

**How Autism's Theory of Mind Hypothesis Defends Massive Modularity**

Arthur G. Ward

Discussion Section 1I – Thursday 11:00 – 11:50 AM

## How Autism's Theory of Mind Hypothesis Defends Massive Modularity

The human brain is a fascinating organ that allows us to connect with the world in remarkable ways. While it is without question that the physical augmentations experienced by our brains throughout human evolution are significant, research suggests that no individually unique trait (either absent or present) in humans accounts for our seemingly advanced cognitive abilities (Laland & Seed, 2021). The question surrounding the emergence of our advanced cognitive functionalities continues to be hotly debated, with many competing hypotheses existing to transcribe the fundamental processes behind human cognition. At the heart of this debate is the integral element behind biological and cognitive evolution—natural selection.

Charles Darwin's 1859 seminal work, *On the Origin of Species*, introduced natural selection to the world, a concept that revolutionized biological science. The late evolutionary biologist and mathematician Richard C. Lewontin summarized Darwin's natural selection as possessing three fundamental principles: phenotypic variation, differential fitness, and heritable fitness, each working together to ensure evolution's continuation (Lewontin, 1970). While lacking in many capacities, Lewontin's summary helps underscore the scientific reformation caused by Darwin's ideas, perpetuating new scientific fields that continue to unlock the secrets of human evolution.

One concentration currently involved in the debate surrounding human cognition, defined by the *American Psychological Association* as all forms of knowing, awareness, or individual precept (2022b), is Evolutionary Psychology, a field that centralizes the role of adaptation—the core product of natural selection—as the driving mechanism behind cognitive development (Downes, 2021). Evolutionary psychologist and anthropologist H. Clark Barrett describes the intersection between natural selection and the human mind in his 2015 book, *The Shape of*

*Thought*, by highlighting the primary functions of the brain: allowing for the identification of the world around us, guiding our attitudes and goals in respect to the world around us, and appropriately moving our bodies concerning those goals and attitudes, arguing the mind's ability to function in this capacity is in correlation to increased biological fitness (2015). The nature of Barrett's description underscores the fundamental question facing modern evolutionary psychologists: what processes are responsible for the development of human cognition?

Many competing theories are currently debated throughout the cognitive sciences, including an emerging ideology surrounding inherited representations and complementary cognition; models that incorporate how natural selection builds upon generationally transmitted information that is used to produce adaptive phenotypes through genetic, epigenetic, and cultural inheritance (Heyes, 2012; Shea 2012; Taylor et al., 2021). While some researchers attempt to blend the relationship between the physical, biological, and social environment, others follow a more traditional model based on the work of American philosopher Jerry A. Fodor, who, in 1983, introduced modularity into the psychological lexicon.

Modularity, as described by Fodor, represents cognition as an operation of individual and distinct processes, fixed with nine primary features: (1) domain specificity, (2) mandatory operation, (3) limited central accessibility, (4) fast processing, (5) informational encapsulation, (6) "shallow" outputs, (7) fixed neural architecture, (8) characteristic and specific breakdown patterns, and (9) characteristic ontogenetic pace and sequencing (Robbins, 2017). Barrett best summarizes *Fodorian Modularity* as representing mental mechanisms (or modules) as automatic, unconscious, fast, inflexible, and innate (2022). Fodor supported the modularity of peripheral systems while maintaining the unspecified nature of more centralized processes (i.e., reasoning, judgment, and decision-making) (Barrett & Kurzban, 2006).

The *post-Fodorian modularity* hypothesis has emerged as the modern incarnation of Fodor's theory, with evolutionary psychologists promoting the presence of modular functionality throughout our cognitive processes, including in higher-level functions, such as belief fixation, problem-solving, mindreading, and planning. Massive modularity is rooted in natural selection's design of specialized mental mechanisms, correlating their presence as the propagator of domain specificity leading to hierarchical modularity or the compounding of adaptations within adaptations, each with specific functional specializations (Berrett, 2022; Barrett & Kurzban, 2006). While the fundamental extent of cognition's modularity continues to be debated, research into unique cognitive dysfunctions plays an integral role in defending the hypothesis.

In 1985, British psychologist Simon Baron-Cohen and associates published an article in *Cognition* addressing the theory of mind account in autism, believing that Autists lack a specific theory of mind and predicting it as a crucial component of social impairment (Baron-Cohen et al., 1985). As in the argument for massive modularity, the presence of adaptive domain-specific cognitive mechanisms is vital to Baron-Cohen's hypothesis, providing the foundation necessary to comprehend the atypical manifestation of a theory of mind among Autists. In his 1997 book, *Mindblindness*, Baron-Cohen defends his position by dissecting the high-function modularity of mindreading, underscoring its vital role in social interactions, including social understanding, behavioral prediction, and verbal and nonverbal communication (Baron-Cohen et al., 1997).

