Narrative Review of the Empathizing-Systemizing Theory in Autism

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Abstract: *The Empathizing-Systemizing (E-S) theory is a extensively examined and debated cognitive model utilized for interpreting Autism Spectrum Disorder (ASD). Within the realm of individuals affected by this condition, it is frequently observed that they exhibit heightened capability in systemizing, which in turn may result in challenges and impediments in navigating social interactions, communication, and behavioral adaptability. In the hyper-systemizing concept, it is an addition to the E-S model, which supposes that persons with this condition have a high dependency on predictable patterns and struggle with change or less structured environments and settings. The aim of this paper is to investigate and discuss the theoretical rationale for the E–S model, which included recent research on its relationship to ASD symptoms, cognitive styles, and neurodevelopmental differences. Examining how this advances our understanding of traits often associated with ASD, such as superior pattern recognition and analytical power, especially in STEM disciplines. Further, this theoretical model must be refined and studied for similarities with other cognitive and neurological explanations of this disorder.*

Keywords: Autism Spectrum Disorder (ASD), Empathizing-Systemizing Theory, Hyper-Systemizing, Cognitive Processing, Narrative Review

1. Introduction

More than 80 years ago, Leo Kanner published his groundbreaking article describing 11 children with a condition that is now known as autism. Although autism is a relatively recent classification in comparison with several neurodevelopmental disorders including schizophrenia and bipolar disorder, historical records suggest that similar conditions have existed for a long time (Casanova & Casanova, 2019). Kanner aimed to distinguish autism from other mental health conditions by emphasizing its distinct behavioral traits (Rutter & Schopler, 1978). Autism was formally identified in 1980 within the Diagnostic and Statistical Manual of Mental Disorders (DSM), barely a year before Kanner's death (Casanova & Casanova, 2019). The current definition text that Autism spectrum disorder (ASD) is a unique neurodevelopmental condition characterized by challenges in social communication, interactions, and distinctive behavioral traits (American Psychiatric Association [APA], 2013).

Autism is a distinct form of developmental disorder that hinders a child's capacity to form significant relationships as they mature. Although its cause is unknown, a number of genetic variables and potentially certain prenatal environmental conditions are responsible for this

disability (Iyama-Kurtycz, 2020). While Folstein and Rutter (1977) suggested that children with this disorder typically do not have parents or siblings who are also autistic, that may give the impression that genetics are not a factor. However, this can be deceiving, as those individuals tend to have low rates of marriage and having children. Approximately 1 in 54 eight-year-olds in the United States, or around 18.5 per 1,000 children, are expected to meet the diagnostic criteria for this disorder, according to the Centers for Disease Control and Prevention (CDC, 2023). Over time, the prevalence of this disorder has seen a notable rise; in comparison with prevalence in 2000 in the United States was about 6.7 per 1,000 (CDC, 2014). Many studies emphasize that the etiology of autism is complex and varies across individuals (Casanova & Casanova, 2019). Numerous factors contribute to ASD, including genetics (Delfos, 2005), with heritability estimates reaching approximately half cases (Sandin et al., 2014), environmental influences, and physiological factors (APA, 2013).

Several cognitive theories have been formulated to elucidate the unique behavioral traits and characteristics exhibited by individuals affected by this disorder, despite the ongoing complexity and multifaceted nature of its precise causes. In this regard, research has led us to Empathizing-Systemizing (E-S) theory, one of the most discussed models built a larger model in which the E-S is based Baron-Cohen (2003), and Golan and Baron-Cohen (2006). The theory Mind suggests that individuals exhibit a variety of cognitive profiles along two dimensions: empathizing, which involves the ability to perceive and respond to emotions and mental states of other individuals, and systemizing, which entails the skill in recognizing patterns, assessing structures, and creating rule-based systems. This is a theory that those with this disorder are "systemizers" whose empathizing abilities fall on the low-end of the spectrum. What consequences do you think this imbalance has on their ability to meaningfully participate in their social interactions. Thus, this review emphasizes the theoretical aspects of the E-S model, its relevance in making sense of autistic cognition, its importance in educational and career trajectories and its limitations and criticisms.

