THE SOCIAL BRAIN IN HUMAN AND RELIGIOUS EVOLUTION: ELUCIDATING THE ROLE OF THEORY OF MIND IN (NON)RELIGIOUS BELIEF

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Contemporary theorists of religion have argued that religious beliefs are “natural” because they arise from normally functioning social cognitive capacities, especially Theory of Mind (ToM). Hence, attempts to explain atheism have relied heavily on the assumption that nonbelievers may have a malfunctioning ToM and other traits associated with the autism spectrum continuum (ASC). However, few studies currently address this topic and the evidence either way remains ambiguous. The current research narrows this empirical gap, addressing these claims with a two-fold approach. First, a near comprehensive review of ToM is provided. Second, this study is exploratory, employing a unique methodology and previously untapped empirical measures to test for differences in ToM components and ASC traits between atheists ($N = 2423$) and theists ($N = 103$).

**Keywords:** theory of mind; cognitive science of religion; evolutionary psychology; atheism; religion
DEDICATION

This thesis is dedicated to three key individuals in my life. The order of their mention reflects only my initial acquaintance with their dear company—many things in life are priceless. To Mark Milam Schmissrauter Jr., I am forever in debt to your companionship and our many youthful adventures. In the ten years since your passing I’ve missed you a lot. To my daughter, Heather Destiny Marie Coleman, the budding zoologist, I look forward to reading your master’s thesis (and doctoral dissertation) in only a few too-short years from now—but I’ll always help you follow any dream you have. To my fiancé, Carmencita Eugenia Guevara Guardado, tú eres mi ángel!
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LIST OF ABBREVIATIONS

ASC, Autism Spectrum Continuum
BAP, Broader Autism Phenotype
BAPQ, Broader Autism Phenotype Questionnaire
CRT, Cognitive Reflection Test
CSR, Cognitive Science of Religion
EDD, Eye Detection Device
EToM, Existential Theory of Mind
HFA, High Functioning Autism/Asperger’s
ID, Intentionality Detector
LFA, Low Functioning Autism
MYA, Million Years Ago
NT, Neuro-Typical
RIS, Rosset Intentionality Scale
RMTE, Reading the Mind in the Eyes Test
SAM, Shared Attention Mechanism
SP, Selection Processor
ToBy, Theory of Body
ToM, theory of Mind
ToMM, Theory of Mind Mechanism
LIST OF SYMBOLS

ANOVA, Analysis of Variance

N, Number

M, Mean

SD, Standard Deviation

CI, Confidence Interval

p, Significance statistic

d, Effect size

F, F-statistic

t, T-statistic

\(\eta^2\), partial eta squared

\(\chi^2\), Chi-Square test statistic
As soon as the important faculties of the imagination, wonder, and curiosity, together with some power of reasoning, had become partially developed, man would naturally crave to understand what was passing around him, and would have vaguely speculated on his own existence….Nevertheless I cannot but suspect that there is a still earlier and ruder stage, when anything which manifests power or movement is thought to be endowed with some form of life, and with mental faculties analogous to our own. – Charles Darwin “The Descent of Man” (1871, p. 64)

When it comes to the topic of vague speculation over the existence of humans, Darwin was clearly on to something. However, cognitive scientists might not postulate a specific “faculty” as Darwin did for “imagination, wonder, curiosity, and reasoning.” Nonetheless, collectively these entities fall under a broad category cognitive scientists do utilize, the social brain. And in the spirit of Darwin’s passage, the social brain is rooted in this earlier, “ruder,” stage, when the brain began—much as it continues today—to attribute human agency and intentionality onto the ever changing environment. Animism is one of the oldest traits found in hunter-gatherer societies (Peoples, Duda, & Marlowe, 2016). This attribution of agency and intentionality has been highly adaptive, transporting homo sapiens into the cognitive niche we occupy at present (Cosmides & Tooby, 2000; Pinker, 2010). Along with the capabilities endowed to us by our social brains, however, comes several by-products, three of which are highlighted: Autism, psychoses, and religion.

The topic of this thesis—differences in religiosity and the social brain—is informed by the greater discipline of the cognitive sciences and cognitive science of religion in particular. The terms religion, religious, religious belief, belief in gods, and other supernatural agents, are used
interchangeably throughout and shall refer to the explicit acknowledgment of and commitment to the proposition that there is some form of external, conscious, mental, agency, that is concerned with human affairs. Chapter-by-chapter, this thesis is an additive process, it should be read as a series of graduated steps, descent with modification—if you will—until the mental systems of interest have been sufficiently characterized to cast the broadest possible light on the role of theory of mind (ToM) in supernatural (non)belief.

The initial sections characterize an evolutionary account of two key aspects of social cognition—causal cognition and joint intentionality (see Chapter II)—which is helpful for elucidating the structure and functioning of two important (but largely overlapping) theoretical accounts of ToM—the “theory of mind mechanism” and the “mindreading system” (see Chapter III). When theory of mind is discussed in relation to cognitive science of religion, it shall refer to the cognitive processes described by these two theories. Chapter IV reviews how theory of mind and related constructs, such as traits characterized by the autism spectrum continuum have been measured, before moving on to discuss variability and stability in theory of mind development and functioning across cultures, within different contexts, and among clinical populations (see Chapter V). Chapter VI reviews how folk psychology and its variability—which concerns the higher level functioning of theory of mind—may relate to belief in supernatural agents. Chapter VII, formally introduces the cognitive sciences of religion and the centrality of theory of mind for explaining belief in these agents, discussing research relevant to the experimental aspects of one key question: Do atheists and theists differ on basic socio-cognitive tendencies in explanation for their belief or nonbelief in supernatural agents? Chapter VIII discusses the diversity of nonbelief research and the remaining chapters present an empirical study testing for ToM differences in atheists and believers.
Imagine you are playing billiards, a game of Eight-Ball with your friends. As you aim and then release your billiard cue, taking the final shot, the pool cue strikes the cue-ball, which strikes the eight-ball, launching it smoothly into the corner pocket. As you boast about this victory to your opponent, you both appreciate the fact that one of you has won the game, while the other has lost. The ability to sink the eight-ball in the corner pocket and the very fact that you even have a friend to engage in both cooperative (you are playing by the rules after all) and competitive (but you’re still out to win) behavior with are rooted in our everyday social cognition. Specifically, this consist of causal cognition and joint intentionality.

Origins of Causal Cognition

One key ingredient to ToM is discerning causality. Causality pertains to conditional reasoning, such that the agent can link one or more representations with another representation in the form of if X, then Y. Understanding causal relations between entities—the ability to link a given action, event, or thought, with another—is highly adaptive (Gopnik, 1993; Stuart-Fox, 2015a). While ToM has been variously conceived of as a module (Baron-Cohen, 1995), mechanism (Leslie, 1994b), or even a network (Schaafsma, Pfaff, Spunt, & Adolphs, 2015), all accounts include causal reasoning within this domain. Particularly as this relates to other conspecifics, understanding causal relationships allows for the exchange of complex social information (Sperber, 1994, 2000). For example, that, if Grog hits Thak, then Thak may hit Grog, keep him away from the day’s meat ration, or perhaps even begin to build alliances against
him within their group. Obviously the combinations of information that can be linked in this way are potentially innumerable and although this is suggested to have been key for social cohesion and the development of culture in anatomically modern *Homo sapiens*, this ability has developmentally earlier roots (Dunbar, 2004; Kurzban & Barrett, 2012; Mithen, 1996).

Sometime between 6-8 million years ago lived the last common ancestor (LCA) shared by modern day humans and chimpanzees (Steiper & Young, 2006). This LCA has yet to be taxonomized and we know only little about early hominids such as *Saehlanthropus*, *Orrorin*, and *Ardipithecus* (approximately 7-4 million years ago [MYA]). The past ten million years of hominin evolution saw the development of the very things humans today take for granted today: “bipedalism, large brains, extended life histories, complex social cognition, and the amplification of technology” (Gamble, 2013, p. 33). One key aspect of this complex social cognition, also known as theory of mind, was the capacity for casual reasoning (Baron-Cohen, 1999; Leslie, 1994b). While there is no crystal clear window to peer through in revisiting our evolutionary deep history, proceeding cautiously, an informed picture can arise illuminating the origins of causal reasoning. And while many animals have mechanisms designed to take advantage of the statistical regularities of causality, the human ability to do this clearly stands out (Penn & Povinelli, 2007).

The early hominids were bipedal and lived in woodland environments, however canopy coverage was widely distributed and forays into more open grassland environments were likely prevalent (Coolidge & Wynn, 2009; White, Lovejoy, Asfaw, Carlson, & Suwa, 2015). Beginning slightly before *Homo* split from *Pan* and continuing into recent history, the climate patterns of East Africa have demonstrated considerable variation (Maslin, Shultz, & Trauth, 2015). Climate variability has played a large role in applying adaptive pressure to hominid evolution in response
to shifting environmental demands (Maslin et al., 2015; Reed, 1997). Adept at locating fruits and other food in the forest canopy, one of early hominids (and today’s *homo sapiens*) best cognitive faculties was the visual system (Kaas, 2006, 2013; Stuart-Fox, 2015a). As the climate varied, food demands waned and waxed, leading to a selective advantage for spatial memory systems capable of mapping terrain, sources of food, and eventually stored food caches (Byrne, 1999; Coolidge & Wynn, 2009).

Although this increase in territorial range clearly had advantages, it also opened up early hominids to new predators (Gamble, 2013; Liebenberg, 1990). Thus, increased threat of predation came from multiple sources, and mechanisms designed to extract every possible source of information from one’s environment about the possibility of a threat would be highly adaptive. Many species in the animal kingdom receive information from their environment and other agents in the form of natural signs (Owren, Rendall, & Ryan, 2010; Stuart-Fox, 2015a). The scent of blood, for example, relays information about a possible source of food for sharks. And, male birds-of-paradise engage in elaborate displays of colorful plumage in attempt to signal its readiness to mate to another female. These two natural signs (*PREY*, *MATE*; among many others), depend on being automatically interpreted as they are produced. Without hesitation, for example, once an odorant has entered the shark’s left or right nostril, the olfactory system immediately registers *PREY*. Almost instantaneously, this signal is relayed to the motor system, and like a missile homing in on its target, the shark’s body is propelled in the direction of the scent (Gardiner & Atema, 2010). Thus, in order to track prey an animal must make and maintain contact with a particular stimulus array—it must be perceptually coupled to its target. In contrast, there is another class of natural signs that are mediated via the environment. These signs can
persist long after the sign maker has left, hence do not require direct agent-to-target coupling for their interpretation (Stuart-Fox, 2015a).

Natural signs, such as a claw mark on a tree or finding a mostly de-fleshed animal carcass would have relayed an important source of visual information, being highly adaptive to detect for early hominids coming under increasing threat of predation (Glenberg, 1997; Liebenberg, 1990). Due to increasing memory capacity driven by foraging associated with environmental pressures (Coolidge & Wynn, 2009), what Stuart-Fox terms (2015a) “incipient working memory,” these hominids likely had the capacity to hold two mental representations in mind—just enough for a cause and effect relationship to take root.

“The defining characteristic of visible indirect natural signs is that they have been produced through prior behavior of some animal that is no longer visible” (Stuart-Fox, 2015a, p. 253). A plausible scenario is as follows: hominids tracking, (or being chased by large prey) detect an animal scurry into a small cave. At the base of this cave entrance are tracks left by the animal. The hominid registers these tracks, that animal. Whether it is disturbed foliage, blood on a leaf, or a smilodon’s urine on a rock, the basic conceptual categories of PREDATOR and PREY (Allen, 1999; Gallistel, 1989) are innately linked in species. However, unlike most other species, as Stuart-Fox suggests, hominid’s innate propensity for curiosity, mixed with a constantly shifting environment with multiple threats, tuned the beginnings of causal cognition to a hair-trigger, yet also selected for great flexibility in their application. However, it was the extraction of this visual information detached from its source and consolidated into a single conceptual category, in which learning to make connections between “categories of signs to the categories that made them” would have been an extremely beneficial adaptation (Stuart-Fox, 2015a, p. 252).
The ability to connect representations in the mind, and work backwards—through several signs—to establish causation is a uniquely human ability. Causal cognition is the foundation upon which many higher order, distinctively human, behaviors rest. However, while it appears necessary for consciousness it is by no means sufficient. The use of information provided by these visible indirect natural signs is what drove hominin evolution further apart from its forest ape cousins (Stuart-Fox, 2015a, 2015b). Of course, it is due to many factors coalescing and accruing over time, not just one ability per se, that ultimately come together to support human uniqueness in certain domains.

**Oldowan and Acheulean Industries: Implications for Joint Intentionality**

While causal reasoning may have been some of the first cognitive processes to utilize a representation that was detached from the thing it represented, the capability to use and combine representations in a flexible manner was further driven by the production of tools (Suddendorf, 1999). The archaeological records reveal rich insight into the cognitive capabilities of our ancestors beginning around 2.5MYA. The habitats of these hominins consisted of an eclectic mix of biodiversity and evidence of tool use and butchery accompanies this diversity. Roughly 2 MYA at the Olduvai Gorge in what is now Tanzania, for example, there is geographical, archaeological, and biomarker evidence for a varied landscape, consisting of a freshwater spring bordered by a rich variety of wetland plants and a wooded forest area surrounded by open grasslands, with numerous deposits of animal bones etched with cut marks (Magill, Ashley, Domínguez-Rodrigo, & Freeman, 2016).

Adept at basic causal reasoning, tracking small prey and scavenging were critical survival activities of hominids during this time. However, once you locate a tuber you have to be able to
dig it up, and if you find a mammoth carcass you won’t be sitting quietly by its side snacking. Other larger animals, are likely also vying for the same meat, and the capability to take meat with you certainly has its advantages (Gamble, 2013; Wynn, 2002). Tool manufacture and use were of critical importance in the Lower Paleolithic and can divulge further secrets about the origins of a ToM system (Coolidge & Wynn, 2009; Mithen, 1996).

While the “first tool” may have come from discovering a broken rock with a sharp edge made for easier digging or butchering of meat, the best tools, and indeed even rudimentary tools are not made by accident. The intentional production of tools by striking one rock against another in order to affect its shape is called knapping. Although there has never been a natural documented case of primates flaking of stone tools, the percussive motions involved in striking with a rock have been documented and it is likely that very early hominids were capable of this (Haslam et al., 2009; Roux & Bril, 2005).

The appearance of Oldowan tools speaks to the increasing reliance on a diet of meat by our ancestors. The earliest tools, known as the Oldowan industry, were made of small pebbles that had been struck by another rock to reveal a sharp edge. These tools were likely made on demand, as needed, used for butchering a carcass, and then discarded. Wynn (2002, p. 395) describes these early tools as “ad hoc technology,” noting that “it is unlikely that they existed as tools in the minds of the knappers.”
To be sure, there are discrepancies within the literature as to the interpretation of the archaeological evidence (Lycett & Chauhan, 2010). For example, Toth and Schick (2009), perhaps speaking of later Oldowan industries, suggest that these tools were carried from location to location, and even certain rock types were selected for. Hence, this indicates the appearance of more complex cognitive capabilities, such as planning and foresight.

Strikingly, stone tools remained relatively unchanged in form from 2.5—1.5MYA. However, beginning around 1.5MYA up until around 500,000 years ago, in what is known as the Acheulean industry, stone tools began to exhibit increasing levels of complexity. For example, rather than appearing as merely sharp rock fragments upon first glance, as much of the Oldowan industry could be mistaken for, Acheulean technology begins to show the hallmarks of design that is clearly intentional (Wynn, 2002). These tools, often known as “bi-faces” in reference to their apparent symmetry, required the tool maker to hold a representation of the final product in their mind while actively constructing this tool.

Figure 1 Example of Oldowan “pebble technology” by José-Manuel Benito Álvarez, 1987, via Wikimedia Commons. Used under Creative Commons Attribution-Share Alike 2.5 Generic license
Thus, and in referring back to incipient working memory (Stuart-Fox, 2015a), at this point in evolution our Homo ancestors had the ability to hold 2 goal representations (or more) in working memory at once (Coolidge & Wynn, 2009). However, and missing from the early evolution of causal cognition, these later hominids were able to utilize this multi representational capacity with directed self-attention. In other words, rather than relationships between natural signs and their responses being automatic, the ability to begin to attentively direct, inhibit, or apply new category relationships was likely developing during this time. Attention and goal directed mental states are key—one cannot hit a rock just anywhere, and with any amount of force, and expect an Acheulean hand axe to be produced. Aside from the attentional resources, and finely tuned motor capabilities evidenced by tool production (Faisal, Stout, Apel, & Bradley, 2010), Acheulean tool production required cooperation. Producing these more complex tools required using a prepared “core” and a special “hammer stone.” The core was prefabricated to fracture along points in the rock, flaking off a sharper edge when struck with the hammerstone.
There are many sites scattered throughout the world with hundreds, perhaps thousands, of both used and unused cores, hammers, and finished hand axes. Tool making was a large industry. This was far from a solitary operation of lone tool makers and our hominid ancestors had not yet developed the vocal and cognitive capabilities to produce the syntax required for the generativity inherent in human language (Dunbar, 2004). Instead of language, this cooperation speaks to the unique human ability of joint attention (J. L. Barrett, 2011; Coolidge & Wynn, 2009; Tomasello, 2014). Joint attention is the ability to form a triadic representation in the mind of an individual, such that, I know that you know that we are both attending to the same subject [either an object or perhaps a mental state (Baron-Cohen, 1995)]. Our ancestors used joint attention to guide the shaping of rocks into highly specialized tools. When we see another conspecific, in most cases, our joint attention is automatically activated. For example, if we happen to notice even a complete stranger starring up at the afternoon sky, our attention shifts to become more in-line with theirs, in attempt to attend to the same perceived object or event, we look up to figure out what they’re looking at. We interpret their behavior in terms of underlying goals and intentions to act (people don’t accidentally stare at the sky). But for our ancestors, one can easily imagine *Homo erectus* or *heidelbergensis* (or a modern day brick mason) using protodeclarative gestures to indicate what rocks were to be used in manufacturing the tools and what were to be discarded (Tomasello & Carpenter, 2007). Furthermore, joint attention is key to the process of knapping itself. It facilitates a “do this” or “copy me” directive (Shipton & Nielsen, 2015) which in the absence of verbal communication is only possible by two or more conspecifics sharing attention at an event or object. But to reiterate, *Homo sapiens* often go beyond mere copying or imitation, when we see another human engaged in some kind of (in)action “we ask why, or to what end” (H. C. Barrett, 2015).
CHAPTER III.

THEORY OF MIND MECHANISMS

Causal cognition and joint intentionality form key aspects of ToM. The two theories of ToM discussed here provide mechanistic characterizations of the relationship between these aspects. Mechanistic characterization of the interplay between thought processes within a complex system allows for specific subcomponents to be identified in a hierarchical fashion (Bechtel & Richardson, 1993). That is to say, you can look at parts of the “mind,” how they are organized, and based on that, they will be organized in some ways and not others. Although these two theories of ToM largely overlap, I discuss them both because they have provided the dominant characterization of ToM as a mechanism or “module” in ToM research in general and this approach has also largely guided the evolutionary cognitive sciences of religion, in specific (J. W. Jones, 2016). Additionally, in this study I connect shared elements of these theories, empirically testing some of their component parts in relation to supernatural belief. Theories of ToM emphasizing its development as conceptual change or re-description, often known as “theory theories” (Gelman & Legare, 2011; Gopnik, 1998; Karmiloff-Smith, 1995), receive only little discussion here, as they describe a change in ToM performance and not the discovery of new conceptual information (Caron, 2009; Goldman, 2012; Leslie, German, & Polizzi, 2005; Scholl & Leslie, 1999).