Described as a "universal human capacity," Baron-Cohen defines the four primary cognitive mechanisms that promote the neurotypical manifestation of mindreading. First is *intentionality detection*, a perceptual device designed to interpret motion in terms of primitive volitional states of goals and desires. Second is *eye-direction detection*, described as possessing three primary functions: (1) to detect the presence of eyes or eye-like objects, (2) to calculate

whether eyes are directed towards the self or something else, and (3) to infer through correlation that when an agent's eyes are directed towards an object, that they can indeed see that object. The third is the *shared-attention mechanism*, the triadic representation between an agent, the self, and a third object. The *theory of mind mechanism* is designed to infer the full range of mental states that hail from behavior, prioritizing epistemic mental states (Baron-Cohen et al., 1997).

According to the *American Psychological Association*, Autism Spectrum Disorder is characterized by differing yet marked levels of dysfunction in communication and social interaction (2022a). Baron-Cohen relates these deficits to a specific dysfunction in the *shared attention* and *theory of mind mechanisms* associated with higher-level mindreading (Baron-Cohen et al., 1997). Considering the more complex *theory of mind mechanism*, Baron-Cohen compiled a series of standardized benchmarks to which an Autist could be compared, each fundamental to the mechanism's overall functionality. A series of experimental studies demonstrated what seems to be a widespread dysfunction in the theory of mind mechanism among Autists, highlighting the importance of low-level modularity among higher-level functions (Baron-Cohen et al., 1997).

By successfully dissecting the lower-level mechanisms associated with the higher-level functionality of mindreading, Baron-Cohen defends his hypothesis while underscoring the significance of massive modularity in the process. The four mechanisms described are prime examples of hierarchical modularity promoting functional specialization and domain specificity. While complex, the underlying methodology of modularity remains the prime candidate for explaining natural selection's role in human cognitive evolution and will remain central to future studies.

## References

- American Psychological Association. (2022a). Autism spectrum disorder. In *APA Dictionary of Psychology*. Retrieved November 23, 2022, from <https://dictionary.apa.org/autism-spectrum-disorder>
- American Psychological Association. (2022b). Cognition. In *APA Dictionary of Psychology*. Retrieved December 1, 2022, from <https://dictionary.apa.org/cognition>
- Baron-Cohen, S., Cosmides, L., & Tooby, J. (1997). *Mindblindness: An Essay on Autism and Theory of Mind*. Amsterdam University Press.
- Baron-Cohen, S., Leslie, A. M., & Frith, U. (1985). Does the autistic child have a “theory of mind”? *Cognition*, *21*(1), 37–46. [https://doi.org/10.1016/0010-0277\(85\)90022-8](https://doi.org/10.1016/0010-0277(85)90022-8)
- Barrett, H. C. (2022). Anthropology 124Q: Evolutionary Psychology Lecture 1a [PowerPoint presentation]. BruinLearn. [https://bruinlearn.ucla.edu/courses/139506/files/10686832?module\\_item\\_id=5421217](https://bruinlearn.ucla.edu/courses/139506/files/10686832?module_item_id=5421217)
- Barrett, H. C. (2015). The Shape of Thought [eBook]. In *How Mental Adaptations Evolve*. Oxford University Press.
- Berrett, H. C., & Kurzban, R. (2005). Modularity in Cognition: Framing the Debate. *Psychological Review*, *113*(3), 628–647. <https://doi.org/10.1037/0033-295X.113.3.628>
- Carruthers, P. (2006). The Architecture of the Mind. In *Massive Modularity and the Flexibility of Thought*. Oxford University Press.
- Cosmides, L., & Tooby, J. (1992). Cognitive Adaptations for Social Exchange. In J. H. Barkow, L. Cosmides, & J. Tooby (Eds.), *The Adapted Mind: Evolutionary Psychology and the Generation of Culture* (pp. 163–228). Oxford University Press.

- Downes, S. M. (2021). Evolutionary Psychology. In *Stanford Encyclopedia of Philosophy*. Retrieved December 1, 2022, from <https://plato.stanford.edu/entries/evolutionary-psychology/>
- Fodor, J. A. (1982). The Modularity of Mind. In *An essay on faculty psychology*. The Massachusetts Institute of Technology.
- Laland, K., & Seed, A. (2021). Understanding human cognitive uniqueness. *Annual Review of Psychology*, 72, 689–716. <https://doi.org/10.1146/annurev-psych-062220-051256>
- Lewontin, R. C. (1970). The Units of Selection. *Annual Review of Ecology and Systematics*, 1(1), 1–18. <https://doi.org/10.1146/annurev.es.01.110170.000245>
- Robbins, P. (2017). Modularity of Mind. In *Stanford Encyclopedia of Philosophy*. Retrieved December 1, 2022, from <https://plato.stanford.edu/entries/modularity-mind/>
- Taylor, H., Fernandes, B., & Wraight, S. (2021). The evolution of complementary cognition: Humans cooperatively adapt and evolve through a system of collective cognitive search. *Cambridge Archaeological Journal*, 32(1), 61–77. <https://doi.org/10.1017/S0959774321000329>