2. Systemizing and Autism

The concept of systemizing reflects a cognitive ability to perceive and create rule-based, highly deterministic systems. They may correspond not only to mechanical and numerical operations but also to rules and patterns that can be investigated in the field of music, engineering, mathematics, or technology (Baron-Cohen, 2006; Hendriks et al., 2022). This fully aligns with numerous observations pointing out that individuals with this disorder have an exceptional knack for patterns and structured activities. Owing to these systems, they are much more efficient at problem-solving in fields that require compliance with patterns and systems, such as mathematics, physics, engineering, computer science, and data analysis. Seemingly, the theory of hyper-systemizing proposed by Baron-Cohen reflects that individuals with ASD feel more attracted to fully deterministic and structured systems, explaining their attachment to routines and structured environments that possess strict rules and a rational basis (Baron-Cohen, 2012). Flexibility is a crucial component in every complex project. While systemizing skills are invaluable in the field of STEM, over-reliance on structured thinking renders it more complex to operate in unstable or frequently changing environments. These strengths also play a role in how individuals interact socially, tackle complex problems, and make decisions in real-life scenarios. The table in Table 1 categorizes individuals based on their ability and inclination toward organizing, analyzing, predicting, and building structured, rule-based systems. Some individuals excel in these areas, while others prefer different cognitive approaches, reflecting a broad spectrum of thinking styles and behavioral tendencies (Baron-Cohen, 2006).

Table 1: Levels of Systemizing

Systemizing Levels of Systemizing		
Low levels of Systemizing		**Description**
First Level	-	Individuals with low SM can adapt to unpredictable and sudden changes but may struggle with structured and rule-based systems. This struggle happened because of a deficit of accuracy when handling detailed and organized information. Moreover, persons lacking curiosity or urge to organize may cope with change and socialize well. Such individuals will have no difficulty socializing.
Second Level	-	Males perform higher in tests such as map reading, mental rotation, mechanics, and systemizing quotient compared to females. Females typically systemize at this level, reflecting interests like socializing, which is why television soap operas are popular due to their lack of systems.
Third Level	-	At this level, most males systemize based on typical male interests, such as mechanics.
Fourth Level	-	Some evidence shows that individuals who systemize more than the average may have more autistic symptoms. Scientists and others who understand a wide range of systems, including the financial market, legal framework, and engineering principles.
High levels of Systemizing		**Description**
Fifth Level	-	Individuals with Asperger syndrome (AS) have a Level 5 SM, which allows them to systematize legal systems such as calendars and rail schedules. They score above-average on the systemizing quotient, perform normally or above-average on intuitive physics or geometric analysis examinations, thrive in mathematics, physics, or computer science, and have an "exact mind" in the arts.
Sith Level	-	Several research suggests that those with a high-functioning autistic system are on this level, which is a diagnosis of this disorder that describes individuals that characterize anticipated to have strong powerful interact with their environment.
Seventh Level	-	Individuals with moderate learning disabilities, also known as medium functioning autism, are believed to systemize at this level.
Eight Level	-	In this level, they are believed to be individuals with a low-functioning level characterized by minimal verbal communication, tend to show challenges in their learning and deficits in the complex requirements.

(Baron-Cohen, 2006)

3. Empathizing and Autism

Empathizing entails the competence to perceive, realize, and react sensitively to the emotional state, ideas, and mental and psychological states of other individuals. This aptitude is a vital element of social awareness, empowering individuals to participate in meaningful exchanges, oversee interpersonal connections, and adapt to evolving social environments. This concept involves several key processes, including recognizing social cues, interpreting facial expressions, understanding tone of voice, and engaging in joint communication (Baron-Cohen, 2003; Warrier et al., 2017). Also, these skills enable individuals in predicting individuals emotions, foresee social reaction, and adapt their behavior accordingly. However, those with this disorder often experience significant difficulties grasping and expressing empathy, which means they struggle with effective communication and social interaction (Lawson et al., 2004). Most of the autistics have trouble deciphering emotions of other individuals and thus become confused about the social cues along with invisible and indirect social expectations. This may lead to awkward or unintentional social gaffes because individuals with ASD may not pick up on sarcasm, irony and the unwritten rules of society. Furthermore, it can make it hard for individuals with this disorder to process and interact with non-verbal cues such as body language, eye contact and expressions, which creates extreme complications for them to engage comfortably in mutual conversations as well as maintain the socially integrated relationships (APA, 2013). These challenges are a few of the reasons that individuals with this disorder struggle to sustain their friendships, work relationships and romantic relationships.

This kind of social uncertainty, in which rules and expectations are not clearly delineated, can be especially daunting.

4. Empathizing, the EMB Hypothesis, and the E-S Theory

E-S theory is generally consistent with Extreme Male Brain (EMB) hypothesis, suggesting that autism reflects an amplified expression of traditional cognitive distinctions between males and females. Proposed by Baron-Cohen (2002, 2005), this hypothesis posits that there exists an overall tendency for distinct cognitive styles between genders, with males showing a inclination towards developing systemizing abilities and females towards empathizing skills. This cognitive difference is believed to be exaggerated in individuals with ASD, leading to an extreme brain, known as the male brain with high systemizing and low empathizing skills. This model clarifies the difficulties of the individuals with ASD with noticing social nuances, recognizing emotional cues and responding accordingly.