Leslie’s Theory of Agency

Leslie (1987, 1994b) provides a hierarchal model of how agency is represented and processed by postulating two distinct cognitive modules with sub processing mechanisms (see
also Leslie, Friedman, & German, 2004). Contained within these modules are three specific, interrelated, domains of knowledge about Agency: mechanical, actional, and attitudinal. These domains constitute our universal, evolutionary endowed, cognitive architecture, which forms the basis for learning and can be traced back (in part) to recurring properties of the world (Cosmides & Tooby, 2013; Tooby & Cosmides, 1992, 2000, 2008). Combined, they are considered “core knowledge,” forming the basis by which cultural learning can proceed (Carey, 2011; Sperber & Hirschfeld, 1999, 2004). The notion of “Agency,” is a core concept derived from these two modules, referring exclusively to objects capable of, or involved in, what appears as causation (Leslie, 1994b). The actional and attitudinal domains of Agency constitute the Theory of Mind Mechanism (ToMM) and the mechanical domain constitutes the Theory of Body mechanism (ToBy).¹

<table>
<thead>
<tr>
<th>Real World Properties of Agents</th>
<th>Processing Device</th>
<th>Levels of Understanding or “theories”</th>
</tr>
</thead>
<tbody>
<tr>
<td>mechanical</td>
<td>ToBy</td>
<td>“Agents and Objects”</td>
</tr>
<tr>
<td>actional</td>
<td>ToMM (system₁)</td>
<td>“Agents and Action”</td>
</tr>
<tr>
<td>cognitive</td>
<td>ToMM (system₂)</td>
<td>“Agents and Attitudes”</td>
</tr>
<tr>
<td>X</td>
<td>Selection Processor (SP) “rear end” of the ToMM</td>
<td>Learning mechanism responsible for creating “theories”</td>
</tr>
</tbody>
</table>

¹It is worth pointing out that Leslie’s three domains of Agency closely follow Dennett’s (1987) distinctions between the “design stance,” the “intentional stance,” and the “physical stance.” This indicates what basic categories Leslie’s tripartite theory consist of. This is in part, because both rely on folk psychological assumptions in lieu of positions, for example, such as eliminative materialism, which view folk psychological states (beliefs and desires) as a radically false foundation for a science of the mind (Churchland, 1981, 1993, 2007).
Theory of Body Mechanism

Due to its privileged operating position within cognitive structure, ToBy is the first mechanism within Leslie’s Theory of Agency. For a helpful analogy, imagine individuals (Agents) trying to get into a night club; they will have to pass through the bouncer at the door. In a sense, ToBy can be thought of as the “night club bouncer” of the ToMM—no Agent gets in without going through ToBy. The ToBy is a module targeting purely mechanical, causal relationships, between bounded, spatiotemporal objects in the world. For example, the launching of one billiard ball as a result of colliding with another. ToBy can be activated not only from visual information, but also via haptic and kinesthetic sensation. When a cause and effect relationship of this type is detected through motion by ToBy, it activates the “primitive” concept of FORCE (Leslie, 1994b). Whereas we would properly say there was a transfer of energy between the billiard balls occurring “in the world,” FORCE can be thought of as the “cognitive correlate of energy” (p. 125, italics in original). FORCE, which concerns the movement and spatiotemporal arrangement of objects, interprets these “objects in terms of the sources and fates – the dynamics – of FORCE” (Leslie, 1987, p. 128). It is worth briefly pointing out, but will be described in greater depth later on, that the relationship described between objects, by FORCE, understood broadly as agent detection, constitutes an important source of explanans for supernatural belief within CSR (J. L. Barrett, 2004, 2012; Bering, 2006, 2011; Boyer, 2001, 2003; Guthrie, 1995; Guthrie et al., 1980; McCauley, 2011; Norenzayan, 2013; Xygalatas, 2014).
Theory of Mind Mechanism

The mechanical properties of Agents set them apart from non-Agents. The ToMM identifies certain classes of objects as Agents, as being motivated by goal state. For example, infant studies demonstrate that human hand reach indicates special mechanical, agentive, attributes when compared to movement using a square block or even a mechanical claw with digits (Cannon & Woodward, 2012; Leslie, 1984; Woodward, 1998). Thus the movement of objects can trigger ToBy (this is why the infants responded at all to the hand, block, and claw instead of staring blankly). However, with the arrival of the ToMM, infants begin to treat some objects as being guided by goals. Once ToBy identifies an object as an Agent, the ToMM is needed to describe the relationship between the goal states of the Agent and the given action. There are two sub-systems to the ToMM and system\textsubscript{1} introduces the concept of “ACTING,” (Leslie, 1994b, p. 139), described as “ACTING to obtain X,” or to work so as to bring about a specific state of affairs and not some other. Importantly, Leslie (1994b) notes that the structure of an ACTING or a desire is not represented propositionally, they can be neither true nor false, they simply are (see also Hutto, 2008; Malle, 2004). In this sense, ACTING is similar to a behavioristic explanation, only discussed in terms of dispositions and drives. Developmentally, with the activation of this rule, desire psychology is enabled (Bach, 2014), and infants understand that Agents act with intentionality (for a review, see Caron, 2009).

System\textsubscript{2} of the ToMM develops slightly later and with its arrival comes the ability to represent thoughts propositionally, as either true or false (Leslie, 1994b). At this stage, full blown “belief-psychology” is possible. The ToMM introduces both the concept of pretending and the concept of believing.\textsuperscript{2} Individuals now understand that other Agents not only act based

\textsuperscript{2} Other accounts of ToM postulate that beliefs and pretends are represented quite differently from one another (e.g. Perner, 1991).
on desires, but that beliefs are a motivating force in the generation of behavior and that Agents can both deceive and be deceived. As will be discussed next, the representations processed by a fully functioning ToMM have special characteristics that set them apart from other representations.

Selection Processor

Most humans assume others are guided by true beliefs. The concepts of belief and desire (mental state concepts) represent the relationship between an agent’s attitude toward an object or situation. These relationships are called “informational relations” in virtue of the content they can be said to represent (i.e., what is the belief/thought about?) and permit learning the deeper aspects of social cognition, such as the fact that others may be guided in their behavior by false beliefs, are subject to intentional deception, and also have the capacity to intentionally deceive. However, these deeper aspects of social cognition also require more than the implicit or explicit understanding of the mental states concepts provided by the ToMM. They draw on resources such as memory and executive functioning in order to select the relevant belief contents (Leslie, 1994a, 2000; Leslie et al., 2005). Leslie suggests a domain-general mechanism, the selection processor (SP), a mechanism of “selective attention” (Leslie, 2000), is the final system to develop in the ToMM, creating the ToMM-SP.

The typical false-belief task requires the participant be able to override their default assumptions about beliefs—that they are always true—and chose that the other individual actually has a belief that is false. This means that typical false-belief tasks make extra demands on EF that can mask performance, as the child has to select the proper belief by a process of inhibiting the “true belief” (Bloom & German, 2000; Leslie, 2000). Additionally, when the
demands of the false-belief task are loosened to ask “where will Sally look for her toy first,” instead of “where will Sally believe her toy is at,” children are able to pass the test at a much younger age. Looking helps calculate belief (Leslie, 2000).

The SP enables the child to move beyond the tacit understanding of belief provided by the ToMM, and towards learning about a wide array of more specific mental states (e.g., sadness), their implications for behavior (e.g., sad people might isolate), and how one might respond in kind (e.g., comfort sad people). Thus, the SP “colors in” and contextualizes the basic informational relation provided by the concept of belief and desire. This will be an important point to keep in mind as the discussion of ToM moves from mechanisms to deployment as an adult embedded in a world of supernatural agent concepts and beliefs.

Meta-representations

According to Leslie (1987, 1994a, 1994b), the ToMM operates using specialized representations. Primary representations are transparent, they stand in direct semantic relationship to a perceptual state of affairs in the world and can be either true or false (e.g., This is a banana. That is a telephone.). In contrast, Meta-representations (M-representations) are derived from primary representations, however decoupled from their referent, they are opaque and lack conditions for veridicality (Bloch, 2008; Leslie, 1994a). M-representations allow for pretense, which is an early version of a full blown ToM (Leslie, 1987; Premack & Woodruff, 1978). By blending two or more primary representations, one can pretend to have, for example, “a banana that is also a telephone.” Thus, M-representations are representations of representations (Leslie, 1987; Sperber, 1994, 2000). That these representations are decoupled, or bracketed off from strict logical truth relations, is critically important in the case of M-
representations. This prevents the application of a primary representation in absurd ways, what Leslie (1987, p. 417) terms “representational abuse,” such as when one pretends an empty cup contains water. By necessity an empty cup cannot contain something, unless the representational context of pretense is specified. Thus, all M-representations are tagged within the context of pretense, acting “As-if.” This process of adding a “tag” to the representation allows for a single representational code to function logically in switching back and forth between primary thought and pretense. Because our folk psychology is always fallible (i.e., representing mental states opens up the possibility of mis-representation, as in the case of a false-belief), mental state representations are prima facie M-representations (J. L. Barrett, 2011; Leslie, 1987; Sperber, 2000; Suddendorf, 1999).

Leslie’s (1994b) theory of Agency, containing ToBy, ToMM-SP, and M-representations, is one of the earliest full models attempting to account for how mind and behavior reading is computed. It is important to note that Leslie’s account, indeed almost all accounts of theory of mind, focus almost exclusively on accounting for this capacity in infants and children as it develops, and have comparatively little to say about ToM in adults or even teens (Apperly, 2012, 2013). This is important to keep in mind, because as an individual grows up, becomes enculturated, experiencing and entering in to a wide array of increasingly complex social relationships with multiples levels of intentionality (Dunbar, 2004), discussing ToM, too, becomes incredibly complex (Whiten, 2013). Nonetheless, Leslie’s theory of Agency serves as the starting point for discussing the theories of mental architecture responsible for the structure of mind reading.
Baron-Cohen’s Mindreading System

Baron-Cohen’s (1995, 1999) account of mindreading closely parallels Leslie’s (1994a, 1994b) version. For example, both conclude that recurring properties of the world should be reflected (in part) in an evolved cognitive modular architecture. Thus many of the component sub-mechanisms of each theory of mind overlap (e.g., detecting intentionality). Both rely heavily on developmental studies and suggest that the primary factor responsible for the autism spectrum continuum is an impairment in the ToM system (Baron-Cohen, 1987, 1995, 2009; Baron-Cohen, Leslie, & Frith, 1985; Leslie, 1987, 1994a). However, it is worth discussing some of the key differences, as well as briefly drawing direct comparisons between some of the constructs of each.

Baron-Cohen’s (1995, p. 32) “mindreading system” describes four hierarchally arranged sub-mechanisms: Intentionality Detector (ID); Eye Detection Device (EDD); Shared Attention Mechanism (SAM); Theory of Mind Mechanism (ToMM).

Figure 3 The Theory of Mind Mechanism
The ID is a perceptual, supramodal mechanism, which tags anything that is registered as “non-random sound” self-propelled and directional stimuli as “AGENT” – attributing goals and desires (Baron-Cohen, 1995, p. 34). Importantly, this device will accept anything that is agent-like, thus its actual domain is much larger than its proper domain (c.f., Sperber, 1994; Sperber & Hirschfeld, 2004). Similar to Leslie’s (1994b) overall theory of agency, the input parameters for detecting intentionality are “set fairly loosely” (Baron-Cohen, 1995, p. 35). As will demonstrated later, this point is of critical concern in discussing CSR and belief/nonbelief, considering Baron-Cohen notes that false positives, such as mistaking a cloud for an agent (e.g., (e.g., Guthrie, 1995), should be overridden given proper experience and background knowledge (Ibid).

On Baron-Cohen’s (1995) account, the function of the ID, detecting intentionality, is conceptually similar to a blend of Leslie’s (1994b) ToBy and ToMM₁. The first comparison lies in how both ToBy and the ID are attempts at generating a structural description of things in the external world by “picking out objects.” Detecting movement is critical to both, however ToBy’s evolved function is concerned prima facie with separating agents from non-agents and describing the mechanical relationships of physical objects, it does not interpret these relationships as intentional (i.e., goal driven). However, according to Baron-Cohen (1995, p. 35), the ID has been structured exclusively for the “social or animate world,” and hence does interpret representations in intentional terms, even of non-agents. Subsequently this is also why the ID shares functions with Leslie’s ToMM₁—by having access to goal-desire concepts. In summary, the differences that are suggested to exist between the ID, ToBy, and ToMM₁ appear superficial at most and, if there are differences, these may not be the kind of differences that make a difference (c.f.,
Kodish, 2012). For example, in what has been relegated to an endnote in Mindblindness, Baron-Cohen (1995, p. 146) states “…one possibility is that ID may be a submodule of ToBy.”

**Eye Detection Device**

“Don’t fire until you see the whites of their eyes,” goes the famous battle cry issued by a General during the Battle of Bunker Hill, in order to ensure each shot fired met its target. Interestingly, humans are the only primates to have a white sclera surrounding their pupil (Baron-Cohen, 1995; Emery, 2000). “The whites of their eyes” are not so much for targeting bullets to your neighbor’s head, as they are for targeting mental state information about your neighbor’s head. Detecting and responding to eyes, or simply spots that look like eyes, is found across animal taxa, has an extremely deep evolutionary homology, stretching back “tens of millions of years” (Janzen, Hallwachs, & Burns, 2010, p. 11659).³

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³ For a technical discussion of whether or not animal eyespots really mimic eyes, see Stevens (Stevens & Ruxton, 2014) and (Stevens, Hardman, & Stubbins, 2008). Regardless of whether this counts as actual mimicry of eye spots, or things that look like eye spots, they carry valuable information that animals detect and respond to.
Both Baron-Cohen (1995, 1999) and McCauley (2011) suggest a special device (although not special to humans) for the detection of eyes. There is growing support for the convergent evolution of this ToM component in corvids and apes (Bugnyar, Reber, & Buckner, 2016; Emery & Clayton, 2004). The EDD’s only input is from the visual system. It has three tasks: targeting eyes or eye like stimuli, registering eye gaze, and, based on the first person perspective, computing whether or not the other agent has the mental state of a SEEING.

In contrast to the ID, which computes representations in terms of goals and desires (agent wants X), the EDD’s representational options are limited to a game of peekaboo: “see’s me” and agent “doesn’t see me.” Both of these mechanisms function to produce dyadic representations. However, the ID and EDD on their own cannot produce the rich “shared” representations that characterize more advanced ToM.
**Shared Attention Mechanism**

Using the mental state representations produced by ID and EDD, the shared attention mechanism (SAM) produces triadic representations (Baron-Cohen, 1995). Thus the SAM accepts information from any modality. However, SAM has a privileged relationship with EDD, due to the centrality of vision for navigating our world, it is simply easier to draw information about mental states through visual access than, say, haptic sensation (Ibid). SAM builds representations such that, one can register: I see Ralph looking (perceptual mental state) at the snake. Thus the agent can attend to the fact that another agent is attending to another fact: I know that you know. The SAM takes EDD’s seeings and typically interprets them in terms of a goal or desire. For example, I may see Ralph looking at the snake, but I will also be looking for the nature of his dyadic representation with the snake: Is Ralph scared to see this snake or excited? Clearly SAM reveals rich information, however more is needed before the mind reading system is able to handle propositional thought.

**Theory of Mind Mechanism**

In Baron-Cohen’s (1995, p. 51) mind reading system, the ID, EDD, and SAM, come together to form the ability to infer “the full range of mental states” in the ToMM. At this final stage, the development of the ToMM is marked by the ability to engage in pretense, as it enables propositional thought, by using referentially opaque M-representations. The ToMM is borrowed from Leslie’s (1994b) use of the term, as Baron-Cohen (1995, p. 51) goes along with “much about what Leslie says about the working of the ToMM.” These two accounts, therefore, appear rather similar and this convergence can be viewed as a strength—these theories are functionally equivalent.
Leslie and Baron-Cohen Compared

Leslie (1994a, 1994b) and Baron-Cohen (1995, 1999) share the idea that ToM is an: evolutionarily ancient, thoroughly computational, domain specific, impaired in the case of autism, largely or wholly unaffected by language, early developmental unfolding of an innate capacity and that a specialized representational vehicle, known as the M-representation, provides the required structure to support the kind of content bearing propositional thought that allows one’s ToM to learn culturally, acquiring explicit folk psychological theories. That both Leslie’s (1994a, 1994b) and Baron-Cohen’s (1995, 1999)’s accounts of ToM should be so similar is to be expected; both researchers are drawing on the same array of developmental studies in outlining their models and variables such as intentionality, action, desires, and beliefs, which are stock-in-trade for describing any account of mindreading (Apperly, 2011, 2012; Brüne & Brüne-Cohrs, 2006; Schaafsma et al., 2015). To use a cooking analogy, the differences between Leslie and Baron-Cohen’s versions of ToM appear not as different “cake recipes,” but as “different ways of cutting the same cake.”

Variation in “Modules” and the Function of “Executive Functioning”

When discussing possible cultural variation in ToM (see Chapter V), the notion of modularity is important to consider. CSR explicitly (Boyer, 2001, 2003; McCauley, 2011; Sperber & Hirschfeld, 1999, 2004) and implicitly (J. L. Barrett, 2012; Beit-Hallahmi, 2015; Boyer & Bergstrom, 2008; Bulbulia, 2005) refers to cognitive modules in explaining supernatural beliefs, but seldom discuss their actual characteristics or parameters.

Leslie (1994b) emphasizes innateness and modularity to a greater extent than Baron-Cohen does (1995, pp. 56-58; but, see also Baron-Cohen, 1998). Baron-Cohen eschews the label
of “modularity,” as he largely rejects Fodor’s (1983) restrictive and ridged structural characterization of modules, whereas Leslie is more willing to embrace them. Although there are many misconceptions about modularity, one key misunderstanding is that modules all exhibit a strong form of informational encapsulation; the idea that some perceptual and cognitive information is impervious to cultural alteration. Fodor draws upon the apparent culturally invariant effects of the Müller Lyer illusion on the human visual system to prove the point. He argues that, despite having the information (knowledge) that the segment between the two arrow lengths is identical, the perception of dissimilar lengths remains.

![Müller Lyer illusion](image)

**Figure 5 Müller Lyer illusion**

However, McCauley and Henrich (2006) reviewed the cross-cultural studies utilizing this illusion, finding that susceptibility to it varies depending on cultural input during key developmental windows. Thus, while a cognitive system may be modular, it can also display some level of flexibility and plasticity (H. C. Barrett, 2012; H. C. Barrett & Kurzban, 2006; Cosmides & Tooby, 1994).

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4 For extensive discussions on the various ways to characterize modularity, see (Baron-Cohen, 1999; H. C. Barrett, 2012, 2015; H. C. Barrett & Kurzban, 2006; Buller & Hardcastle, 2000; Sperber, 1994; Sperber & Hirschfeld, 2004).
Domain specific, adaptationist, modular accounts have been critiqued for relying solely on the evolutionary environment of adaptation to characterize the functioning of a particular mental system, for their alleged innateness, inflexibility, and inability to learn (Chiappe & MacDonald, 2005; J. W. Jones, 2016). There is much to agree with here, however these critiques may be more a caricature than a character of evolutionary psychology. Modular, adaptationist accounts, have been revised (re-conceptualized) well beyond the narrow sightedness enveloped in the early schematics of modularity critiqued above. For example, modules can function as (both) fast (Type 1) or slow (Type 2) processes (H. C. Barrett, 2012; Morgan, 2016), levels of informational encapsulation will also vary, and thus integration with other systems and modules, or “learning,” will exhibit heterogeneity. Still, the central feature of modularity is functional specification (Cosmides & Tooby, 2013; Kurzban & Athena Aktipis, 2007).

Cognitive systems without functional specification are non-practical in the same way a carpenter’s tool box would be useless if it only contained a single “general tool,” or array of vaguely specified generic tools (Cosmides & Tooby, 2002). Natural selection drives adaptive specialization towards increasing functionality in the face of utter disarray (Cosmides & Tooby, 1994; Tooby, Cosmides, & Barrett, 2003). The characteristics of these adaptations can be quite diverse and may function in evolutionary novel situations and environments, but they still serve to filter out some information within the possible space of all decisions that could in fact be made.

Executive functioning (or the supervisory attentional system) is often described in the literature as a general ability comprising of working memory and the selection/inhibition of response in achieving some goal (Morasch, Raj, & Bell, 2013). There is also a robust discussion as to whether executive functioning is unitary in nature or consists of some procedural
specialization (Ardila, 2008; Miyake, Friedman, Rettinger, Shah, & Hegarty, 2001; Morasch et al., 2013). Yet even these proposals leave undefined any ultimate function, what are/were executive capabilities for?

Evolutionary psychologists agree that the brain handles information in ways described by the wealth of excellent research on executive functioning capabilities, such as shifting, updating, or inhibition. However, they do disagree that these mechanisms exist without any functional specification, without any domain. Laboratory paradigms used to measure executive function typically focus on abstract tasks (e.g., Tower of Hanoi), which are content free, however, when “social situations and biological drives are involved, the ability to rationally solve problems seems to decrease in a significant way” (Ardila, 2008, p. 97). For example, when the Wason selection task, originally involving an arbitrary reasoning process that individual’s ultimately proved altogether horrible at, is reframed so that the participant has to reason about whether or not a social rule is being violated, task performance increases substantially (Cosmides, 1989; Sugiyama, Tooby, & Cosmides, 2002). When the task moves from a general one to become more specific, the functionality of the system can display more, not less intelligence.

This is because natural selection has designed the brain not as an abstract, general, problem solver, but as a series of specialized computational devices (H. C. Barrett, 2015), that handle content in specific ways. The absence of discussion between executive function psychologists and evolutionary psychologists has, combined with the general suspicion of evolutionary psychology and self-disciplinary narrow sightedness present in almost every field, produced two strangers with overlapping interests that just need a proper introduction to hit it off right. Part of the misalignment pertains to the functional properties of the mind and where they are stored or what system they reside in. For example, executive function researchers commonly
cite tasks in which automatic activation of responses would be unwise (Chiappe & MacDonald, 2005). However, this does not color all of the executive function literature, not all domains generate automatic responses, or are incapable of delivering more controlled or refined abilities (H. C. Barrett, 2015). Indeed, evolutionary psychologists do acknowledge a small helping of less specified mechanisms (H. C. Barrett, 2015; Cosmides & Tooby, 1992; Krill, Platek, Goetz, & Shackelford, 2007).

Given the paucity of general, generic, environmental problems to overcome (Cosmides & Tooby, 1994, 2002), combined with the recurring force of more or less specific problems, perhaps domain general skills, evolved within the array of modules within the social brain. Similar proposals have been put forth in ridding psychology of folk notions of “the self” (Kurzban & Athena Aktipis, 2007), which rather than existing as a unitary sui generis, mystical, essence, is the clap trap propaganda of an array of specialized cognitive devices exchanging information within specific environmental contexts. Given the strong systematic feedback of selective pressures for adaptations in the social domain, the appearance of generality could have developed from this. Thus, domain generality may be a collection of slower processing features of special computational devices with actual domains much larger than the target domains.