Females with typical neurodevelopment tend to outperform males with typical neurodevelopment in tasks assessing empathy skills, such as identifying emotions, taking social perspectives, and interpreting facial expressions (Baron-Cohen et al., 2005). Conversely, males tend to exhibit high level proficiency in systemizing-oriented tasks, including pattern recognition, mechanical reasoning, and logical problem-solving. In individuals with autism, these cognitive patterns appear to be altered, leading to a heightened preference for systematic, rule-based systems and difficulties in social-emotional understanding. That is why individuals with ASD tend to excel in STEM disciplines that reward structured, predictable thinking but struggle in dynamic, emotionally charged environments where the ability to identify with others is vital. Moreover, some research has examined biological explanations, such as prenatal testosterone levels, that might account for this cognitive disparity. Researchers have indicated that elevated levels of fetal testosterone are associated with diminished social inclination, limited gaze engagement, and a propensity for rule-based cognitive characteristics, which are more pronounced in individuals with this disorder (Baron-Cohen et al., 2004). Implications of these findings imply that hormonal influences could play a significant role in theory.

Overall, while E-S theory and EMB hypothesis do add to the understanding of cognitive differences involved in autism, they also seem to suggest the need to address empathizing difficulties in individuals with this disorder. Struggles with empathy do not mean that a person does not care about or is not interested in the feelings of others; they reflect a different way of learning social and emotional cues. Understanding that individuals with ASD differ cognitively allows for a targeted approach in education, therapy, and support systems to empower social mapping, making them emotionally stronger while developing their reciprocal interaction skills. Structured approaches to learning, explicit social skills training, or incorporating assistive technologies can enable these individuals to navigate social interactions more successfully, as well as play to their strengths, such as strong systemizing skills. This leads us to seek new approaches that provide a balance of recognition of systemizing abilities and empathizing challenges, in order to create inclusive education, meaningful social bonds and better quality of life. This hypothesis is borne out in empirical research (Zeyer & Dillon, 2019).

5. Critique and Constraints of the E-S Theory

Despite its valuable contributions, this theory faces criticism for its tendency to oversimplify traits of autism. Some researchers argue that it generalizes the characteristics too broadly,

assuming that all individuals with ASD exhibit high systemizing and low empathizing tendencies. However, autism is incredibly diverse, and not all individuals with this condition conform to these patterns (Harvey, 2018). Second, the theory does not fully account for the social challenges apparent in this disorder. Although this explanation is in some ways a cognitive one, it falls short in respect of providing for neurodiverse features, sensory overloads and environmental impacts. Third, the theory suggests that while males are thought to exhibit greater systemizing tendencies compared to females, there is evidence indicating that gender disparities in cognition may not be as rigid as initially proposed. Additionally, it is suggested that specific cognitive styles can be significantly shaped by socialization and environmental factors (Morsanyi et al., 2012).

Moreover, many researchers disagree about the direct causative role of systemizing abilities with social deficits vs. whether social problems stem from different neurological and environmental influences. Autistic traits did not appear to be significantly related to systemizing once control variables (covariates) were accounted for, and other individual cognitive mechanisms like spatial reasoning or executive function took on just as much importance as trait level (Andrew et al., 2008). Another criticism is that, although individuals with ASD often have amazing skills in patterning and logic, not all of these individuals are highly proficient in mathematics or mechanical reasoning, leading to questions about whether the systemizing account of autism works for everyone (Morsanyi et al., 2012).

6. Conclusion and Future Directions

The E-S theory is still a useful model for understanding autistic cognition, especially in the context of social-emotional understanding and problem-solving strengths that differ across the spectrum. Similarly, this model offers perspective on the professions in STEM of individual learners who face societal barriers and have learning preferences. Helping schools and businesses create environments that are more representative and inclusive for the learners they serve. And instead of relying on this hypothesis as the single explanation for ASD, it should be seen as one of many perspectives. Future research should look at understanding the underpinnings of systemizing and empathizing ability, as well as possible interventions to build on systemizing strengths while facilitating social adaptation and developing more inclusive education, institutional and workplace policies that also reflect cognitive diversity in individuals with ASD. Therefore, through the integration of cognitive investigations with real life implementation in educational settings, work environments, and supportive organizations, the E-S theory must further dissect understanding this unique disorder and provide accommodations for such issues. And, finally, by taking a broader view that combines ideas from cognitive psychology, neuroscience, and studies of social development, we can arrive at a fuller and deeper understanding of autism.

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