Even systems which are often considered domain general, such as executive functioning or the supervisory attention system, etc. are biased toward the social domain. For example, humans don’t apply their “attention” to the underside of a plant leaf such as the *Acythosiphon pisum* do (pace the exception of a biologist or two), but in principle they could if attention was some all-purpose, unspecified, general learning function. In other words, above all, human attention is focused towards communicating with other humans. Importantly, even though human cognition is geared towards sociality (Bandura, 2001; Korman, Voiklis, & Malle, 2015; Pinker,
2010), this does not prevent it from functioning elsewhere outside the social domain (H. C. Barrett, 2015; Cosmides & Tooby, 2002; Sperber & Hirschfeld, 2004) and it does not prevent the development of fine grained specialization within a particular domain of information, as evidenced by the very fact that biologists exist alongside a great many other specialists, from bakers and stock brokers, to sail boat riggers and plumbers. However, as any comparative biologist can attest to, they must be vigilant against constant anthropomorphization of their research. Even science can be constrained by folk cognition (Shtulman, 2015) and even scientists display tendencies to perceive intention where there is none (Kelemen, Rottman, & Seston, 2013). This marks the pervasiveness of the social brains influence on all cognition.

The human “attentional” system is biased through and through towards a specialization in the social cognitive domain. This is because, on average, when any one of our “attentional systems” is triggered or applied, either by movement (Heider & Simmel, 1944), hearing a bump in the night (J. L. Barrett, 2004), seeing faces in the clouds (Guthrie, 1995), ultimate meaning in serendipitous events (Bering, 2002, 2003, 2011) etc., its default is the social realm of intentional agents with internal states such as beliefs and desires, when and where attentional facilities are employed in human cognition, we look for a mind first and ask questions later. When discussing the function of executive functions, supervisory attention systems, or some other “general” supervisory system, these mechanisms are likely part and parcel of social cognition modules.

H.C. Barrett (2012, 2015) has argued that the empirical signature of human brain adaptations (i.e., modules) may turn out to be quite different from what psychologists currently believe. This is because we should expect that an evolutionary descent with modification approach to brain functional organization will have produced modular adaptations exhibiting heterogeneity in their functional characteristics. Thus, the distinction between domain general
CHAPTER IV.
MEASURING THEORY OF MIND AND ASSOCIATED CONSTRUCTS

Different aspects of ToM are commonly measured using tests that probe an individual’s ability to understand false beliefs, detect mental states and provide an appropriate response, detect sarcasm or white lies. There are also individual differences in ToM ability, which, if careful attention is paid, can be detected in day-to-day conversations with others, particularly individuals with the Autism/Asperger’s spectrum continuum (ASC). A perturbation in normal ToM processes has been primarily implicated in explanation of ASC individuals varying levels of trouble understanding intentionality and meta-representational ability (Baron-Cohen, 1995, 2009; Leslie, 1987, 1994a). Below, several measures of traits associated with ASC are discussed, which are often operationalized to refer to various components of social cognition. Some of these measures—the Broader Autism Phenotype Questionnaire, Reading the Mind in the Eyes, and Rosset’s (Rosset, 2008) intentionality task—I utilize in this study.

Measuring the Mental

The most commonly used measure of ToM is the false belief task. This test is primarily utilized by developmental psychologists. It measures the point at which an individual (typically a young child) has adequate enough conceptual understanding of belief to know that others can hold beliefs that differ from their own (Apperly, 2012; Gopnik, 1993). More formally, this is known as perspective taking. In a paradigm example of the task an object is placed in one of two opaque containers by the experimenter, and in full view of the participant and a second “confederate.” The knowledge that the object is located in one container (but not the other) is
shared by all three individuals. However, the confederate leaves the room and the experimenter then switches the location of the object to the other container. The experimenter then asks the participant where the confederate would look for the object when they return to the room. If the participant indicates that the confederate would look in the original location, despite their personal knowledge that this is not where the object really is, then they understand that others can hold beliefs that are different than their own.

Figure 6 Example of a false belief test. Adapted from (Frith, 2003, p. 83)
These types of tasks are construed as tapping into the “first-order” of ToM, the mind-reality distinction (Gopnik, 1993; Reddish, Tok, & Kundt, 2016). However, passing this type of false belief task only indicates that the BELIEF concept has been acquired. Not why it has been acquired (Apperly, 2012; Hutto, 2008). Additionally, around 20% of individuals with high functioning autism (HFA) are still able to pass these tasks (Francesca Happé, 1994; Hutto, 2008). In recent years, false belief tasks not requiring language ability have been developed and utilized in pre-verbal’s based on looking times and facial reactions (e.g., Buttelmann, Over, Carpenter, & Tomasello, 2014; Onishi & Baillargeon, 2005). Although interpretation of these preverbal paradigms is conflicting (c.f., Apperly & Butterfill, 2009; Heyes, 2014; Hutto, 2015); for a full review, see the 2012 special issue of the British Journal of Developmental Psychology on “Implicit and explicit theory of mind” (Low & Perner, 2012), there appears to be a substantive qualitative shift in whatever ToM abilities exist once language is acquired (Hutto, 2008). Nevertheless, once the concept of belief has been acquired these tests are of little use in measuring individual differences in the ToM abilities of neurotypicals over the age of 8.

That individual differences exist in ToM is apparent to anyone who engages in casual day-to-day conversations (Apperly, 2012). Simply, it can be more or less hard to understand what other people are thinking. These differences, however, extend beyond the more fundamental distinction of the first order belief task. Individuals are now capable of having beliefs about beliefs, also known as the ability to meta-represent (Sperber, 1994). Meta-representation has also been structured as levels of intentionality (Dunbar, 2004), such that perspective taking can become increasingly complex (e.g., I think, that my advisor thinks, that the department head knows, that my advisor believes he forgot to zip up his fly). These situations
involve tracking intentions/beliefs and as in the example above, they can reach up to four or six levels (Dunbar, 2004; Gamble, 2013).

Table 2 Levels of intentionality (gratuitously adapted from, Gamble, 2013, p. 23) (original in J. N. Cole, 2008)

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ego is self-aware</td>
<td>Ego recognizes another person’s belief states as similar/different to theirs</td>
<td>Ego wants another person to recognizes Ego’s own belief state</td>
<td>Ego believes that the group understands that another person recognizes Ego’s own belief states</td>
</tr>
<tr>
<td>My advisor believes he forgot to zip his fly</td>
<td>My advisor believes that the department head thinks he forgot to zip his fly</td>
<td>My advisor desires that the department head know he forgot to zip his fly</td>
<td>My advisor knows that both he and the department head are aware that the department head thinks his fly is down</td>
</tr>
</tbody>
</table>

Second order mind reading tasks, such as the “ice-cream man story” (c.f., Perner & Wimmer, 1985; Reddish et al., 2016) require an individual to infer the beliefs of one person about the knowledge of another. Due to this complexity, these tests are more informative than first order tasks regarding individual differences in ToM. However, adolescent and adult neurotypicals—and even some HFA (e.g., Reddish et al., 2016)—still score at ceiling levels (Bowler, 1992). As individuals age it becomes harder to separate the intuitive and automatic aspects of mind reading from those that are at least minimally reflective using these tests. This is due to additional systems that support increasing social cognitive complexity, such as verbal intelligence quotient,
executive functioning, and working memory capacity (Apperly, 2011; Apperly & Butterfill, 2009).

Eye Gaze

Another way second order ToM can be measured comes from tracking eye gaze. The eyes provide a cue toward the object(s)/event, or emotion an individual is tending to, allowing for the other(s) to share in this intentionality (Tomasello, 2014; Zuberbühler, 2008). Infants begin using gaze tracking, proper, between 9 to 10 months old (Meltzoff & Brooks, 2007) and higher gaze following scores predict having significantly more mental state words within the child’s verbal repertoire at 2 and a half years-of-age (Brooks & Meltzoff, 2015). As young children gain proficiency tending to gaze direction and the eyes region in general, the eyes elicit automatic mental state inferences with maturity into adolescence (Baron-Cohen, Wheelwright, Spong, Scahill, & Lawson, 2001) and adulthood (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001). The reading the mind in the eyes test (RMTE), developed by Baron-Cohen and colleagues (2001), is a commonly used operational indicator of individual differences in the first stage of mentalizing, applying the correct mental state concept (e.g., ashamed, alarmed).
The measure consists of 36 cross section pictures of the eye region, which represent a corresponding mental state. The participant selects the appropriate mental state from 3 other incorrect “foils” and a sum score is computed. Eye gaze activates the neurological architecture reliably implicated in ToM tasks (Crespi & Badcock, 2008), such as the superior temporal sulcus and the medial prefrontal cortex (Calder et al., 2002). Evidence for the stability of these findings exists developmentally (Moor et al., 2012; Overgaauw, van Duijvenvoorde, Moor, & Crone, 2015) and cross-culturally (Adams et al., 2009). RMTE test has seen use in previous studies on religion (Caldwell-Harris, Murphy, Velazquez, & McNamara, 2011; Lindeman, Svedholm-Häkkinen, & Lipsanen, 2015; Norenzayan, Gervais, & Trzesniewski, 2012).

Other second order ToM tasks involve reading another’s mental state using auditory information. Toddlers understand that changes in voice pitch can indicate a change in mental state and goals (e.g., was that a happy scream or an angry one?) (Williamson, Brooks, & Meltzoff, 2015), as do adults (Golan, Baron-Cohen, Hill, & Rutherford, 2007; Rutherford,
Baron-Cohen, & Wheelwright, 2002). Much less is known about the relationship between mental state attribution and auditory mind reading (Williamson et al., 2015) when compared to other lines of research in ToM. However, measures such as the “Reading the Mind in the Voice” (Golan et al., 2007) test, which asks individuals to pair verbal sentences with correct emotions, and experimental paradigms involving similar tasks (Chevallier, Noveck, Happé, & Wilson, 2011), consists in another way individual differences in mentalizing can be measured.

Moving beyond second order intentionality, some tests tapping into individual differences in mentalizing combine both visual information (particularly eye gaze) and auditory information. These are known as more “advanced” measures and involve the ability to understand subtle social concepts such as sarcasm, conflicting emotions, white lies, and misunderstandings, and to keep track of, for example, what John thinks Susan thinks about him. The Movie for the Assessment of Social Cognition (Dziobek et al., 2006) contains a carefully scripted movie where individuals are asked to follow the unfolding story line (friends coming over for dinner). The advantage with this task, as opposed to the previous tests based only on reading a story, is that the individual is able to draw on perceptual faculties that would normally be used in any day-to-day situation. They can track information from eye gaze, for example, facial expression, tone of voice, or even bodily actions in a single paradigm when inferring the mental states of the actors. Golan’s (2006) “Reading the Mind in Films” task follows a similar structure, however contains clips from movies that require inferring mental states, as opposed to a more fluid, diachronically unfolding, story line, such as the Movie for the Assessment of Social Cognition. While these movie-based tests appear to be a more ecologically valid way to capture the full range of processes involved in the domain of ToM, they have not been used in the social
scientific study of religion to date. The reasons for this are somewhat unclear, however they may be seen as requiring more set-up effort on the part of the experimenter in certain situations.

Other, more commonly used “advanced” tests of mentalizing, do not integrate audio and visual elements in real time. However, they still capture important nuances in mind reading. For example, Happe’s (1994) “Strange Stories” test presents short vignettes of social situations where individuals are probed for their appreciation of social cognitive concepts similar to the Movie for the Assessment of Social Cognition. Other tests, such as the Faux Pas Recognition Test (Stone, Baron-Cohen, & Knight, 1998), follow a similar conceptual domain of vignettes, and probe for the individual’s ability to detect inappropriate comments, intentions, beliefs, and show empathy.

The most widely utilized individual difference measure of mentalizing is the empathizing quotient (Baron-Cohen, 2002, 2009; Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001). Empathizing is a construct tapping into an individual’s “drive to identify another person’s emotions and thoughts and to respond to these with an appropriate emotion” (Baron-Cohen, 2002, p. 248). It pertains more to an understanding of mental state attribution, as measured by an appropriate, perspective taking response, than to applying the appropriate mental state, per se. However, the former is largely necessary for the latter to be conducted adequately (Baron-Cohen, 2009). In its various forms, the empathizing quotient ranges from 15 items (Muncer & Ling, 2006), 25 items (Wakabayashi, Baron-Cohen, Wheelwright, Goldenfeld, et al., 2006), to 60 items (with 20 foils) in its full version (Baron-Cohen, Richler, Bisarya, Gurunathan, & Wheelwright, 2003). It has the participant respond to questions such as “I tend to get emotionally involved with a friend’s problems” (Ibid, p. 373). The empathizing quotient has been used widely in research on religion (e.g., Banerjee & Bloom, 2014; Lindeman & Lipsanen, 2016;

Broader Autism Phenotype

Cognitive psychologists interested in the functional organization of the human mind often utilize populations of individuals with deficits in the domain of interest (c.f., Caldwell-Harris, 2012). Individuals with ASC are the key population of interest for researchers interested in ToM (Crespi & Badcock, 2008; McCauley, 2011) as mentalizing ability is one of the central deficits underlying ASC (Baron-Cohen, 2009). All of the previous measures discussed are characterized by their ability to separate ASC individuals from neurotypicals (NT). ASC traits have been detected at subclinical levels, as present in the wider population, typically in relatives of ASC individuals. This is known as the broader autism phenotype (BAP) (Losh & Piven, 2007). Aside from low sociality (characteristic of mentalizing deficits), the BAP also consists of pragmatic language deficits and rigidity (Baron-Cohen & Hammer, 1997; Hurley, Losh, Parlier, Reznick, & Piven, 2007).

Often paired with the empathizing quotient in studies on religion, the autism quotient (Baron-Cohen, Wheelwright, Skinner, et al., 2001) was the first scale designed to specifically measure the traits associated with the BAP. The full version consists of 50 questions, short version only 10 (Allison, Auyeung, & Baron-Cohen, 2012), with 5 subscales covering “attention to detail, attention switching, communication, imagination, and social” aspects of the BAP. However, the communication, imagination, and social subscales theoretically overlap with one another in what I would best describe as ToM-social cognition domain related based on my discussion of ToM up to this point. And while the autism quotient has 5 subscales, its use in
studies on religious belief have only ever reported the overall sum score to date (e.g., Banerjee & Bloom, 2014; Caldwell-Harris, Murphy, et al., 2011; Norenzayan et al., 2012). Whether or not the autism quotient has an appropriate factor structure for research on religious belief remains an open question.

A recent attempt at capturing BAP characteristics by Hurley, Losh, Parlier, Reznick, and Piven (2007) has resulted in the construction of the BAP Questionnaire (BAPQ). It has three subscales: Aloof personality, rigid personality, and pragmatic language. The content of these three subscales appear to match up fairly well with the autism quotient subscales, however questions regarding imagination are absent from the BAPQ. Of particular interest, the “Aloof personality” subscale operationalizes the social deficit aspect of ASC, which Hurley et al. (2007, p. 1681) define as “lack of interest in or enjoyment of social interaction.” However, the BAPQ has proven psychometrically superior to the autism quotient (Ingersoll, Hopwood, Wainer, & Brent Donnellan, 2011). The Aloof invites participants to rate on a six point Likert scale (1, Vary rarely—Very often, 6) how much each of 12 statements applies to themselves. The content of the statements range from how much the individual enjoys social interaction (e.g., “I like being around other people”), to how much the individual feels they are connecting in social engagements (e.g., I feel like I am really connecting with other people”) (Hurley et al., 2007). Although scores on the Aloof (and the autism quotient) should correlate highly with measures such as Baron-Cohen’s empathizing quotient, due to the relationship between mentalizing ability and social interaction, the Aloof is not a measure of mentalizing. Nonetheless, it necessarily captures the downstream effects of lower mentalizing without suggesting that each and every low Aloof score is sufficiently explained via lower mentalizing. In other words, lower desire for
social engagement can stem from a variety of domains, only one of which may be variations in ToM. The BAPQ has not yet been utilized in a study regarding religious belief.

Other methods available tapping into higher level aspects of ToM concern narrative evaluation coding for intentionality, teleology, use of emotion and mental state words (Bamberg & Damrad-Frye, 1991), negative propositions (Losh & Capps, 2003), and causal connecting phrases (Chakrabarti et al., 2009).

All of the measures discussed here have two key points in common, their relationships to, and predictions for ASC and NT’s, as well as ToM in these two groups.
CHAPTER V.
THEORY OF MIND: CONVERGENCE AND VARIATION

Variation and convergence in any complex socio-cognitive trait or ability is, at some level, a to-be expected outcome of multiple factors. In this chapter, I provide a near exhaustive review of sources of possible variation in ToM. I do this in order to suggest, that, with as many possible ways as ToM can vary—having absolutely nothing to do with ASC—that ASC should only be seen as a peripheral concern in the relationship between mentalizing, ToM, social cognition, etc., and supernatural belief. I first discuss sources of this variation within the social brain, then, I draw attention to occurrences of convergence and apply the relevance of that literature to briefly touch on the theoretical strength of Leslie’s (1994b) ToM and the role of the SP in developing variation. Next, I introduce the “social brain” and “social disorders,” briefly discussing the case of schizophrenia and providing a more in-depth look at ASC and the BAP. This research directly relates to the measures utilized in the current study. Finally, I discuss a promising proposal from evolutionary psychiatry suggesting variation in ToM functioning is “normal” (also characterized by psychoses individuals), existing as a continuum of the “social brain.”

Cross-Cultural Convergence and Variation in Theory of Mind

Influences on variation in ToM development come from multiple sources, both environmental as well as biological. Multiple brain regions are implicated in different aspects of mindreading, however there is evidence of “core regions” (Brüne & Brüne-Cohrs, 2006; Carrington & Bailey, 2009; Deen, Koldewyn, Kanwisher, & Saxe, 2015; Rice & Redcay, 2015).
False belief tasks tap into an important milestone in ToM development, the ability to deploy belief-desire concepts. ToM consists of much more than the ability to pass a false belief task (Apperly, 2012; Boyer & Barrett, 2005). Nonetheless, studies using the false belief task have shown remarkable convergence on the developmental trajectory of this conceptual change across and within cultures (Wellman, Cross, & Watson, 2001). Despite the overall evidence of false belief understanding, for example among Chinese and Americans (Liu, Wellman, Tardif, & Sabbagh, 2008, p. 529), the course of development for theory of mind necessarily includes “specific experiential factors” that may affect the time table and order of developing specific concepts.

For example, during narrative exchanges with their children, Chinese mothers tend to emphasize behavior whereas American mothers emphasize thoughts and emotions (Doan & Wang, 2010). This suggestion is telling in light of recent studies extending and combining false belief paradigms with more nuanced measures of conceptual emphasis in order to probe for variation between cultures. Children from so-called “individualistic” societies, for example, such as Turkey (Etel & Yagmurlu, 2015) & the United States (Wellman, Fang, Liu, Zhu, & Liu, 2006), and Australia (Shahaeian, Nielsen, Peterson, & Slaughter, 2014; Shahaeian, Peterson, Slaughter, & Wellman, 2011) tend to develop an understanding of diversity of beliefs first (i.e., that people can believe different things about the same situation). Children from so-called “collectivistic” societies, however, such as Iran (Shahaeian et al., 2014; Shahaeian et al., 2011), China (Wellman et al., 2006), and possibly Pakistan (Nawaz, Hanif, & Lewis, 2015), tend to develop understandings of knowledge access prima facie (i.e., that something could be true, but that others might not know this). However, one study, by O’Reilly and Peterson (2014) contrasting Aboriginal Australians (presumably collectivist) with Anglo-Australians (presumably
individualistic), found both groups to be similar in diverse belief emphasis. Thus, in light of O’Reilly and Peterson (2014) and Doan and Wang’s (2010) study, variations in the development of conceptual emphasis may have more to do with parenting styles than an individualist vs. collectivist divide, although more research is needed.

Despite the convergence, there is evidence for cultural variation in passing false belief tasks. In a study with Samoan children, from within a culture discouraging discussions of mental states, Mayer and Trauble, (2013) found false belief performance improves only gradually, with the majority succeeding after the age of 8 years old (Callaghan et al., 2005). Mayer and Trauble (2015) found Samoan children failed the false belief task and did not perform above chance on a true belief task in comparison to German children. Ahn and Miller (2012) found that Korean children outperformed US children across 3 false belief tests, and variations in “self-concept” were also identified. In a study indicating variation within Western culture, British children outperformed their matched Italian counterparts on 1st and 2nd order false belief tasks, although their performance understanding mixed emotions was similar (Lecce & Hughes, 2010).

Additionally, Naito and Koyama (2006) identified a developmental lag in the ability for Japanese children to pass the false belief task based on comparisons with western children. Since ToM is a learning mechanism, these differences, likely reflect expected developmental variation in false belief understanding trajectories rather than any ground breaking evidence that the core processes involved in ToM is substantively culture dependent. All “cultures” produce children capable of detecting agency and reading minds.

Convergence on core aspects of ToM measured by developmental milestones, such as passing a false belief task, are unsurprising if ToM has at least a minimally innate basis (Baron-Cohen, 1998, 1999; Scholl & Leslie, 1999, 2001). Some features should reliably converge
around core aspects of cognitive architecture regardless of culture (Sperber & Hirschfeld, 1999, 2004). As executive function capacity matures, ToM will inevitably be able to process increasingly complex representations (Carruthers, 2016; Leslie, 2000). While the intuitions to deploy the mind reading process are universal, these intuitions can be framed in a myriad of ways by higher level, reflective processes (Baumard & Boyer, 2013; Coleman & Hood, 2015). Since ToM is the core mechanism enabling learning about beliefs and desires, which eventually form customs and traditions, the adult ToM entails a great deal of cultural “filling-in” (Apperly, 2013; Heyes & Frith, 2014). For example, if you travel to Central or South America and are unaware of the customary “cheek kissing” greeting, depending on the context, you may end up thinking some strange thoughts.

It is still unclear what is accounting for some of these cross-cultural differences. Overall, the research in this area is likely to be affected by many unobserved variables, which may have less to do with “culture” and more to do with sampling and measurement. For example, many cross-cultural studies fail to take into account that false belief test performance can vary with family size and bilingualism (Slaughter & Perez-Zapata, 2014). Nonetheless, cultural “filling-in” does occur, typically at the direction of learning algorithms embedded within a particular module (H. C. Barrett, 2015; Boyer, 2010), or by changing the in-put information for a mechanism, as “what goes through our minds changes our minds” (Morin, 2016, p. 456). For example, an American four-year-old who views her parents praying each night may be enculturated into the idea that the mind is porous and can be influenced by the stray thoughts of other people (c.f., Luhrmann, 2011b); A child from Thailand is likely to develop the idea that minds can “wander” (c.f., Cassaniti & Luhrmann, 2011) upon hearing his parents discuss that their neighbor’s maladjusted mind may be controlling another individual in the community. Research supporting
this enculturation account has been recently published suggesting that a child’s religious background influences attributing awareness to God (Lane, Evans, Brink, & Wellman, 2016). The processes behind cultural learning come online at roughly the same time (Legare & Nielsen, 2015) as the selection processor begins to function as a mechanism of selective attention (Leslie, 2000). This allows for variation in ToM.

**Environmental influences on the Development of Theory of Mind**

Hughes, Jaffee, Happe, Taylor, Caspi, and Moffitt’s (2005, p. 356) twin study sample of 1,116 sixty-month-old twin pairs in England, who were administered a wide range of ToM tasks, found that “environmental factors explained the majority of the variance in ToM performance. Theory of mind competency can be boosted a number of ways. Across five experiments, Kidd and Castano (2013) demonstrated that reading literary fiction temporarily improves affective ToM. Additional research suggests reading metaphor (Bowes & Katz, 2015), playing video games with virtual narratives (Bormann & Greitemeyer, 2015) and fictional TV dramas also produce similar enhancements. Controlling for age, gender, vocabulary, and parental income, Mar, Tackett, and Moore (2010) found that engagement with storybooks and children’s movies predicts ToM development. Educational research with preschool children makes clear the importance of storytelling and sharing for the development of ToM (Curenton, 2011; Fernández, 2013) and has begun to identify ways teachers can increase aspects of ToM in the classroom (Ziv, Smadja, & Aram, 2015); for a review of studies indicating that Training ToM and executive function through school related tasks can boost performance, see (Kloo & Perner, 2008). The use of mentalistic words in caregiver-child dyads (and quality of interaction; c.f.,
Slaughter, Peterson, & Mackintosh, 2007) is not only correlated with ToM development (Bretherton & Beeghly, 1982), but can predict its developmental stage (Doan & Wang, 2010).

A common denominator in these studies is the use of mental state words embedded in a narrative. Depending on the extent to which the linguistic practices within a given culture utilize mentalistic terms (belief-desire words) in their vocabulary, this may influence an individual’s understanding of other minds (for a review, see Lillard, 1998; Vinden, 1999).

Variations in ToM have also been identified due to poverty and lifestyle conditions. In assessing trauma experienced in childhood with a sample of over 5000 adults, Germine, Dunn, McLaughlin, and Smoller (2015) found that exposure to adverse circumstances, such as abuse, was related to variations in ToM. Furthermore, there is evidence that emotion recognition in maltreated children is also impaired (Cicchetti, Rogosch, Maughan, Toth, & Bruce, 2003; Curenton, 2011; Moulson, Fox, Zeanah, & Nelson, 2009; Pollak, Cicchetti, Hornung, & Reed, 2000) and in addition, the development of PTSD stemming from childhood abuse in females is linked with slower emotion recognition of complex mental states (Nazarov et al., 2014). Social and environmental factors, such as exposure to various hydrocarbons (e.g., tobacco smoke or neurotoxins) has, perhaps unsurprisingly, been shown to predict reduced cognitive development (Lovasi et al., 2014) and may contribute to variations in the social brain (Crespi, 2016; Nowack, Wittsiepe, Kasper-Sonnenberg, Wilhelm, & Schölmerich, 2015). Studies indicate that alterations in symbolic play, which is another hallmark of a developing ToM (Leslie, 1987), can occur in infants with prenatal substance abuse exposure when compared to their socio-economic matched counterparts (Beckwith et al., 1994) or even when compared to similarly matched preterm toddlers (Rodning, Beckwith, & Howard, 1989). Nonetheless, economic disadvantages may also
contribute to variation in ToM and social cognitive competencies (see, (for a review, see Heberle & Carter, 2015) for a review).

Kuntoro, Saraswati, Peterson, and Slaughter (2013) found that lower economic status individuals in Indonesia lag behind both middle class Indonesians and Australians in knowledge access and emotion concealment. In another study finding a distinct socioeconomic advantage, Shatz, Diesendruck, Martinez-Bexk, and Akar (2003) also found that the linguistic markers for false belief in the Turkish and Spanish languages delivered an advantage when compared to English and Portuguese preschoolers. Cole and Mitchell (1998, p. 191) administered a false belief test and other measures of representational understanding to test for the ability to both appreciate deception and behave deceptively in young British children, finding socioeconomic status strongly linked to performance in understanding this representational capacity and a later study has yielded similar results (K. Cole & Mitchell, 2000).

Over the course of two longitudinal studies with Australian children, one with a predominantly upper-class sample and another with a more socioeconomic diverse sample, McAlister and Peterson (2007; 2013) found having more siblings predicts better ToM ability across times 1 and 2, but speculate the socioeconomic status of their sample may have played a role (see also Perner, Ruffman, & Leekam, 1994; Ruffman, Perner, Naito, Parkin, & Clements, 1998). Using more advanced tests of ToM involving actively reasoning about mental states in a sample of middle childhood aged children, Kennedy, Lagattuta, and Sayfan (2015) (however, no socioeconomic data was reported), and Wright and Mahfoud (2012), who also found a relationship based on number of friends, find further support for the number of siblings one has positively scaffolding ToM development and richness.
Conversely and on one hand, other studies, such as (Cutting & Dunn, 1999) find a strong relationship between socioeconomic status and false belief performance see also (Guiberson & Rodriguez, 2013), but fail to find any sibling effects. Whereas on the other hand, studies also find no relationship between passing false belief tasks and socioeconomic status only (K. Cole & Mitchell, 2000), or fail to find relationships between false belief tasks, socioeconomic status, and sibling effects (Shahaeian, 2015) (in Iranian children with 3 socioeconomic levels). A recent study with schizophrenia, schizoaffective disorder, and psychoses patients found a negative relationship between number of older siblings and ToM performance (Murray et al., 2015). This effect has been identified in ASC individuals even after controlling for age, verbal mental age, executive function, and severity of autism (O’Brien, Slaughter, & Peterson, 2011); but for contradicting results, see Matthews, Goldberg, and Lukowski (2013). From a biological perspective, motherly care is expensive and interaction time with each child decreases as the number of children in a particular family increases. Thus, both patterns may reflect the magnitude of maternal investment costs within a multi-child home associated with ASC and psychotic spectrum disorders, however (Crespi & Badcock, 2008).

Overall, if, when, or precisely how, socioeconomic status may affect ToM development remains a muddled question. However, evidence is more clear that siblings do contribute positively to ToM in typically developing children by providing expertise in mental state discourse. The relationship between maltreatment in childhood and problematic variations in ToM is also robust, if not intuitive (i.e., if you verbally or physically abuse children this has psychological consequences). Engagement with other resources scaffolding ToM, such as narrative fiction, show temporary benefits, however more research is needed to confirm this and shed light on possible cumulative effects.
Day-to-Day Variations in Mindreading

Social perception can be influenced by top down effects, based on context, person specific knowledge, and previous interactions (Malle, 2004; Teufel, Fletcher, & Davis, 2010). In men, making a fist can influence how powerful individuals perceive themselves to be (i.e., internally directed ToM reflection) (Schubert & Koole, 2009). Social judgments and decision-making can be influenced by haptic sensation (Ackerman, Nocera, & Bargh, 2010). Social exchanges involving money and the context of the exchange affect males and females’ responses on the RMTE (Ridinger & McBride, 2015). Not only do individuals show an in-group bias towards perceiving same culture facial features (Krumhuber, Swiderska, Tsankova, Kamble, & Kappas, 2015) and decoding mental states (Adams et al., 2009), but this preference is also demonstrated in situations involving political affiliation and perceived threat (Hackel, Looser, & Van Bavel, 2014). However, out-groups may also be ascribed mentality differently based on the motivations of the perceiver. Waytz and Young (2014) found that motivations driven by affiliation emphasize emotions and feelings in out-group mind attribution compared with effectance motivation, emphasizing agency, planning, and intentionality. Given mind attribution plays such a mediating role in intergroup relations (J. L. Barrett, 2011) it should also function in the domain on morality.

Young and Waytz (2013, p. 93) have argued that the “primary” function of mind attribution and mental state reasoning is “for moral cognition and behavior” (see also Gray, Young, & Waytz, 2012). The eyes play a pivotal role in the ascription of mentality, eyes = minds (Baron-Cohen, 1995). Simply placing googily eye spots innocuously by a computer screen can increase prosociality (Bateson, Nettle, & Roberts, 2006; Haley & Fessler, 2005) and a poster featuring eyes, but not flowers, cuts lunchroom littering behavior by half in one study (Ernest-
Jones, Nettle, & Bateson, 2011). Compared to the nose, when the eyes are missing from pictures of faces, individuals find these faces as uncanny and soulless (Schein & Gray, 2015). By activating our ToM system eye spots contribute to day-to-day variations in moral cognition.

**Affiliation, Empathy, and Coordination**

Affiliation, empathy, and coordination lay at the heart of ToM (Seyfarth & Cheney, 2013). Perceiving scenes of affiliation or isolation engage core neural regions of social cognition (Beadle, Yoon, & Gutchess, 2012). Anxiety is induced whenever strangers meet, however sharing in a brief cooperative experience (playing the video game Rock Band) amongst complete strangers’ increases empathy, trust, and affiliation (Martin et al., 2015). The motor performance coupling between two individuals engaged in a joint action task is greatly facilitated when preceded by a shared musical listening experience (Lang et al., 2015). Simple repetitive behavior, such as tapping, synchronizes between dyads based on their ability to predict the action of another (Konvalinka, Vuust, Roepstorff, & Frith, 2010). For spectators of some “extreme” rituals such as firewalking, their heartbeat synchs up with those of the fire-walkers (Konvalinka et al., 2011), and even being a mere spectator to the event can be more emotionally exhausting than actually participating (Fischer & Xygalatas, 2014). Behavioral synchronicity is one avenue that can tune our minds with the minds of others (Baimel, Severson, Baron, & Birch, 2015).

**Clinical Variations in Theory of Mind**

The etiology behind possible variation in ToM is expansive. As one unique human trait is a hyper social brain (Gowlett, Gamble, & Dunbar, 2012), a normally working ToM mediates all of what we know to be our social lives. Disorders such as Autism and psychosis may represent
the extreme polar ends in a continuum of the social brain (Crespi & Badcock, 2008). ToM functioning is critically diminished in autism spectrum individuals (and unaffected siblings show slight decreases; (Baron-Cohen, 1995, 2009; Frith, 2003), but appears amplified in cases of psychosis (Crespi & Badcock, 2008). However, from a clinical perspective variation in ToM can be affected by a number of mental health related concerns and disorders. These psychiatric disorders are the extreme ends along a continuum of typical ToM functioning.

In typical healthy individuals, ToM ability decreases with normal aging (for a meta-analytic review, see Henry, Phillips, Ruffman, & Bailey, 2013). Both Alzheimer’s and dementia patients show impairments in emotion recognition (Henry et al., 2013; for a meta-analytic review, see Sandoz, Démonet, & Fossard, 2014). In other neurodegenerative disorders, such as Huntington’s disease, diminished ToM ability has been identified in clinically diagnosed, and to a lesser degree, preclinical cases (Adjeroud et al., 2016; for a meta-analysis, see Bora, Walterfang, & Velakoulis, 2015). Parkinson’s patients also show noticeable deficits in ToM (Bora et al., 2015; for a meta-analysis, see Péron et al., 2010). Specific impairments in ToM, separate from executive function, have been found in Fibromyalgia suffers (Di Tella et al., 2015). Patients with multiple sclerosis demonstrate trouble with sarcasm and lie detection compared with controls (Genova, Cagna, Chiaravalloti, DeLuca, & Lengenfelder, 2016). Individuals with frontal and temporal lobe epilepsy, as well as children suffering from generalized seizures, have been identified with ToM impairments (for review and meta-analysis, see Stewart, Catroppa, & Lah, 2016). Additionally, ToM variations can be found in schizophrenia patients (for a review, see Bora, Yucel, & Pantelis, 2009), unaffected siblings (Ho et al., 2015) and relatives of schizophrenic patients (Mohnke et al., 2016). Borderline personality disorder (Vaskinn et al., 2015), psychopathy (Baez et al., 2015; Sharp & Vanwoerden, 2013),
depression (Cusi, Nazarov, MacQueen, & McKinnon, 2013; Zobel et al., 2010), comorbid (Hezel & McNally, 2014) and non-comorbid social anxiety disorder (Washburn, Wilson, Roes, Rnic, & Harkness, 2016). Both bipolar disorder type I and II show impairments in mental state reasoning (but not mental state decoding), however this effect may be state dependent, being expressed only during active episodes of psychological impairment, and also depend on other cognitive functions and possibly psychotropic medication (Ioannidi, Konstantakopoulos, Sakkas, & Oulis, 2015; Martino, Strejilevich, Fassi, Marengo, & Igoa, 2011). In one study, chronic somatoform pain sufferers demonstrated lower ToM ability (Zunhammer, Halski, Eichhammer, & Busch, 2015), however similar to bipolar disorder, this may have been due to psychotropic medications as well. Individuals with dissociative identity disorder have trouble integrating the narrative self as stable and coherent across time (Seligman & Kirmayer, 2008).

Many neuropsychiatric disorders suggest a links to increased inflammation. Recently researchers have been able to temporarily induce inflammation (Moieni, Irwin, Jevtic, Breen, & Eisenberger, 2015), finding it impairs emotion recognition on the RMTE task. Deficits have also been identified in children with specific language impairments and attention deficit hyperactivity disorder (for meta-analyses, see Nilsson & de López, 2016; Uekermann et al., 2010) as well as preschool children with mild (Bellerose, Bernier, Beaudoin, Gravel, & Beauchamp, 2015) and severe traumatic brain injury (Ryan et al., 2015). Individuals with alcohol use disorder show impaired ToM (Bosco, Capozzi, Colle, Marostica, & Tirassa, 2014), and one study found half of recently detoxified alcohol dependent individuals showed impairments relative to controls (Maurage, de Timary, Tecco, Lechantre, & Samson, 2015). Emotion recognition is impaired in active methamphetamine abusers (Kim, Kwon, & Chang, 2011), methamphetamine abusers with 6 months’ abstinence (Henry, Mazur, & Rendell, 2009), and polysubstance abusers in general.
Child sex offenders show slight ToM impairments when inferring the mental states of other adults when compared to controls (Elsegood & Duff, 2010; Ward, Keenan, & Hudson, 2000), however do not differ from controls when inferring the mental states of children (Elsegood & Duff, 2010).

**The Social Brain Continuum and Social “Disorders”**

Psychiatric “disorders” do not represent unique, sui generis, puzzles to cognitive science informed by evolutionary theory. Risk alleles for these disorders would not be favored by evolution if they were solely maladaptive (Crespi, 2016). In providing the ultimate collection of adaptations for homo sapiens (Dunbar, 2009; Gamble, 2013) the social brain entails evolutionary tradeoffs. Autism spectrum and the psychotic spectrum represent two opposing end points on a continuum of the social brain (Baron-Cohen, 2009; Baron-Cohen & Belmonte, 2005; Crespi, 2011a, 2016; Crespi & Badcock, 2008; Crespi & Go, 2015).

![Social brain continuum](https://via.placeholder.com/150)

Figure 8 Social brain continuum. Reproduced from (Crespi & Badcock, 2008, p. 257)
This is the “cost” of the social brain (i.e., evolutionary tradeoffs). Furthermore, from a biological perspective the social brain represents an expression of the genetic battle field for warfare between two opposing yet intermingling genomic imprints: Prototypically male and female traits.

The autism spectrum and psychotic spectrum are not underpinned by any single gene (Crespi, 2011a; Verhoeff, 2014). Any notion that there are genes directly for these etiologies is extremely misleading under this evolutionary model. Ultimately, however, there are genes for the social brain. Extreme dysregulation in this brain, as manifest in AS and PS disorders, anchor opposing ends of a social brain continuum. Genetic evidence supports this account, indicating that at four gene loci, genes deletions can predispose an individual towards one end of the continuum while duplications may predispose them to the other end (Crespi, Stead, & Elliot, 2010).

Psychotic-Spectrum

The “psychotic-spectrum”” captures a whole suite of symptomologies associated with variation in the social brain. For example, hallucinations, delusions, self-rumination, and magical ideation are present in schizophrenia, depressive disorders, and bipolar disorder (Crespi & Badcock, 2008). These conditions predispose individuals to over detect agency and increase mind perception (Gervais, 2013b) such as hearing voices, thought insertion, or paranoia. The effect of different psychoses on ToM tasks can vary and is heavily debated. In schizophrenic disorders, ToM may either be impaired or amplified (for a review, see Brüne, 2005).

The precise data on the gender distribution for schizophrenia is somewhat unclear, however, males have a “higher presence of negative and disorganized symptoms…” and females have a “higher prevalence of affective symptoms,” as well as faring better overall in severity
(Ochoa, Usall, Cobo, Labad, & Kulkarni, 2012, p. 2). Interestingly, studies suggest that questionnaires used to measure the BAP closely resemble the negative social and disorganized dimensions of schizotypy (Crespi, 2011b). Testing for schizophrenia spectrum serum biomarkers has demonstrated effectiveness in differentiating between NT controls and schizophrenia roughly 60-75% of the time. This is rather weak, but when differentiating schizophrenia from ASC, the prediction rate shoots up to 96% (Schwarz et al., 2012). Thus, there are characteristics of psychoses that partially overlap with the characteristics present in ASC.

**Autism-Spectrum**

Although variations in ToM can be found in a variety of clinical disorders, a deficit in ToM was identified as the defining characteristic for individuals diagnosed with autism in the 1980’s (Baron-Cohen, 1995; Baron-Cohen et al., 1985). Up until this point, the underlying mechanism(s) responsible for autism eluded developmental psychologists since Kanner (1943) first outlined its diagnostic criteria 73 years ago. Autism is not underpinned by any single gene or neurocognitive structure. Instead, it represents the combined influence of any system responsible for development of the human social brain (Crespi, 2011b, 2016). The diversity behind the symptomology of autism gave way to what is known as the “autism spectrum” (AS) (autism spectrum continuum, ASC) (Verhoeff, 2014). Individuals on the ASC can be typified by impairments “in understanding and coping with the social environment” (Baron-Cohen et al., 1985, p. 38) as well as a proclivity for narrow interests, repetitive behavior, and attention to detail (Baron-Cohen, 2002, 2009; Frith, 2003, 2012). These two areas of variation (counting the latter description as a second cluster) differ dramatically depending on where on falls on the ASC and have wide ranging impacts on the day-to-day social life of ASC individuals.
The main criteria for the low functioning autism (LFA) is a general deficit in intelligence. Typically, the intelligence quotient cutoff for this classification is below an 80. This negative variation in intelligence compounds and amplifies the potentially deleterious effects of an already diminished ToM. Towards the low end of the ASC, when an individual has trouble understanding intentionality, it may be hard to learn much of anything, as communicative acts that are meant for you (e.g. Sally this is how you tie your shoe laces) are unable to cognitively register as anything other than a random action in one’s environment (e.g. Sally hears speaking and sees someone moving). In this situation agency can be detected, but it does not cue up the “intentional stance,” to borrow from Dennett (1987). Thus Sally is unable to learn many of the life skills that would be acquired by individuals who are capable of deciphering the intentions behind a particular action, to varying degrees. Repetitive, stereotyped behavior, specific interests, and an aversion to interruptions in routine are also particularly exaggerated in LFA (Baron-Cohen, 1995, 2009; Caldwell-Harris, 2012; Crespi & Go, 2015; Hurley et al., 2007).

The high functioning end of the ASC is characterized by average or above average intelligence, while retaining less extreme variations in ToM and mechanistic cognition etc. than are found in LFA (Baron-Cohen, 2009; Caldwell-Harris, 2012). Whereas an individual with LFA may be easily detected in a casual conversation by a neurotypical with little ASC knowledge, provided the LFA impairment is not so severe as to impeded any communication, the average person is unlikely to detect a HFA. Interestingly, such “narrow” interests and mechanistic cognition may actually contribute to an everyday advantage for HFA operating in contexts where attention to detail and analytic thinking are of importance (Baron-Cohen, 2002). Collectively, these behaviors are termed “systemizing” (Baron-Cohen, 2009; Caldwell-Harris & Jordan, 2014).
Autism is four times more likely to affect males than females. When autism does occur in females, its expression is typically more severe (Baron-Cohen & Belmonte, 2005; Crespi & Badcock, 2008). Similarly, Asperger’s Syndrome, which maintains an etiology identical to HFA (but without the delayed linguistic development) is nine times more likely to occur in males than females (Baron-Cohen & Belmonte, 2005). Characteristics of the autism spectrum, such as deficits in mentalizing and social communication combined with the strengths of systemizing and attention to detail (Baron-Cohen, 2009; Frith & Frith, 2010) also appear to characterize BAP males in the general population (Hurley et al., 2007; Sasson et al., 2013). For example, females consistently outperform males when inferring mental states from the eye regions (for a meta-analysis, see Kirkland, Peterson, Baker, Miller, & Pulos, 2013) as well as consistently scoring higher than males on the empathizing quotient (Baron-Cohen, 2009). During infancy, males cry longer and more often than females (Baron-Cohen, 1995). In further support of the “maleness” of ASC, males and females with autism perform similarly on both of these measures (Baron-Cohen et al., 2015).

Adult males demonstrate greater emotional reactivity to pictures without humans while females show the opposite pattern (Althaus et al., 2014). On average, and at only 24 hours old, before cultural effects may show influence, male neonates orient their gaze more towards physical objects, whereas females tend to focus on faces and people (Connellan, Baron-Cohen, Wheelwright, Batki, & Ahluwalia, 2000; Geary, 2010). As children, males are drawn more towards mechanical, construction, and wheeled toys, whereas females show more varied choice in toys (for a review, see Hines, 2011; Jadva, Hines, & Golombok, 2010). These differences are not purely the result of enculturation as these same sex differences in toy preferences are also found in young chimpanzees (Kahlenberg & Wrangham, 2010) and rhesus monkeys (Hassett,
Siebert, & Wallen, 2008). Rat, Meadow Vole, Rhesus monkey, and deer mice, males all show a spatial navigation advantage (c.f., C. M. Jones, Braithwaite, & Healy, 2003). In humans, compared to females, it is well established that males show enhanced mental and spatial rotation (Cosmides & Tooby, 2013; Kaufman, 2007; Parsons et al., 2004). This likely reflects the recurring division and specialization of labor throughout hominid evolutionary history, with males primarily tracking and hunting prey across long distances and unfamiliar terrain (Cosmides & Tooby, 2013); studies of hunter gatherers also confirm this division of labor (Whiten & Erdal, 2012). Tracking and hunting require fairly accurate navigational skills and attention to detail that is rapid, otherwise one risks losing the trail and dinner (Cosmides & Tooby, 2013; Liebenberg, 2006). On tasks measuring performance in attending to detail, such as the embedded figures test, which requires one to locate a “hidden” shape embedded within a larger geometric shape (Francesca Happé, 2013) non-clinical populations with autistic traits (Russell-Smith, Maybery, Bayliss, & Sng, 2012), TD males (Baron-Cohen, 2002), and children and adults with autism (Jolliffe & Baron-Cohen, 1997; Keehn et al., 2009; Schlooz & Hulstijn, 2014) show an advantage. When this test was given to ASC and TD participants under an fMRI scan, females demonstrate more activity in the Posterior parietal cortex then males, and both males and females show more activity than the ASC group, suggesting basic perceptual visual processing is attenuated in ASC (Manjaly et al., 2007). Despite this attenuation, however, ASC groups still outperform TD’s and fMRI studies also suggest atypical activation of a number of brain regions when completing the executive function test for ASC, even in their non-clinical

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5 Although not directly related to the present discussion, it is important to point out that there is a domain specific female advantage in spatial memory for the absolute location of plant foods. This likely reflects the recurring specialization of women as primarily foragers, tasked with remembering the specific locations of edibles for gathering (Cosmides & Tooby, 2013). Gathering has proved important to human evolution (Buss, 2016), yet it is an under researched topic in hunter gatherer studies and due to the nature of, and materials required for, gathering, the archaeological evidence is quite literally not set in stone (Whiten & Erdal, 2012).
siblings (Spencer et al., 2012). Additionally, performance on the test in childhood has demonstrated the ability to predict the severity of repetitive behavior in adolescence (Eussen, Gool, Louwerse, Verhulst, & Greaves-Lord, 2016). Two-year-old children with ASC do not utilize biological motion cues (measured as a light point display) the way typically developing children do, instead utilizing cues from their physical contingencies (Klin, Lin, Gorrindo, Ramsay, & Jones, 2009). Compared to the looking times for images of social interaction in toddlers ages 12 to 43 months old, looking at geometric patterns for more than 70% of the time almost guarantees a diagnosis of autism (Pierce, Conant, Hazin, Stoner, & Desmond, 2011).

Males in general and both high functioning females and males on the ASC demonstrate superior ability in systemizing.

**Systemizing**

Systemizing is a cognitive style driven by preference for the identification and manipulation of rule based systems (Baron-Cohen, 2009). It involves detecting regularities and extracting behavioral rules in the form of “If I do x, then y happens” (Baron-Cohen, 2002). Quantifying and breaking wholes into various parts that can be manipulated and tested are key features of systemizing. Systemizing is a prototypical activity for males and male systemizers show positive correlations of activation in resting state activity between the dorsolateral prefrontal cortex and the dorsal anterior cingulate cortex, while the opposite is true for females (Takeuchi et al., 2014). Almost like the ends of two magnets, the systemizer is attracted to systems. Baron-Cohen (2010) gives examples of some of the more prevalent types of systems; abstract systems (e.g., musical notation), social systems (e.g., business management hierarchy), mechanical systems (e.g., car engine), natural systems (e.g., weather patterns), numerical...
systems (e.g., calendar), and motoric systems (e.g., throwing a Frisbee). Thus systemizing is, ipso facto, folk physical ability. It is concerned with causality and interactions with objects displaying non-agentive movement (Paganini & Gaido, 2013). Systemizing is useful for repairing your old video cassette player or changing the breaks on your car, but much less so when trying to infer the intentions and desires of another person. For intuitive understandings of the mental state of others, empathizing works best.

**Empathizing**

Empathizing is a cognitive style encompassing much of the domain of social cognition, it involves “the attribution of mental states to others, and an appropriate affective response to the other’s affective state” (Baron-Cohen, 2002, p. 248). In contrast to systemizing, empathizing allows you to predict the behavior of other biological agents and “requires an imaginative leap in the dark” (Ibid), as inferences are made into the unseen mind, often in the absence of enough data. Females are more likely to be high empathizers than males (Baron-Cohen, 2009, 2010). Studies also suggest a female advantage on the ability to pass false belief tasks (Baron-Cohen, 2002; Charman, Ruffman, & Clements, 2002). Taking into account the previous two sections, the female advantage for mental expertise is clear.

**Systemizing and Empathizing**

Males typically outnumber females in jobs or activities that entailing systemizing, such as the sciences (Baron-Cohen, 2002). This occurrence could be attributed to outright male dominance and control of resources, discouraging females from being motivated to engage in these activities. Interestingly, one cross-cultural study in four countries found that systemizing
explained 27% of the variance in motivation to learn science, while gender explained only 1.5% (Zeyer et al., 2013). Subsequent studies have strengthened the relationship between systemizing, male gender, and the specific interests found in the sciences (Byrd-Craven, Massey, Calvi, & Geary, 2015), however, others suggested that while the previous relationships hold, the empathizing and systemizing quotient may not affect performance in these disciplines (Morsanyi, Primi, Handley, Chiesi, & Galli, 2012). When differences in the empathizing and systemizing quotient are plotted between the sciences and the humanities, individuals within science, technology, engineering and math based fields score higher on systemizing, individuals within the humanities show stronger empathizing, and the expected sex differences can even be found within each field (Billington, Baron-Cohen, & Bor; Focquaert, Steven, Wolford, Colden, & Gazzaniga, 2007).

The differences in cognitive style assessed by the empathizing and systemizing quotient are candidates for universal aspects of human cognition (Wakabayashi, Baron-Cohen, Wheelwright, & Tojo, 2006). The sex differences between men and women, as well as the ability to separate ASC from NT’s, has remained stable between Japan and Britain (Wakabayashi, Baron-Cohen, Wheelwright, & Tojo, 2006). Females typically score higher on tests and tasks requiring empathizing, lower on tests and tasks requiring systemizing, whereas the inverse is true for males and ASC individuals (Auyeung, Allison, Wheelwright, & Baron-Cohen, 2012; Auyeung et al., 2009; Baron-Cohen et al., 2003).
CHAPTER VI.
FOLK PSYCHOLOGY, THEORY OF MIND, AND VARIATION

The development of ToM into adult years and within a given cultural context has been under studied and to the extent that (Apperly, 2013; Baron-Cohen, 1995; Gelman & Legare, 2011; Gopnik & Wellman, 1994; Heyes & Frith, 2014; Leslie, 2000; Vinden & Astington, 2000) ToM is “colored-in,” shaped via natural pedagogy (Taves, 2015), and other environmental factors through ontogenetic construction (Heyes, 2003) there should be cultural variation (H. C. Barrett, 2012; Robbins, 2008; Whiten, 2013). Furthermore, depending on the extent to which the linguistic practices within a given culture utilize mentalistic terms (belief-desire words) in their vocabulary, this may influence an individual’s understanding of other minds (for review, see Lillard, 1998; Vinden, 1999). The mind is understood by the formation of a folk psychological theory.

Folk Psychology concerns how behavior is related to the mind. Using the belief-desire concepts introduced by ToMM-SP (see Chap III.), the mind constructs “theories,” linking these concepts to our experience (Morton, 2009). These theories have the potential to shape the way events and situations are perceived and the appropriate behavior required in a specific context. This chapter discusses variations in folk psychology, which may influence how we view other minds and their relationship to the unseen—beliefs and supernatural agents.

Cultural Variations in Folk Psychology

Psychological–anthropological studies, focusing on “the way in which cultural content ‘interfaces’ with psychological processes” (D'Andrade, 1981, p. 182) constitute a promising
avenue to explore cultural variations in how the mind is construed. Folk psychology, our everyday understanding of reasons for actions and their relationship to the mind (Hutto, 2008; Malle, 2004), provides the appropriate interface to explore how “the folk” conceptualize “the mind.” For example, as an individual living in the European-American world, explaining unusual behavior, such as if my thesis committee chair came to school with his head shaved bald, would likely entail appealing to a breakdown in his own mental faculties (e.g., He’s gone crazy!). Although alternatives could be offered, nothing else is needed to describe this occurrence. If this situation occurred somewhere in Thailand or Indonesia, however, the explanation may be that someone’s uncontrolled mental energy has entered my advisor’s brain and has caused him remove all of the hair from his head (e.g., He’s been possessed!). And while both of these explanations are related to ToM—in that they concern the socially acceptable constraints in which behavior is interpreted in light of a particular conception of the mind—neither case may be influencing some of the implicit, automatic processes recruited by ToM. These processes allow the creation of folk psychologies. For example, just because a given culture has a folk psychological theory denying the possibility of knowing what is in another’s mind does not mean that they do not think about the minds of others (Lillard, 1998; Luhrmann, 2011b). At the explicit level, ToM is ultimately a social enterprise, incorporating not just cognitive processes but also explanations of behavior, contextual meaning, and utilized for social control and management (H. C. Barrett, Cosmides, & Tooby, 2010; Byrne, 1996; Korman et al., 2015; Kurzban & Athena Aktipis, 2007; Malle, 2004; Tomasello, 2014; Whiten & Erdal, 2012). Understanding variations in the folk psychology of the mind contributes to an understanding of ToM.
Folk psychology represents an important level of description for the more basic processes of ToM and for explanations in CSR (Taves, 2009). Luhrmann (2011a, p. 77) reviews the anthropological literature on hallucinations and sensory overrides, connecting them to supernatural belief and the functioning of the social brain continuum. Hearing voices or seeing things that might not be there qualifies as a non-ordinary experience. No individual would deny that people legitimately believe many non-ordinary experiences (or even ordinary) consist of episodes where they are communicating with a supernatural agent. No researcher would deny that ToM is involved when engaged in supernatural communication. However, the target or “proper” domain of ToM is other humans—not gods—but our folk psychological framework, as evidenced in the case of religion, spills over into the cultural or “actual” domain of this mechanism. The framing of these non-ordinary experiences is under grid by an individual’s biology (i.e., modular structure), it always involves a “cultural invitation” to a “specific theory” (p. 77). This is congruent with the social control and management function of folk psychology (Malle, 2004). Folk psychology opens humans up to what Galen (in prep) has characterized as “libel phenomenology.” In sum, there is a difference between having an experience and the description of that experience, whose characterization necessarily includes information gleaned from others, some of which will be false. The phenomenology of perception is important, but both of these descriptions/processes are inferential. Is that awe inspiring and interconnected feeling you get walking in the woods “the work of God” or the equally beautiful byproduct of a strictly materialist worldview? Did Joseph Smith’s “seer stones” really allow him to receive direct revelations from God or was the founder of the Latter Day Saints simply a charismatic man who had interesting conversations with rocks? Due to the functioning of humans evolved coalitional psychology (Boyer, Firat, & van Leeuwen, 2015)—trust—everyday folk
psychological discourse opens us up to misdirection regardless of how sincere the misdirector may be (Sperber, 2010). Non-ordinary experiences can occur regardless of cultural background, but these are in turn shaped by how individuals conceptualize the mind. Luhrmann (2011a, 2011b, 2012, 2013) emphasizes the role of learning in acquiring these capabilities. She notes that while all folk theories of the mind are acquired socially, it is usually only in spiritual contexts that one is urged foster the idea of a “porous mind.”

**Folk Psychology and Language**

One avenue for variation in folk psychology centers on language (Astington & Baird, 2005). Acquiring language, with its appropriately structured syntax, can not only scaffold the implicit process involved in ToM (for review, see J. de Villiers, 2007; J. G. de Villiers & de Villiers, 2014; Hale & Tager-Flusberg, 2003; see for a review), but also directly delimits the range of given mental states terms (Lillard, 1998). Mental state terms are a human universal, all languages and all cultures have at least some. The English language has over 2,000 words denoting emotions, however the Chewong of Malaysia, in addition to possessing 5 terms for mental processes (translated as want, want very much, forget, know, and miss or remember), have roughly 23 terms for bodily states, traits, or emotions (Howell, 1981, 1984; Lillard, 1998). As Lillard (1998, p. 13 italics in original) directs us: (Note that “think” is not even among them.)

The Junin Quechua of Peru, do not regularly appeal to or even have equivalent words for, the English and Spanish equivalents of “think,” and instead use “say” in its place (Adelaar, 1977; Vinden, 1996). In turn, this may limit the ability to pair mental states with corresponding actions, thus resulting in a developmental variation in ToM and folk psychological explanations, as mentalistic concepts are largely superfluous for the Quechua (Vinden, 1996). Another similar
form of cultural variation in explicit ToM comes from Papua New Guinea. In many Melanesian communities the ability to make inferences as to the mental contents of another is something viewed with great skepticism, as the mind is strongly considered to be opaque (Robbins, 2008). When minds are considered “unknowable,” motives may become less important (Lillard, 1998; Ochs, 1988). For example, Lillard (1998, p. 13) points out that “Children in Samoa do not try to get out of trouble by saying, ‘I did not do it on purpose,’ as they do in [European-American] culture; instead they deny having done the deed at all.”

Folk Psychology and the Mind

Lillard (1998) suggests that most European Americans have a very dualistic notion of the mind, first put forth by Descartes, which conceives of the mind as distinctly separate from the body, yet located within it. The mind, however, is what people typically speak of when referring to a notion of themselves (Johnson, 1990). Thus, to lose an arm in an industrial accident, for example, is not to lose a part of “the self” only a part of one’s body. The European American mind is also seen as a stable, unitary concept—after all, one typically says they have changed their mind, not their prefrontal cortex (Lillard, 1998). In contrast, the Japanese emphasis on mind is more fluid—it is integrated at various levels with the body. The Japanese term “kokoro,” translated as “the embodied mind” (Lebra, 1993, p. 63), is affect laden, located in the heart and includes links to genes and blood (Lebra, 1993; Lillard, 1998). Even the terms “hara, ki,” and especially “seishin,” which denote more spiritual conceptualizations of the mind, are associated with the body (Lebra, 1993). Naito and Koyama (2006, p. 299) found Japanese children tended to emphasize behavioral or rule based explanations in false belief understanding, only “scarcely” appealing to mental states. Not to syncretize or conflate Japanese and Chinese cultures, however,
but Naito and Koyama’s (2006) finding is buffered by Doan and Wang’s (2010, p. 1498) discovery that Chinese mothers emphasize “physical and behavioral manifestations of emotions” in narrative interactions with their children in comparison to their American counterparts, thereby temporarily emphasizing the body (behavior = body) over the mind. Despite these close associations with the body, Japanese minds are thought of more as relational entities than fixed structures, the mind(s) both are and are not a part of the body (Lebra, 1993). European American’s may change their mind, but their Japanese counterparts could be changing their hara, ki, kokoro, or seishin.

As discussed above, different folk psychological conceptualizations of the mind may entail variations in attributions of and reasons for behavior. The most current and extensive exploration of this variation is summarized in Luhrmann (2011b, p. 5) and colleagues’ collection of “position papers” on the possibility of an “anthropological theory of mind.” That is, a ToM that is rooted in universal psychological processes, yet pays mind to cultural variation. A brief summary of these six positions will help elucidate the cultural variance of how individuals conceive of the mind:

The Euro-American modern secular ToM treats the mind as having a clear boundary between itself and objects in the external world. Thus, under this model of the mind, any notion that a thought could be “inserted” or wander into another’s brain, is more likely to be treated as a case of schizophrenia than a message from the planet Xenu. The modern secular ToM is the proprietary, basic programming for the theories of mind that follow.

The Euro-American modern supernaturalist ToM (Luhrmann, 2011b), largely emulates its secular brother. However, it treats the mind as something selectively permeable, allowing for mental penetration for special classes of entities, such as gods, spirits, or “mental-like energy”
involved in new age healing practices. Through training and practice, the supernaturalist ToM is open to developing expertise in communicating with unseen agency.

The opacity of mind theory (Luhrmann, 2011b) conceives of the mind as inherently unknowable to other individuals. Most often found throughout the South Pacific and Melanesia, variants of the opaque mind privilege intentions that are expressed in explicit communication over all else. It is considered bad manners to look in another’s eyes, as this might indicate one is thinking about the unexpressed mental contents of the other. While allegedly impervious to other humans, the opaque mind is nonetheless permeable by a special class of agents—spirits.

In the transparency of language theory, the best examples of which stem from Central America (Luhrmann, 2011b), language is (should be) a reflection of entities and relationship that hold in the world—not internal mental states. In some cases, fiction and pretense by children is discouraged. Mental state vocabulary words are few, as what matters most is the relationship between an utterance and facts in the world, not correspondence to an inner mental state.

Under the mind control theory, the best example being found in Thailand but also in other parts of Asia, discipline of the mind is emphasized (Luhrmann, 2011b). Minds can exhibit greater or lesser degrees of “control.” In a poorly controlled mind, one where emotions and thoughts may be overbearing, these mental states can infect other unbalanced minds and vice versa. This theory of mind differs noticeably from the secular mind, as “mind stuff” is able to enter the minds of others, still partially bearing the original thinkers mental state.

The final theory of mind Luhrmann (Luhrmann, 2011b) has identified, perspectivism, typical of some Amazonian peoples, suggests that minds can travel from one body to the next. Individuals may believe that they can take up the mental faculties of, say, a jaguar. Likewise, a
jaguar could contain a human mind and individuals have claimed to see just such instances. There is also the fear that one could end up permanently in some non-human form.

Two themes emerge amongst these different cultural theories of mind; the distinction between a porous and a bounded mind (Luhrmann, 2011b, 2012). While no cognitive scientist would deny cultural variation of ToM, the extent to which a particular cultural expression has the ability to affect implicit, lower level, processing and representation of mental states is a key point of contention (Astuti & Bloch, 2012; Danziger, 2009). Thus, while different cultural theories of mind may enable an individual to believe their thoughts can inhabit and control the body of another individual (Cassaniti & Luhrmann, 2011) or that they are engaged in a conversation with the Christian god (Luhrmann, 2012; Luhrmann & Morgain, 2012), or that the secular mind is bounded—existing only in the head (Luhrmann, 2011b)—these are cultural expressions, the “theories” of an underlying cognitive architecture (Sperber & Hirschfeld, 1999, p. cxxvi).

It is easy to see how the different folk theories of the mind characterized by Luhrmann (2011b) underlie, and indeed are, much of what we think of when conceptualizing religion. But, “religion” is hard to define outside of its Christian history and its status as a useful category must be proved and not assumed. Drawing on attribution theory, Taves (2009) has recently introduced the expression “things deemed religious or special” in order to create a tractable category for scientific inquiry, connecting first-hand accounts of folk psychological experience to the cognitive mechanisms that generated them. The next chapter reviews these mechanisms.
CHAPTER. VII

THEORY OF MIND AND COGNITIVE SCIENCE OF RELIGION

Why does human belief in some sort of supernatural agency appear, stretching far back into deep history, and, currently, across oceans and continents? If a family member or friend suffered from blindness, why, in order to return their vision, might someone choose to perform a ritual that has no actual causal connection to any possibility of reversing blindness, such as prayer (pace Jesus Christ himself; John: 9, King James Version), or concoct a potion of rust, dehydrated pig’s eye, and wild honey to inject into their loved one’s ear to rectify this malady (Legare & Souza, 2012)? Why do humans believe that there is a soul and that this immaterial “self” may venture into the afterlife upon death? These types of questions, along with many others commonly regarded as comprising “religion,” can be addressed by the cognitive science of religion.

Rather than constantly engaging in debates over what religion “really is,” the strategy of fracturing religion into individual components, such as anthropomorphism (Guthrie, 1995), teleology (Kelemen, 2004), theory of mind (Boyer, 2001) etc., has been met with great success in CSR. The different theories of ToM used in CSR, or terms rather, all capture phenomena that can be categorized as either secular or religious. Take, for example, ritual drumming (or other musical engagement), which is a common component of religious gatherings. What separates a religious ritual from a nonreligious ritual? Is there something inherently special about banging on a container to produce a sound that makes this act particularly “religious?” Although religion and religious rituals do hold great personal meaning and special status to many individuals, there is nothing particularly special about them. McCauley and Lawson (2002, p. 10) exemplify the
relationship between a religious ritual and a nonreligious ritual by drawing attention to the
particular action(s) and not the aura of cultural meaning the act is embedded in: “Ritual
drummers ritually beating drums are still drummers beating drums.” The categories of religion
and the secular are modern inventions of the nation state; they are co-constructive and depend on
one another to gain their own meaning (Jong, 2015; McCutcheon, 2007). There is nothing
special about religion (Bloch, 2008), it is a folk concept, a family resemblance category
(Bulbulia, 2005).

Nonetheless, CSR does find that there are still something’s that deserving of the label
“religion.” Following McCauley (2011), I distinguish popular or folk religion from theological
reflection. An example of popular religion would be the widespread belief in the evil eye; the
idea that a curse or hex can be given to an individual through a malignant glare. This kind of folk
belief—sending or receiving causally opaque mental energy—goes hand in hand with the idea of
a “porous theory of mind.”
From West Asia to the Americas and stretching back into antiquity, people have created or purchased amulets and other artifacts to protect both themselves and their children from its malevolent powers. But this kind of religion exists and pervades through theological reflection as evident by the fact that believers in the evil eye are not just “pagan folk,” although many may be, they are Muslims, Christians, Jews, etc.—much to the chagrin of the theological reflection espoused by these ecclesial authorities. Still, “if humans were naïve realists there would be no religion” (Lieberoth, 2013, p. 169). And indeed, many times these folk beliefs are commandeered by theology and even absorbed into a particular religious’ tradition (Xygalatas,
Forthcoming). Shops selling “religious” artifacts side by side with various magical powders, potions, or other items can be found throughout the Americas (Chesnut, 2012). The natural roots of “religion” lay in cognitive mechanisms with a deep evolutionary history and do not necessarily align with their theological counterparts, although their cultural expression is continually elaborated on.

Religion is not a sui generis phenomenon (Coleman & Hood, 2015; McCutcheon, 2007; Taves, 2009), it requires no unique or special postulates in order to be explained by science—according to McCauley (2011, p. 155) “the sundry psychological dispositions that develop in human minds” are all that is needed (also see Lawson, 2000). Thus, no matter what the mechanism is called that mediates social interaction with gods and other spirits, this will be a mechanism that operates in a number of domains having absolutely nothing at all to do with religion. CSR is methodologically pluralistic, encompassing a variety of disciplines from religious studies, anthropology, and primarily, cognitive science. Religious ideas are natural byproducts of ordinary cognitive faculties and this makes them appealing, and easy to transmit (J. L. Barrett, 2011, 2012; Bering, 2006; Bloom, 2007; Boyer, 2001, 2003, 2010; McCauley, 2011; Taves, 2015; Xygalatas, 2014). Despite the appearance of widespread surface variation in religious beliefs there are remarkable convergences across people, places, and time. As McCauley (2011, p. 152) puts it:

A small number of variations on a limited set of elements lies beneath the assorted myths, rituals, beliefs, doctrines, icons, sacred spaces, and more that humanity’s religions present. Our maturationally natural cognitive systems are primarily responsible for those elements and the forms that their variations take.

It is no coincidence, then, that religious representations often involve a violation of the kinds of features the ToM system has been “designed” to expect (e.g., That two solid objects can’t pass through each other) (see Chapter III.).
Religious ideas are about belief in supernatural agents (Beit-Hallahmi, 2015; Franek, 2014). Theologians (Plantinga, 2011) and other religiously inclined appear to premise this much (e.g., J. W. Jones, 2016). Despite “religion” being a problematic and deeply contested category, reflecting euro-protestant ethnocentrism (Cotter & Robertson, 2016), supernatural agents do differ from ordinary agents (e.g., humans) by possessing non-ordinary powers (Taves, 2015), violating our intuitive assumptions about culturally available schemas (Purzycki & Willard, 2015) and reoccurring core domains of knowledge (Boyer, 2001, 2003). This characterization may not capture the precise qualities possessed by each and every “religious representation,” pace J. W. Jones (2016), but one has to start somewhere and at some level of generalization.

Table 3 Counter-intuitive agent concepts (Adapted from Boyer, 2003, p. 119)

<table>
<thead>
<tr>
<th>Person</th>
<th>+ counter-intuitive physics</th>
<th>“Ghost entered room through the wall!!!”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Person</td>
<td>+ counter-intuitive biology</td>
<td>“Spirits never die!!!”</td>
</tr>
<tr>
<td>Person</td>
<td>+ counter-intuitive psychology</td>
<td>“This statue will listen to your prayers!!!”</td>
</tr>
</tbody>
</table>

For example, despite the fact that trees lack ears and a brain, the Uduk-speaking people of Sudan believe that ebony trees hold strategic knowledge and can listen in on their conversations (Boyer, 2001). In the monotheistic traditions quasi-incorporeal beings such as angels are not only thought to communicate socially with individuals, but they can pass right through your bedroom wall on their way to perform a miraculous feat. For many individuals, interacting with these incorporeal beings is a daily occurrence (Luhrmann, 2012). Studies suggest that thinking about these supernatural agents activates the same areas of the brain utilized in normal, everyday, social
cognition, when thinking about ordinary agents (Epley, Converse, Delbosc, Monteleone, & Cacioppo, 2009; Gray, Jenkins, Heberlein, & Wegner, 2011; Kapogiannis et al., 2009; Kapogiannis, Deshpande, Krueger, Thornburg, & Grafman, 2014; Schjoedt, Stødkilde-Jørgensen, Geertz, & Roepstorff, 2009). ToM is a core system supporting religious thought.

**The Meta-Representational Mind and Supernatural Belief**

Meta-representations, to recall its earlier discussion in the manuscript, is a representational, cognitive copy, of some other primary representation (e.g., the difference between *seeing* a particular tobacco pipe and thinking about a tobacco pipe). Along with others (Bloch, 2008; Boyer & Bergstrom, 2008; Gervais, 2013b; Lane & Harris, 2014; McCauley, 2011; Norenzayan & Gervais, 2013), J. L. Barrett (2011, 2012) suggests the relationship between ToM and religious belief rests not on any single cognitive system per se, but in the capacity to have a meta-representational ToM (or something like it), instead. On his account, ToM of the highest order is the adaptation that makes religious belief possible. “The concurrence hypothesis,” which J. L. Barrett (2011, p. 212) puts forth, argues that whatever capacities exist that makes humans, human, also makes religion distinctively human. In order to have a relationship with an unseen god, just like having a relationship to the mind of another, one must be able to represent and reflect on the content of other’s thoughts. According to J.L. Barrett, meta-representational ToM covers several domains, from enabling cooperation and trust, to facilitating the transmission of cumulative culture. This is why archaeologists often emphasize the role this ability has played (much as it continues today) in socio-political control and dominance (Gamble, 2013; Lewis-Williams, 2002), which evolved hand-in-hand with religion.
Like Bering’s account below, J. L. Barrett finds other animals lack the symbolic capacities required for religious belief.

**Meta-representational Research**

The human social cognitive system, effortlessly and intuitively, generates and responds to religious ideas, such as belief in supernatural agents in neurotypical individuals. Perceiving these non-ordinary agents is surprisingly quite similar to perceiving other minds or believing in other unseen entities, germs for example (Gervais, 2013b; Lane & Harris, 2014). In the domain of religion, meta-representational ToM has been primarily explored through variations of false belief tasks in young children. Around the age of four, with the development of a full meta-representational theory of mind, children are able to make a variety of mental state and knowledge distinctions with this ability. Children’s reasoning about God beliefs often matches the implicit responses in adults (for reviews, see Heiphetz, Lane, Waytz, & Young, 2016; Lane & Harris, 2014), who represent God as being limited by the same anthropomorphic constraints as average humans (J. L. Barrett & Keil, 1996). For example, children believe that God is more likely to know another’s desires than their own parents, however they treat God with the same human limitations as their parents—being able to hear some things yet not others (Canfield & Ganea, 2014). But, in addition to parsing what God or their parents might know (Knight, Sousa, Barrett, & Atran, 2004), young children also have a tendency to parse and attribute knowledge to animals (Richert & Barrett, 2005) and imaginary friends (Wigger, Paxson, & Ryan, 2013). In sum, the development of supernatural agent concepts closely mirrors each stage of development in children’s’ mentalizing abilities (c.f., Lane & Harris, 2014; Norenzayan & Gervais, 2013).

Adept at applying their meta-representational ToM, around the age of seven years old, children can perceive intentionally communicated messages in otherwise random events (Bering
& Parker, 2006). Nonetheless, children at this age still do not seem to appreciate that two mental states can conflict and affect behavior (Choe, Keil, & Bloom, 2005), thus they may not be able to appreciate that belief in supernatural agency is counter to a naturalistic worldview. Both religious and nonreligious adults, however, also carry-on this tendency to endow certain classes of life events with purposeful, intentional, meaning.

**Existential Theory of Mind**

Bering (2002, 2006, 2011) conceptualizes the EToM as a derived, domain general, evolutionary adaptation of human cognition. The EToM is a uniquely human trait, according to Bering (2002), having a phylogenetic history that places the precursors for the evolution of this capacity within the divergence of hominins from *Pan troglodytes*. However, he suggests that EToM as a fully functioning system shows its appearance with the arrival of full symbolic capacity in *Homo sapiens*, arguably occurring between “30,000 and 60,000 years ago” (Bering, 2002, p. 9). If religion goes hand in hand with the development of the EToM, then, on Bering’s account, religion—or anything worthy of the label—did not exist before the transition to to behaviorally modern humans.6

EToM is an extension of the typical processes of ToM, however rather than functioning to predict mental states and actions, it is specified to attribute personal meaning to certain kinds of autobiographical experiences (e.g., What was the meaning of this particular event for me?). Like other theories of ToM, EToM processes meta-representations—the opaque, copy of a copy of a primary representation. However, EToM is focused on existential meaning, in abstract,

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6 The notion that there has been some axial point in which anatomically modern humans magically became behaviorally modern is highly contested within the archaeological literature (c.f., Gamble, 2013; Lewis-Williams, 2002; Nowell, 2010).
causally opaque situations (Bering, 2003). For example, a recent study with Latino mothers’ of 
autistic children found that, despite having some who attributed this occurrence to purely 
biological factors, many mothers saw their children’s condition as an intentional “message from 
God” (Salkas, Magaña, Marques, & Mirza, 2016). However, it is not just in challenging life 
situations when chance happenings can combine to be perceived as part of some greater 
meaning. For another example, think of the happenstance situation of the flighty bachelor 
running into an old crush from high school at a supermarket 30 years later, only to end up 
settling down and getting married. What were the chances that these two should meet at this 
particular moment in time and after all these years? While there is most certainly a complex 
causal explanation to be had, at some level, this will not be the “go-to” folk intuition. Rather, this 
fortuitous rendezvous is more likely to be seen as the hand of God shepherding his children 
together once more (e.g., Salkas et al., 2016), or the powers of the universe combing just so these 
two old lovers could reignite the flame. These explanations are pregnant with intentional 
meaning that a strictly physical universe, according to Bering, could never account for.

The few studies that have aimed to capture aspects of EToM—that individuals have a 
tendency to imbue life events in general and some important events in specific, with a telos— 
have yielded promising results. Primarily utilizing self-report or open-ended questions, asking 
individuals to report on their level of belief in teleological concepts, such as agentive or non-
agentive “fate” (Banerjee & Bloom, 2014) and “life’s purpose” (Willard & Norenzayan, 2013), 
these studies have suggested that supernatural belief (and even belief in the paranormal) are 
correlated with these tendencies. Only Banerjee and Bloom’s (2014, p. 277) study explicitly 
included atheists in their sample, finding a small percentage who tended to perceive design and
purpose in life events, concluding that this teleological perception does not belong to supernatural thinking alone, residing instead in “more general social propensities.”

Heywood and Bering (2014), who also included atheists in their study, utilized semi-structured interviews to probe for teleological answers in response to questions about autobiographical events. The authors measured explicit religious identification, postulating that, despite the atheist stance (as they operationalized it) ruling out any type of higher purpose, atheists would nonetheless generate intuitive responses that were incompatible with their explicit worldview. And while theists generated the highest number of teleological narratives, atheists did make some attributions of a higher purpose in their responses. Similar to Banerjee and Bloom (2014), Heywood and Bering (2014) conclude that the EToM is an ability shared, to varying degrees, regardless of religious identification.

**Teleology**

Alongside the meta-representational ToM, children develop an overactive sense of teleology. As discussed in chapter X, this teleological impulse—finding people and occasionally objects, appear to “act” on the basis of purposeful intentions—is a core component of ToM. Children as young as 2 and 3 years old show a preference for purposeful explanations, finding explanations such as “rocks are pointy so you don’t sit on them” more appealing than physical causal explanations, “rocks are pointy because stuff builds up over time” (Casler & Kelemen, 2007; Kelemen, 1999a, 1999b, 2003, 2004). Although less pronounced, these teleological tendencies continue into adulthood (Kelemen & Rosset, 2009), appear to be further attenuated by cultural input such as education (Casler & Kelemen, 2007), however are still present even in physical scientists (Kelemen et al., 2013). Teleological reasoning even bleeds into the minds of
nonbelievers (Järnefelt, Canfield, & Kelemen, 2015), however appears to be strongest in individuals who already hold religious beliefs (Banerjee & Bloom, 2014) and are raised within a religious environment (Rottman et al., 2016). This data indicates that while the teleological bias is pervasive, it is also widely susceptible to cultural influence and rooted in more general socio-cognitive tendencies rather than the narrower domain of the religious impulse.

**Dualism**

Similar to teleology, dualism, the perspective that separates mind (or the “soul”) as an intentional entity apart from matter, an intentionless object, is another early developing cross-cultural intuition that underlies religious beliefs (Bloom, 2007). For example, when I lecture on the topic of ToM, I show people a picture of a brain and ask them, “what is this a picture of”? Of course they respond, “it’s a brain!” However, even in a room full of atheists’ no one ever shouts out, “it’s a mind!” This is because the notion that the mind is not the brain is intuitive, perhaps leading even some philosophers and cognitive scientists (e.g., Chalmers, 1995, 2007; Searle, 1980, 2013) to embrace a kind of Cartesian dualism. Nuances in this debate abound (c.f., Lowe, 2011), but the eliminative materialist position—that the existence of the folk mental states processed by the mind, such as beliefs and desires, constitute a radically false scientific account of the mind—appears to be the most scientifically tractable and productive account of the mind (Churchland, 1981, 1989, 1993, 2007). Nonetheless, that mind is separate from the body may be a libel intuition that further enriches supernatural beliefs.

The development of dualistic intuitions (i.e., intuitive dualism) also appears cross-culturally (Astuti & Harris, 2008; Huang, Cheng, & Zhu, 2013). For example, both children and adults attribute desire, emotional, and other epistemic mental states (e.g., thinking about one’s
spouse or knowing they may be angry) to the recently deceased as ghosts and spirits (Bering, 2002; Bering & Bjorklund, 2004; Huang et al., 2013). And, most often it is these mental states and not psychobiological or perceptual states (e.g., feeling hungry or seeing something) that are attributed to the dearly departed (Bering, 2002; Bering, Blasi, & Bjorklund, 2005; Huang et al., 2013; Lindeman, Riekki, & Svedholm-Häkkinen, 2015). Shtulman (2008) has demonstrated that adults attribute psychological properties to religious agents, over and above physical or biological properties, however children appear to weigh these aspects equally (also see Shtulman & Lindeman, 2016).

In some contrast to intuitive dualism, reflective dualism is the explicit stance that mind and matter are not the same. Again, think about philosopher David Chalmers (2007). Chalmers has certainly pondered his place in the universe and with philosophical training, has defended the idea that consciousness is irreducible to the physical. This is reflective dualism. Research has suggested that confusing “core” knowledge (c.f., Spelke, 2000)—for example, mixing agentive properties with physical properties, such as “Stars live in the sky.”—is at the root of not only reflective dualism, but also supernatural and paranormal beliefs (Lindeman, Riekki, et al., 2015; Lindeman, Svedholm-Häkkinen, et al., 2015; Riekki, Lindeman, & Lipsanen, 2013).

Importantly, humans are not determined to be unapologetic dualists and individual differences have been identified. For example, Lindeman, Riekki, and Svedholm-Hakkinen’s (2015) study found at least a small group of “monists” who attribute mental, psychobiological, and biological functions only to the brain. And, on the opposite end, the researchers discovered a large group of “spiritualists” who attribute these functions not only the brain, but also the mind and soul. Although some theoretical debate remains as to whether or not humans are truly cognitively capable of being dualists, due to the contributions of offline social cognition to
represent agents as embodied (Hodge, 2008, 2011) at the level of the “folk,” research indicates that people generally believe that the mind is not the body in life, and even can continue after death (also see Lane & Harris, 2014).

**Mentalizing**

Mentalizing involves thinking about and attributing mental states to other agents. These agents can be human (e.g., I wonder what Ralph does in his free time?), supernatural (e.g., If I lose my religion, Allah will be very angry.), or ambiguous (e.g., Hearing a tree limb snap in the night and wondering, “who’s there?”). Mentalizing combines some of the core components of ToM, mental state attribution.

Overwhelmingly, women are more likely to be religious than men, as well as have superior mentalizing capabilities (Beit-Hallahmi, 2015). Both of these relationships are consistently found in the literature (e.g., Norenzayan et al., 2012; Rosenkranz & Charlton, 2013). In the “earliest” attempt to explore the relationship between mentalizing and supernatural belief, across three studies, Norenzayan et al. (2012) found mentalizing to mediate belief in a personal God, however each study only had a marginal number of atheists (13.7%, 11.6%, 4%). Furthermore, their analyses only compared high and low belief, and found only weak relationships to mentalizing. Thus both groups were, methodologically speaking, all theists as there was no grouping for atheism or “no belief”. Nonetheless, systemizing alone predicted lower god beliefs.

In a single study, Rosenkranz and Charlton (2013) found mentalizing predicts “religious orientation” and systemizing predicts “science acceptance.” And, while there were atheists and theists in their sample, it might be assumed that theists were the latter and atheists the former,
however the researchers never measured directly compared atheists and theists, only an individual’s level of religious orientation or science acceptance.

Both dualism and to a lesser degree teleological reasoning, have been shown to mediate the relationship between mentalizing and supernatural belief (Willard & Norenzayan, 2013). According to Willard and Norenzayan’s (2013, p. 388) study, which tested for individual differences in mentalizing, anthropomorphism, and dualism, found that the relationship between these cognitive biases was directional, leading to religious and paranormal belief, and belief in life’s purpose, “and not the other way around.” However, all the SEM path relationships in Willard and Norenzayan’s study going from mentalizing to these cognitive biases were “either weak or non-significant” (Lindeman, Svedholm-Häkkinen, et al., 2015, p. 64). In a similar study, Banerjee and Bloom (2014) found that while mentalizing predicted teleological reasoning about one’s own life, belief in fate, and finding meaning hidden in life events, it failed to predict the attribution of life events to God or tendencies for to apply teleology more generally. Lindeman et al. (2015) also found a weak relationship from mentalizing ability (and promiscuous teleology) to predict supernatural belief, testing this against several other biases, of which, confusing core ontological knowledge (e.g., assigning “mental” properties to physical objects) was the single best predictor of belief in supernatural purpose. While the researchers did not allow participants to report if they were atheist, over 50% of their Finnish sample identified as “non-religious.” Having similar methodological limits to other studies I have mentioned, one should not confuse a survey identification of “no religion” with having no god beliefs (Lee, 2014). Interestingly, their analysis did reveal that individuals with strong mentalizing skills, but with poor understandings of physical causality and low systemizing skills professed more supernatural belief than all other groups. This is what we would expect given the role of the social brain in human evolution—
overly mentalistic individuals with poor causal reasoning abilities will hold fairly high levels of supernatural beliefs. Nonetheless, other recent studies have continued to find weak relationships with mentalizing and supernatural belief (e.g., Reddish et al., 2016; Wlodarski & Pearce, 2016).

*High Functioning Autism, Theory of Mind, and Religious Belief*

Few studies exist examining variation in ToM alongside religiosity, in individuals with HFA spectrum disorders. In one of the first studies, Caldwell-Harris et al., (2011) found that HFA individuals were more likely to be atheist or agnostic and if they did identify as “religious,” they constructed their own religious belief system. In addition, she also found atheists to have significantly higher systemizing scores and did not uncover any differences in mentalizing. Reddish, Tok, and Kundt (2016) found several significant differences between mentalizing in ASC and NT’s in how anthropomorphic they viewed God, or felt closeness to Him, however all had small effect sizes. As suggested by others (Bering, 2002, 2011), the image of God possessed by ASC individuals may be different from NT’s. For example, Schaap-Jonker, Sizoo, Roekel, and Corveleyn (2013) found that the God image of individuals diagnosed with ASC had more negative traits and fewer positive traits than their NT group.

Qualitative approaches, focusing on individual manifestations of religiosity and spirituality in ASC individuals, are rare. However, one study, conducted by Visuri (2012), utilized semi-structured interviews to probe for the relationship between BAP traits and religious views in four persons on the ASC. Given the wide net cast by EToM over existential questions (Coleman & Hood, 2015), Visuri (2012, p. 373) uncovered that her participants possess some form of existential ponderance, but “they do not tell of coming to any conclusions,” she writes. Rather than thorough impairments in mentalizing abilities, the curiosity and reflexivity of the
participants may have triggered not disbelief, but instead, a deeper existential mystery. Noting this, Visuri (2012) concludes that regardless of the possible differences in mentalizing and EToM displayed by ASC individuals, there are substantial cultural influences, which will need to be further taken into account in much needed future research.

Using the cognitive styles framework—empathizing/mentalizing and systemizing/analytic thinking—Lindeman and Lipsanen (2016) recently uncovered 5 subgroups each of atheists and theists who differed on aspects of cognitive style. Additionally, Norenzayan and Gervais (2013) have suggested four paths to nonbelief, two of which concerns mentalizing and analytic thinking. This research suggests that any totalizing attempts to conceptualize a binary of cognitive traits characterizing either religious believers or nonbelievers is problematic. This data supports an account of belief and nonbelief following an individual differences approach to religiosity (Beit-Hallahmi, 2015; Caldwell-Harris, 2012; Reddish et al., 2016; Wlodarski & Pearce, 2016).
CHAPTER VIII.

DIVERSITY OF NONBELIEF

The scientific study of nonreligion is still in its infancy, particularly from a psychological perspective (Coleman, Hood, & Shook, 2015). The number of atheists measures over half a billion worldwide (Norenzayan & Gervais, 2013). Secular and atheistic individuals can even be found in predominantly Muslim countries such as Turkey (Sevinc, Coleman, & Hood, In Press; Sevinc, Hood, & Coleman, In Press). The vast majority of atheists are deconverts (Fazzino, 2014; Streib & Klein, 2013). There are “hidden” atheists in the Christian pulpit (Dennett & LaScola, 2010) and surrounding the Jewish Ark (Shrell-Fox, 2015)—there are certain to be more. Atheists and the nonreligious comprise some of the fastest growing “religious” demographics (Twenge, Exline, Grubbs, Sastry, & Campbell, 2015) and are projected to maintain this growth (Stinespring & Cragun, 2015). Despite these positive projections of growth, perceptions of atheists are negative.

Widespread stigmatization and prejudice of atheists exists within the public sphere (Cragun, Kosmin, Keysar, Hammer, & Nielsen, 2012; Edgell, Gerteis, & Hartmann, 2006; Mann, 2015). For example, many state constitutions in the United States officially forbid atheists from holding public office, however these laws are no longer enforceable. Research suggest that discrimination against atheists is primarily based upon a perceived lack of “moral trust” (Gervais, 2013a) and that even exposing individuals to information suggesting our moral sense is innate does not reduce this view (Mudd, Naijle, Ng, & Gervais, 2015). Nonetheless, atheists appear to lead lives as normal and moral as any other religious group (Coleman & Arrowood,
2015; Zuckerman, 2014). However, comparatively little research has been conducted with atheists compared to the religious.

Over the past century, hundreds of scales have been developed measuring different “facets,” “orientations,” or “dimensions” of religiosity (Hill & Hood, 1999). Measurement scales appropriate for a secular or nonbelieving person are virtually nonexistent, however recent years have seen some developments (e.g., Bradley, 2014; Cragun, Hammer, & Nielsen, 2015; Schnell, 2015). However, initial survey and experimental research does exist for atheist samples, measuring atheism as a nominal variable. This research highlights personality and cognitive variation among nonbelievers, as well as their convergence and contrast to religious believers.

There is now some evidence that compared to theists, atheists and the nonreligious are more open to experience, less dogmatic, favor analytic thinking styles over intuitions (Pennycook, Ross, Koehler, & Fugelsang, 2016), and have specific interests in the sciences (Caldwell-Harris, 2012; Farias, 2013). Among themselves, atheists also demonstrate differences in personality variables. For example, despite individuals overwhelmingly viewing atheists as “angry,” this relationship varying as a function of religiosity (Meier, Fetterman, Robinson, & Lappas, 2015), research suggests only a small portion of atheists (less than 15%) may have higher trait anger (Silver, Coleman, Hood, & Holcombe, 2014). Using an individual difference in personality variables approach, Silver, Coleman, Hood, and Holcombe (2014) have uncovered at least 6 “Types” of nonbelief, and variation in psychological type has been reported elsewhere (Baker & Robbins, 2012; Gibson, 2006). There is a strong intellectual component to atheism (Caldwell-Harris, Wilson, LoTempio, & Beit-Hallahmi, 2011) and nonbelievers can demonstrate cognitive styles that vary on levels of empathizing, mechanistic (systemizing) cognition, autism quotient traits, and analytic thinking (Lindeman & Lipsanen, 2016). This is because the same
processes supporting belief also support nonbelief (Banerjee & Bloom, 2013; Coleman et al., 2015; Geertz, 2010, 2013). Despite this, paths to atheism have been conceptualized from a deficit point of view, finding atheists must be lacking normally functioning brains in explanation for their lack of belief.

**Atheism and Theory of Mind**

Is not believing in any gods is similar to having a physical disability? While one might first laugh at such a provocative statement, perhaps rub their eyes in disbelief, J. L. Barrett (2012, p. 203) has suggested precisely this: “Not believing in any sort of gods may prove to be a trait that is analogous to not being able to walk.” One of the most important theoretical assumptions within CSR literature is that variations in ToM or mentalizing abilities can explain diminished or absent god beliefs (i.e. explain nonbelief). In short, it has been suggested that atheists may not believe in God because they are “socially disabled” (J. L. Barrett, 2012, p. 85), “mind-blind” (Norenzayan & Gervais, 2013)\(^7\), or have a “malfuction” in their mind-reading abilities (Clark & Visuri, In press) that is characterized by mentalizing deficits associated with the autism spectrum (Norenzayan & Gervais, 2013). Using the term “male-brained” as a stand-in for mentalizing deficits, J. L. Barrett (2012, p. 205) further summarizes this view by suggesting that:

> If theory of mind and related social cognition are so critical for theistic belief and if severe male-brained people are weak in or lack these social cognitive abilities, then we would predict that people who have always found it difficult or impossible to believe in any gods might tend to be more male-brained.

\(^7\) In order to better characterize this suggestion, Norenzayan and Gervais (2013) note that “mind blindness” is only one possible cognitive route to nonbelief. However, the other routes they cover are typically out of favor with CSR standard accounts, and of no relevance to the current thesis.
The theoretical centrality of ToM in explanations of religious (non)belief should not outweigh its empirical signature. Do atheists really lack a properly functioning ToM when compared to theists and to what extent do males and females vary in ToM functioning and supernatural belief? Based on a review of the literature the following hypotheses are tested:

Hypothesis 1: Atheists will score lower than theists on the Mentalistic ToM components of intentionality and mental state attribution.

Hypothesis 2: Atheists will score higher than theists on the selection processor component of ToM.

Hypothesis 3: Atheists will display more BAP traits than theists.

Hypothesis 4: Sex differences are predicted in both atheist and theist groups on all measures, with females scoring higher than males on mentalistic aspects of ToM and social components of the BAP.

Hypothesis 5: ASC (self)diagnoses will be more prevalent among atheists compared to theists.

Hypothesis 6: Atheists with ASC (self)diagnoses will differ significantly from non-ASC atheists on all measures.
CHAPTER IX.

METHODS

Baron-Cohen (1995) and Leslie’s (1994b) characterization of a theory of mind module are combined and specific components of this device are related back to the following measures: Rosset (2008) intentionality bias scale [ID/ToBy/ToMM\textsubscript{1}]; Baron-Cohen et al. (2001) Reading the mind in the eyes [ToMM\textsubscript{2}/ SAM], and the cognitive reflector test (CRT) (Frederick, 2005) [SP].

Participants and Procedure

This study received institutional review board approval (exemption, protocol # 3010X) from Boston University (BU) and was conducted under the supervision of the principal investigator, Dr. Catherine Caldwell-Harris in collaboration with myself, Thomas Coleman. The study also received institutional review board approval at the University of Tennessee at Chattanooga (# 16-068), specifically requesting to use this (now) archival data. The data was collected through the BU Qualtrics online survey software. Participants were recruited from the BU undergraduate psychology majors research pool and by responding to an online posting published by The Friendly Atheist blog (http://www.patheos.com/blogs/friendlyatheist/) at the request of Thomas Coleman. This online posting invited “atheists, theists, and anyone who might consider themselves ‘in-between’” to respond to an online survey about how personality and cognitive styles might influence belief and attributions of intentionality. While it is possible to raise some questions regarding the psychological typicality for any theists recruited from a predominantly atheist blog (e.g., Did you have theists that were bordering considering, or close
to, atheism in your sample?), this interpretation is unlikely. For example, religious individuals do subscribe to The Friendly Atheist and this blog is hosted as part of a much larger website (Patheos.com), which primarily contains popular theist blogs. In addition, the individuals in the theist group all selected statements affirming the existence of God (see, Dawkins theism scale below).

Compared to theists (N = 103), atheists were intentionally oversampled (N = 2423), in order to detect subtle individual differences in traits associated with ASC and specific ToM components. The survey was completed in the following order: A brief demographics section, the CRT, a measure of religiosity, the Rosset (items were randomized), the BAPQ, the RMTE (items were randomized), religion questions and Dawkins theism scale. In addition to the scales analyzed in the current study, the survey contained a dimensional measure of religiosity and several demographics questions, which are outside of the scope of this thesis and have been omitted. All data was analyzed using the SPSS-23 statistical package.

This sample analyzed consisted of a total N = 2526 fully completed participant responses. The mean age represented in the data set was 39.05 years and 59.6% of the sample identified as male. Atheists were intentionally oversampled (N = 2423), in order to detect subtle individual differences in traits associated with ASC and specific ToM components in comparison theists (N = 103). The atheist group was predominately male (59.6%) and the theist group was predominately female (59.2%).

**Materials**

ASC conditions question. The survey invited participants to check one or more of the following categories if they had: Clinician diagnosed Asperger’s, self-diagnosed, “not sure if I
have it or not,” Autism, Pervasive Developmental Disorder, Sensory Integration, and “other.” Only the Autism and Asperger’s categories will be utilized in the analyses.

Broader Autism Phenotype Questionnaire (BAPQ). The BAPQ is a quantitative measure of 3 domain traits as described by Diagnostic Statistical Manual of Mental Disorders IV (2000). The subscales for each domain are: aloof personality (e.g., I enjoy being in social situations.), rigid personality (e.g., I am comfortable with unexpected changes in plans [reverse scored].), and pragmatic language problems (e.g., I find it hard to get my words out smoothly.). All subscales invite participants to respond on a six point Likert scale (1, Vary rarely—Very often, 6) how much each statement applies to themselves. Although other scales measuring the BAP have been utilized in research on religion (e.g., the autism quotient), when these scale are compared with each other the BAPQ out performs all the rest (Ingersoll et al., 2011).

Rosset Intentionality Scale (RIS). The RIS measures one’s tendency towards an “intentionality bias” (Rosset, 2008) and will serve as a measure of the intentionality component of ToM. It asks participants to infer actions as either “on purpose” or “on accident” in 40 situations (10 per factor) that are unambiguously intentional (“He buttoned his jacket.”), unambiguously accidental (“He poked himself in the eye.”), prototypically accidental (“He hit the man with his car”), and neutral/prototypically intentional (“She cut him off driving.”). This will be (has been) given to participants without any emphasis on speed, so they are free to take as little or as long as they like. A sum score of correct responses are computed for each category.

Reading the mind in the eyes test (RTME). The RTME test is a measure that taps into subtle differences in the attribution of appropriate mental states (i.e., sadness, joy) using 36 small black and white visual cross-sections of the eye region (Baron-Cohen, Wheelwright, Hill, et al., 2001). Participants select the appropriate mental state from 3 other incorrect “foils” and a sum
score is computed. This makes calculating a Cronbach’s alpha score extremely difficult, however test re-test methodology has established its reliability (Fernández-Abascal, Cabello, Fernández-Berrocal, & Baron-Cohen, 2013; Vellante et al., 2013). This test is widely used in research on ToM in general and ASC in specific, reliably separating individuals with clinical impairments in social cognition from NT’s. Furthermore, this test has seen use in previous studies on religion (Caldwell-Harris, Murphy, et al., 2011; Lindeman, Svedholm-Häkkinen, et al., 2015; Norenzayan et al., 2012).

Cognitive Reflection Test. The CRT (Frederick, 2005) consists of three questions tapping into an individual’s preference for analytic thinking compared to intuitive (e.g., A bat and a ball cost $1.10 in total. The bat costs $1.00 more than the ball. How much does the ball cost? While the intuitive answer is typically 10 cents, the correct answer is 5 cents. This is a performance based measure, developed in the field of behavioral economics, that is correlated with success overcoming a number of cognitive biases (Toplak, West, & Stanovich, 2011), specifically, improbable or conflicting beliefs (Pennycook, Cheyne, Barr, Koehler, & Fugelsang, 2014; Pennycook et al., 2016). Due to this, the CRT is commonly utilized as a measure of “analytic thinking” and has never been explicitly operationalized as the SP component of ToM. This is unfortunate, because the CRT’s psychometric properties (which taps into a domain general, Type 2 process, involving the selective inhibition of an intuitive choice for an alternative one) directly overlap with the characterization of the SP (c.f., Frederick, 2005; Leslie, 2000; Leslie et al., 2005; Toplak et al., 2011; Toplak, West, & Stanovich, 2014). Additionally, the individual differences found in CRT performance (Frederick, 2005) closely mirror the predicted pattern of variation for ToM ability, male/female sex differences and their associated levels of religiosity combined (Beit-Hallahmi, 2015; McCauley, 2011). This study will utilize the number of correct
CRT responses, as well as the mean time spent attempting the questions for measurement. The response time data was captured using Qualtrics, measured from the first “click” to the last “click” on the page.

Dawkins Theism “Scale.” In Richard Dawkins’ (2006) book, The God Delusion, he posits that individuals can fall somewhere on a spectrum of belief in God from being certain of His existence to certain of His nonexistence. He provides 7 categories of identification: Strong Theist (e.g., I do not question the existence of God; I know he exists), De-Facto Theist, Weak Theist, Pure Agnostic, Weak Atheist, De-Facto Atheist, and Strong Atheist (e.g., I am 100% sure there is no God.). Measuring levels of (non)religiosity nominally, allowing participants to self-select the term that best describes their position on God allows for a direct answer to the question of ToM variability between atheists and theists. The de-facto and strong theist and atheist categories will be collapsed to create 2 master categories: atheists and theists. Questions over possible ToM differences in agnostics is beyond the scope of this proposal and they will be excluded from the analyses along with the “weaker” belief categories.
Hypotheses 1–4: A series of two-way ANOVAs were conducted between religious identification (atheist vs. theist) and gender (male vs. female) with each (sub)scale. Residual analysis was performed to test for the assumptions of the two-way ANOVA. Outliers were assessed by inspection of a q-q plot, normality was assessed using Shapiro-wilk’s normality test for each cell design and homogeneity of variances was assessed by Leven’s test. All outliers were kept in the data and in cases where residuals were non-normally distributed, skewness and kurtosis were within acceptable range (-1.5, +1.5) to allow comparison (Tabachnick & Fidell, 2012). (See, table 4. below.) There was homogeneity of variance and equal variance was assumed across all tests, except for the performance based measures CRT total, CRT time, RMTE and for unambiguously accidental and unambiguously intentional subscales, which function as “control” sentences and is expected (Rosset, 2008).
Table 4 Sample Variances

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>RMTE</td>
<td>2444</td>
<td>26.0397</td>
<td>3.7127</td>
<td>-.851</td>
<td>2.361</td>
</tr>
<tr>
<td>Rosset overall</td>
<td>2889</td>
<td>.4713</td>
<td>.0904</td>
<td>-.002</td>
<td>.856</td>
</tr>
<tr>
<td>Unambiguously accidental</td>
<td>2888</td>
<td>.0213</td>
<td>.0688</td>
<td>4.216</td>
<td>20.795</td>
</tr>
<tr>
<td>Prototypically accidental</td>
<td>2887</td>
<td>.2654</td>
<td>.1748</td>
<td>.647</td>
<td>.287</td>
</tr>
<tr>
<td>Unambiguously intentional</td>
<td>2887</td>
<td>.9927</td>
<td>.0434</td>
<td>-12.280</td>
<td>216.022</td>
</tr>
<tr>
<td>Prototypically intentional</td>
<td>2888</td>
<td>.6068</td>
<td>.2257</td>
<td>-.381</td>
<td>-.311</td>
</tr>
<tr>
<td>BAPQ total</td>
<td>2806</td>
<td>2.9525</td>
<td>.6205</td>
<td>.287</td>
<td>.145</td>
</tr>
<tr>
<td>BAPQ-alof personality</td>
<td>2707</td>
<td>3.2</td>
<td>.8920</td>
<td>.107</td>
<td>-.486</td>
</tr>
<tr>
<td>BAPQ-pragmatic language</td>
<td>2712</td>
<td>2.7196</td>
<td>.6497</td>
<td>.520</td>
<td>.433</td>
</tr>
<tr>
<td>BAPQ rigid personality</td>
<td>2696</td>
<td>2.9343</td>
<td>.7462</td>
<td>.320</td>
<td>.219</td>
</tr>
<tr>
<td>CRT total</td>
<td>3433</td>
<td>1.2196</td>
<td>1.1747</td>
<td>.332</td>
<td>-1.409</td>
</tr>
<tr>
<td>CRT time</td>
<td>2866</td>
<td>4.2315</td>
<td>.8636</td>
<td>.270</td>
<td>4.260</td>
</tr>
</tbody>
</table>

BAPQ overall: A two-way ANOVA was conducted to examine the effects of (non)religious identification and gender. There was no significant difference between religious identification $F(1, 2503) = .373, p = .542$, partial $\eta^2 = .000$. Observed power was .094. There was a significant difference between genders $F(1, 2503) = 3.876, p = .049$, partial $\eta^2 = .002$. Males had more overall BAPQ traits than females. Observed power was .503. There was no significant interaction between religious identification and gender for BAPQ overall score $F(1, 2503) = .013, p = .910$, partial $\eta^2 = .000$. Observed power was .051.

BAPQ aloof personality: A two-way ANOVA was conducted to examine the effects of (non)religious identification and gender. There was a significant difference between religious identification $F(1, 2423) = 30.760, p < .001$, partial $\eta^2 = .013$. The atheist group had higher aloof
traits than theist group. Observed power was 1.00. There was no significant difference between gender $F(1, 2423) = 2.782, p = .095$, partial $\eta^2 = .001$. Observed power was .385. There was no significant interaction between religious identification and gender for BAPQ aloof $F(1, .000) = .000, p = .988$, partial $\eta^2 = .000$. Observed power was .050.

BAPQ pragmatic language problems: A two-way ANOVA was conducted to examine the effects of (non)religious identification and gender. There was a significant difference between religious identification $F(1, 2423) = 6.858, p = .009$, partial $\eta^2 = .003$. The theist group had higher pragmatic language problem scores than the atheist group. Observed power was .745. There was a significant difference between gender $F(1, 2423) = 8.910, p = .003$, partial $\eta^2 = .004$. Observed power was .847. Males had higher pragmatic language problem scores than females. There was no significant interaction between religious identification and gender $F(1, 2423) = .218, p = .640$, partial $\eta^2 = .000$. Observed power was .075.

BAPQ Rigid personality: A two-way ANOVA was conducted to examine the effects of (non)religious identification and gender. There was a significant difference between religious identification $F(1, 2409) = 6.628, p = .010$, partial $\eta^2 = .003$. The theist group had higher rigid personality traits than the atheist group. Observed power was .730. There was no significant interaction between gender $F(1, 2409) = .007, p = .932$, partial $\eta^2 = .000$. Observed power was .051. There was no significant interaction between religious identification and gender $F(1, 2409) = .758, p = .384$, partial $\eta^2 = .000$. Observed power was .140.

RMTE: A two-way ANOVA was conducted to examine the effects of (non)religious identification and gender. There was no significant difference between religious identification $F(1, 2257) = .120, p = .730$, partial $\eta^2 = .000$. Observed power was .064. There was no significant interaction between gender $F(1, 2257) = 2.290, p = .130$, partial $\eta^2 = .001$. Observed
power was .328. There was no significant interaction between religious identification and gender $F(1, 2257) = .075, p = .784$, partial $\eta^2 = .000$. Observed power was .059.

RIS, overall: A two-way ANOVA was conducted to examine the effects of (non)religious identification and gender. There was no significant difference between religious identification $F(1, 2501) = 1.463, p = .227$, partial $\eta^2 = .001$. Observed power was .227. There was a significant difference between gender $F(1, 2501) = 5.549, p = .019$, partial $\eta^2 = .002$. Males scored higher than females on the overall RIS. Observed power was .654. There was no significant difference between religious identification and gender $F(1, 2501) = .432, p = .511$, partial $\eta^2 = .000$. Observed power was .101.

RIS, unambiguously accidental: A two-way ANOVA was conducted to examine the effects of (non)religious identification and gender. There was a significant difference between religious identification $F(1, 2501) = 11.947, p = .001$, partial $\eta^2 = .005$. The theist group responded with more “on purpose” answers than the atheist group. Observed power was .933. There was no significant difference between gender $F(1, 2501) = 1.984, p = .159$, partial $\eta^2 = .001$. Observed power was .291. There was no significant difference between religious identification and gender $F(1, 2501) = 1.032, p = .310$, partial $\eta^2 = .000$. Observed power was .174.

RIS, unambiguously intentional: A two-way ANOVA was conducted to examine the effects of (non)religious identification and gender. There was a significant difference between religious identification $F(1, 2501) = 12.216, p < .001$, partial $\eta^2 = .005$. The atheist group responded with more “on purpose” answers than the theist group. Observed power was .937. There was a significant difference between gender $F(1, 2501) = 13.308, p < .001$, partial $\eta^2 = .005$. Females responded with more “on purpose” answers than males. Observed power was .954.
There was a significant difference between religious identification and gender $F(1, 2501) = 11.972, p = .001$, partial $\eta^2 = .005$. The male atheists and female theists and atheists responded with more “on purpose” answers than the male theists. Observed power was .933.

RIS, prototypically accidental: A two-way ANOVA was conducted to examine the effects of (non)religious identification and gender on the RIS unambiguously prototypically accidental subscale. There was no significant difference between religious identification $F(1, 2501) = .936, p = .333$, partial $\eta^2 = .000$. Observed power was .162. There was a significant difference between gender $F(1, 2501) = 5.345, p = .021$, partial $\eta^2 = .002$. Males responded with more “on purpose” answers than females. Observed power was .637. There was no significant difference between religious identification and gender $F(1, 2501) = 1.067, p = .302$, partial $\eta^2 = .000$. Observed power was .178.

RIS, prototypically intentional: A two-way ANOVA was conducted to examine the effects of (non)religious identification and gender. There was no significant difference between religious identification $F(1, 2501) = 2.668, p = .103$, partial $\eta^2 = .001$. Observed power was .372. There was a significant difference between gender $F(1, 2501) = 4.302, p = .038$, partial $\eta^2 = .002$. Males responded with more “on purpose” answers than females. Observed power was .545. There was no significant difference between religious identification and gender $F(1, 2501) = .210, p = .647$, partial $\eta^2 = .000$. Observed power was .074.

CRT: A two-way ANOVA was conducted to examine the effects of (non)religious identification and gender. There was a significant difference between religious identification $F(1, 2505) = 22.504, p < .001$, partial $\eta^2 = .009$. The atheist group had more correct CRT responses than the theist group. Observed power was .99. There was a significant difference between gender $F(1, 2505) = 28.471, p < .001$, partial $\eta^2 = .011$. Males had more correct CRT responses
than females. Observed power was 1. There was no significant difference between religious identification and gender $F(1, 2505) = .071, p = .791$, partial $\eta^2 = .011$. Observed power was .058.

CRT, time: CRT total response time data was transformed into a normal distribution using natural logs. A two-way ANOVA was conducted to examine the effects of (non)religious identification and gender. There was a significant difference between religious identification $F(1, 2428) = 6.135, p = .013$, partial $\eta^2 = .003$. Regardless of whether or not their response was correct, the atheist group spent more time attempting to solve the CRT than the theist group. Observed power was .697. There was no significant difference between gender $F(1, 2428) = .804, p = .370$, partial $\eta^2 = .000$. Observed power was .146. There was no significant difference between religious identification and gender $F(1, 2428) = 1.607, p = .205$, partial $\eta^2 = .001$. Observed power was .245.

Hypothesis 5: A Chi-square was conducted to explore whether or not ASC (self)diagnoses would be more prevalent among atheists compared to theists. Of the 2516 cases analyzed for the study, 74 individuals reported some diagnoses of ASC (theists $N = 5$; atheists $N = 69$) and 2452 were non-ASC. A chi-square goodness of fit test was conducted to determine whether ASC was overrepresented in atheists and underrepresented in theists. The test indicated that the prevalence of ASC did not significantly differ across (non)religious identification ($\chi^2(1) = 1.399, p = .237$).

Hypothesis 6: A series of t-tests were conducted to test for differences between ASC atheists and Non-ASC atheists on all measures. The BAPQ Aloof and Rigid subscales displayed heterogeneity of variances and the “equal variances not assumed” (Welch-t test) column was interpreted in the output. This test is robust, allowing for the comparison of groups with unequal
variances (Weathington, Cunningham, & Pittenger, 2010; Welch, 1947). In order to control for the increase in the probability of making a Type I error due to running multiple tests a Bonferroni correction was calculated and the significance level was set to $p = .004$. All effect sizes were calculated using Cohen’s $d$.

Table 5 ASC atheists vs. non-ASC atheists $t$-tests

<table>
<thead>
<tr>
<th></th>
<th>ASC</th>
<th>Non-ASC</th>
<th>CI</th>
<th>$t$</th>
<th>$p$</th>
<th>$d$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$N$</td>
<td>$M$</td>
<td>$SD$</td>
<td>$N$</td>
<td>$M$</td>
<td>$SD$</td>
</tr>
<tr>
<td>RMTE</td>
<td>65</td>
<td>23.923</td>
<td>4.196</td>
<td>2113</td>
<td>26.176</td>
<td>3.534</td>
</tr>
<tr>
<td>Rosset overall</td>
<td>69</td>
<td>0.462</td>
<td>0.089</td>
<td>2350</td>
<td>0.473</td>
<td>0.089</td>
</tr>
<tr>
<td>Unambiguously accidental</td>
<td>69</td>
<td>0.013</td>
<td>0.057</td>
<td>2350</td>
<td>0.018</td>
<td>0.063</td>
</tr>
<tr>
<td>Prototypically accidental</td>
<td>69</td>
<td>0.253</td>
<td>0.159</td>
<td>2350</td>
<td>0.268</td>
<td>0.176</td>
</tr>
<tr>
<td>Unambiguously intentional</td>
<td>69</td>
<td>0.999</td>
<td>0.012</td>
<td>2350</td>
<td>0.995</td>
<td>0.032</td>
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<tr>
<td>Prototypically intentional</td>
<td>69</td>
<td>0.585</td>
<td>0.242</td>
<td>2350</td>
<td>0.611</td>
<td>0.225</td>
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<td>BAPQ total</td>
<td>69</td>
<td>3.965</td>
<td>0.566</td>
<td>2352</td>
<td>2.922</td>
<td>0.593</td>
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<tr>
<td>BAPQ-aloof personality</td>
<td>67</td>
<td>4.296</td>
<td>0.645</td>
<td>2277</td>
<td>3.196</td>
<td>0.871</td>
</tr>
<tr>
<td>BAPQ-pragmatic language</td>
<td>68</td>
<td>3.765</td>
<td>0.686</td>
<td>2275</td>
<td>2.678</td>
<td>0.617</td>
</tr>
<tr>
<td>BAPQ rigid personality</td>
<td>64</td>
<td>3.816</td>
<td>0.957</td>
<td>2265</td>
<td>2.898</td>
<td>0.722</td>
</tr>
<tr>
<td>CRT total</td>
<td>69</td>
<td>1.652</td>
<td>1.122</td>
<td>2354</td>
<td>1.466</td>
<td>1.147</td>
</tr>
<tr>
<td>CRT time</td>
<td>64</td>
<td>4.117</td>
<td>0.665</td>
<td>2282</td>
<td>4.252</td>
<td>0.839</td>
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</tbody>
</table>
Cognitive science explains religious (non)belief, in part, due to ToM ability. Indeed, without the ability to make inferences about the unseen mental states of others, it is unlikely supernatural beliefs would exist (J. L. Barrett, 2004, 2011, 2012; Bering, 2001, 2002). But upon reflection, this kind of simple thinking resembles what Dennett (2009) terms a “deepity”—a statement that is profoundly true yet utterly trivial. Other examples of deepities include “love is just a word” and “the Theory of Evolution is only a theory”. Both of these statements describe something true, perhaps even profound, but when put into a broader, more specific, meaningful, context, they become trivial. Could the disciplinary mantra, “mentalizing underlies supernatural belief” be a deepity? Scholarship on the cognitive and cultural foundations of religious belief may comically wish to begin including lengthy, Victorian-esque, subtitles several lines long (Norenzayan et al., 2016), in order to better describe claims that are accurate, yet trivial when properly contextualized. This manuscript has argued for “religion” as a folk category, like “belief,” which while a useful heuristic in many day-to-day pursuits and even scientific research, ultimately belies these endeavors. Just like other abstract social representations, such as notions of sister/brother hood (Berger & Luckmann, 1967), marriage, governments, and many other institutions (Boyer & Petersen, 2012; Searle, 2013), the relationship between ToM and religion, may be at such a fundamental level that it is certainly an important, indeed necessary, causal variable in the generation, maintenance, and transmission of these representations, but it is not sufficient.
Atheism, ToM, and the BAP

The aim of this study was exploratory, it tested several hypotheses on the nature of the relationship between ASC traits, gender, ToM, and supernatural (non)belief. Specifically, it examined key components of the ToM system—intentionality, mental state attribution, selection processor—and three components of the BAP—aloof personality, rigid personality, and pragmatic language deficits. Despite being well informed by predictions in the empirical and theoretical literature, this study failed to locate many differences where predicted. Out of 48 separate statistical tests, only 20 detected significant differences. Moreover, where significant differences were identified, their practical and theoretical significance in support of robust or even weak differences between atheists and theists is called into question. Interestingly, when compared to atheists, the theists were significantly higher on two BAPQ subscales (a point that will be returned to below). Overall, however, these results actually jibe well with recent studies (Lindeman & Lipsanen, 2016) and cautionary pleas on the relationship between ToM and other cognitive biases and their role in explaining supernatural (non)belief (Lindeman & Svedholm-Häkkinen, 2016).
Table 6  ANOVAS and t-test quick reference sheet

<table>
<thead>
<tr>
<th></th>
<th>Atheist vs. theist difference?</th>
<th>Gender difference?</th>
<th>Interaction?</th>
<th>ASC atheist vs. Non-ASC atheist</th>
</tr>
</thead>
<tbody>
<tr>
<td>RMTE</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Yes</td>
</tr>
<tr>
<td>Rosset overall</td>
<td>X</td>
<td>Yes</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Unambiguously accidental</td>
<td>Yes</td>
<td>Yes</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Prototypically accidental</td>
<td>X</td>
<td>Yes</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Unambiguously intentional</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>X</td>
</tr>
<tr>
<td>Prototypically intentional</td>
<td>X</td>
<td>Yes</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>BAPQ total</td>
<td>X</td>
<td>Yes</td>
<td>X</td>
<td>Yes</td>
</tr>
<tr>
<td>BAPQ-aloof personality</td>
<td>Yes</td>
<td>X</td>
<td>X</td>
<td>Yes</td>
</tr>
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<td>BAPQ-pragmatic language</td>
<td>Yes</td>
<td>Yes</td>
<td>X</td>
<td>Yes</td>
</tr>
<tr>
<td>BAPQ rigid personality</td>
<td>Yes</td>
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<td>X</td>
<td>Yes</td>
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<tr>
<td>CRT total</td>
<td>Yes</td>
<td>Yes</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>CRT time</td>
<td>Yes</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

The complete absence of differences on the RMTE is curious (except comparing ASC and non-ASC atheists). However, it is possible that males and atheists utilized systemizing and analytic skills in decoding the mental states, thereby masking possible differences in mentalizing (Valla & Ceci, 2011). Another possibility, is that when CSR suggests ToM underlies supernatural belief, they are referring to ToM at a wholly different level (Reddish et al., 2016), perceiving minds and intentionality where there is none (Gervais, 2013b).
Nonetheless, super natural belief (like nonbelief) is multiply determined (Banerjee & Bloom, 2013; McCauley, 2011; Norenzayan & Gervais, 2013; Norenzayan et al., 2016), with cognitive variables being only a (substantial?) component. As Norenzayan et al. (2016, p. 54) argue, “therefore, we should not expect overwhelming effect sizes from cognitive variables alone on religious beliefs.” While this is certainly an agreeable and humbling point, the effect sizes found in the current study—when and where they occur—wouldn’t seem to meet even the marginal differences predicted by this view. For example, in the current study, the effect size showing atheists score higher than theists on only one BAP trait (aloof personality) was $d = .013$. In other words, the variance present in the atheist and theist samples overlaps with one another by roughly 99.6%. Despite the fairly small and often ambiguous empirical literature surrounding ToM and supernatural (non)belief, which can be common for the early stages of inquiry into any topic (Norenzayan et al., 2016), there are reasons to begin hedging bets that there is any straightforward, meaningful, relationship between BAP traits or ToM that will be uncovered by survey research—especially since (non)belief is multiply determined.

All effect sizes in the current study were small, sans the differences between ASC atheists and non-ASC atheists. When compared to theists, atheists do not appear to have mentalizing deficits. However, ASC atheists did score over a half standard deviation below non-ASC atheists on mentalizing, and almost two standard deviations above non-ASC atheists on BAP trait characteristics. Thus, the strongest difference identified in this study suggests that ASC atheists differ markedly from non-ASC atheists.

While the ASC spectrum is often characterized by reduced religious belief, aspects of the psychoses spectrum are related to increased religious belief (Gervais, 2013b; Wlodarski & Pearce, 2016). A blurry distinction between schizophrenia and autism has haunted psychiatry
since both were identified in the 20th century (Crespi, 2011b). From a social brain perspective, autism and psychoses may place the atheist and the theist on fairly level playing field. If the significant differences but marginal effect sizes are interpreted by others as having some strong theoretical relationship to expected variation in BAP, then it is important to emphasize that theists, and not just atheists, scored higher than one another on different components of the BAP. In fact, Crespi (2011b) suggests that the BAPQ, captures some positive symptomologies of psychoses.

Schizophrenia and autism are not “real,” “natural,” categories (Crespi, 2011b). Of the many adaptations provided by the social brain in human evolution, mentalizing skills and the capacity for analytic thought are key (Baron-Cohen & Belmonte, 2005). And while the literature is replete with connections between autism and atheism or psychoses and religion, it remains largely unconnected to informed discussions on the relationship between these psychiatric categories, or rather, their non-natural kind and diffusion into normality and adaptive variation under an evolutionary model.

This study suggests that atheists do not have deficits applying intentionality and interestingly, they seem to be fairly judicious and discerning in their application of intentionality where appropriate. For example, when compared to the atheist group, the theist group over-attributed intentionality in ambiguous situations (e.g., “She cut him off driving.”) and under-attributed intentionality in situations that most would consider fairly intentional (e.g., “She baked a cake.”). This is in line with recent data suggesting that application of intentionality, teleology rather, is better controlled by atheists (Järnefelt et al., 2015) and that nonreligious contexts may encourage better tuning, better control (Rottman et al., 2016). After all, these kinds of
mechanisms are learning mechanisms (H. C. Barrett, 2015), being open to and requiring testimony and contextual influence.

The differences in atheist vs. theist applications of intentionality is also in line with data suggesting that confusing ontological properties (i.e., applying intentionality to intention-less objects or events) is a better predictor of supernatural belief than mentalizing ability (Lindeman, Svedholm-Häkkinen, et al., 2015). It is important to consider that the “positive” symptoms of schizophrenia concern the over extension of intentionality and mental states, whereas the RIS taps into the ability to inhibit the application of intentionality as an adaptive human default, explaining most any happening on earth (and surely Heaven). The “negative” symptoms of schizophrenia concern deficits in social responsiveness and aspects of language manipulation (Ochoa et al., 2012).

The female trend towards religiosity and male trend towards atheism is supported by this data. However, given the research area is in its infancy, the various differences demonstrated by theists and atheists on these measures are difficult enough to interpret that bringing gender into the picture appears to complicate things even more—perhaps. To my knowledge, the RIS has never been explored from a gender/sex differences perspective. In fact, it is a rather new measure that has not seen much use to date, presumably due to this newness. It has however, been used in a study of schizophrenia patients and a control group (Peyroux, Strickland, Tapiero, & Franck, 2014). While the researchers did not explore any possible sex differences, the sample of schizophrenia patients demonstrated an intentionality bias above the control group in every condition. Moreover, the researchers found the negative symptoms related most to attributions of intentionality. In terms of the social brain continuum for these adaptive functional traits (Crespi, 2011b), again, the negative symptomology of schizophrenia appears to be expressed most
strongly in males (Ochoa et al., 2012), these negative symptoms overlap with the symptomology of ASC (Crespi & Badcock, 2008), and males are over represented in ASC (Baron-Cohen & Belmonte, 2005). The BAPQ may capture some of the disorganized, negative, symptoms of schizophrenia. The present study demonstrated that males had more overall BAPQ traits when compared to females. The interpretation of ASC and schizophrenia as key variables of the social brain, contributing to sex differences and differences in supernatural (non)belief, possibly affected by ToM modular functioning, was not explicitly tested in the present study. However, in light of other recent studies exploring psychoses and schizotypy traits, ASC, and supernatural belief (Lindeman & Lipsanen, 2016; Wlodarski & Pearce, 2016), this remains a plausible, but tangled path, to explaining differences in supernatural belief from a social brain perspective.

Whereas males performed worse at inhibiting intentionality compared to females, they demonstrated an advantage at inhibiting intuitive, yet incorrect, responses on the CRT. This fits with research indicating that on average, males appear to favor analytic cognitive styles (Baron-Cohen, 2009; Caldwell-Harris, 2012). Furthermore, males were overrepresented in the atheist sample for the current study and the atheists outperformed theists, and spent more time reflecting over the CRT problems regardless of their response. For the absence of differences between ASC atheists and non-ASC atheists, it may be that they are more similar in analytic thinking styles to one another, while differing markedly in mentalizing abilities and BAP traits.

**Limitations and Future Directions**

Sample size may have been one possible limitation, as the ratio of atheists to theists or gender in the theist category, may have yielded some serendipitous results. However, there is no single trend for how the variables measured here should play out empirically and future studies
should examine gender differences whenever possible. It is possible that administering the RIS and RMTE with speeded instructions would produce further differences and larger effect sizes. Furthermore, while self-report, correlational methodology may be highly informative at some levels of inquiry (e.g., Streib & Hood, 2016), it can be wholly remiss at other levels, as only a small portion of mental processes are available for introspection (Jong, Halberstadt, & Bluemke, 2012; Nisbett & Wilson, 1977). Future studies should look for alternative ways to measure ToM, drawing from the wide array of social cognitive tasks and experimental paradigms utilized within the cognitive sciences as whole, and move beyond seeking correlations with the RMTE and self-report measures of empathizing. Another possible limitation is that the language in the informed consent, inviting participants to complete a survey on how “personality and cognitive styles might influence religious belief and attributions of intentionality,” may have directly tipped individuals off as to the studies purpose. Future studies must seek to include not only measurements of religiosity as a dimensional construct (which has been the norm), but measure supernatural (non)belief using implicit measures, alongside nominal categories of identification, when exploring different variables in CSR. This should help to elucidate not only scientific knowledge, but provide a more accurate presentation of this data to the general public.

Individuals always identify their “beliefs” nominally at the folk level and do not use mean scores on dimensional religiosity scales to reply to the question “what are your (non)religious beliefs?”

The primary purpose of this study has been to test for social-cognitive differences between atheist and believers. The role of ToM in explaining supernatural (non)belief is emphasized to various degrees and in differing contexts depending on what literature is consulted. This mirrors the point that CSR does not have a unified set of questions, methodologies, and constructs. It does not, currently, comprise a stable research program with
clear and well defined objectives and tools to reach them (Coleman, 2013; Jong, 2014). Although it has been predicted that atheists may have deficits in ToM, the current data does not support this hypothesis.

In closing, it is important to introduce a distinction that has been implicit up until this point in the study. The difference between design space and phenotypical space is important to understand when explaining variation in the social brain (H. C. Barrett, 2015). Design space is the area where invariant, hill climbing, fitness increasing, evolutionary “designs,” can be acted upon by natural selection. The ToM system exists in the design space (H. C. Barrett, 2015). The design space is tethered to the phenotypic space, which concerns fitness relevant outcomes exhibiting wide variation in a given environment. Variation in phenotypic space is always expected and indeed necessary for evolution to work at all. Meaning in life is a high level, adaptive, function of ToM (Bering, 2011), which represents the phenotypic space, within which, humans develop in virtue of their species typical adaptation. For "religion," we might say that meaning making is the central feature (Coleman, Silver, & Hood, 2016; Paloutzian & Park, 2013). Thus natural selection may not favor “religion” or “religious traits” per se, but instead favor the construction of a meaningful worldview and existence—the will to meaning (Frankl, 1962)—that different individuals pursue in different ways. “Religious beliefs” can be “replaced” (Farias, 2013). There is evidence in support of this view, demonstrated by the curvilinear relationship between religious belief and wellbeing/health (Galen, 2015). As Galen (2015, p. 63) describes the data, “it is beneficial to have a coherent worldview and to engage in regular meaningful interactions with others who share this view in a supportive environment that allows for prosocial engagement with the broader community.”
Phenotypic space should not be confused with “design space” (H. C. Barrett, 2015). A “religious phenotype” should not be confused with the possible design space of an evolutionary, fitness relevant, adaptive complex, or mechanism(s) that places a premium on meaning, making and finding meaning in life. Carving up the phenotypic space can be done in, potentially, countless ways and this presents “a kind of frame problem, but not for [natural] selection—for us” (H. C. Barrett, 2015, p. 174). Thus, the correlations between mentalizing and “religion” will indubitably remain mixed and weak, especially if atheists and other nonreligious eschew supernatural representations or beliefs in favor of other, equally counter intuitive, fantastical ones, or meaningful ones (Coleman et al., 2016; Farias, 2013; Visuri, In Prep). There is a natural world to be discovered and measured, but it is always done so without the “epistemological grace” (Bloor, 2007) present in broad conceptualizations of “religion” and narrow conceptualizations of “science.” There are more things in heaven and earth than have beendreamt of in an evolutionary cognitive science of religion up until this point and perhaps it will take an evolutionary cognitive science of atheism to explore them further.
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