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The sovereignty of social cognition: Insights from neuroscience

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Abstract

Reflecting twenty-five years ago on the emerging dominance of cognitive approaches to the study of social phenomena, Tom Ostrom referred to the “sovereignty” of the field of social cognition. In ways unanticipated at the time, recent findings from the neurosciences suggest two ways in which social cognition may indeed make sovereign contributions to human thought. First, researchers have repeatedly demonstrated that human social capacities draw on neural regions distinct from those that subserve comparable nonsocial aspects of cognition and perception. Second, the regions implicated in social cognition reflect a “default network” of brain activity, suggesting that the dominant mode of human thought may be inherently social in nature. Patterns of impaired and spared abilities in autism complement these neuroimaging findings. Together, such observations call into question attempts to explain social cognition in terms of “general-purpose” mental operations and underscore views that a driving force in human evolution has been the development of unique, species-typical social abilities that distinguish *Homo sapiens* from other primate species.

Sovereign (adj)

1. autonomous, independent, self-governing
2. greatest in status or authority or power

Human social behavior depends critically on an ability to make rapid and accurate sense of other minds, often on the basis of limited clues about the thoughts, feelings, and dispositions they comprise. Understanding how humans meet these challenges has long been a central goal of social psychology (Festinger, 1955; Heider, 1958). In doing so, social psychologists of the last several decades have made increasing use of the methods and empirical findings of cognitive science, a development that blossomed into the “social cognition” movement in the late 1970s (Fiske & Taylor, 1984; Hamilton, Katz, & Leirer, 1980; Hastie & Kumar, 1979; Wegner & Vallacher, 1977). Much as the broader field of cognitive psychology has sought to understand mental phenomena such as memory, language, or perception in terms of the underlying cognitive operations that give rise to them, the field of social cognition has sought to understand mental phenomena that occur in the course of social interaction—such as attributions about others’ behavior or the formation of impressions about others—in terms of the cognitive operations that give rise to them.

Reflecting some twenty-five years ago on the emerging dominance of these cognitive approaches to the study of social phenomena, Tom Ostrom (1984) referred to the “sovereignty” of this social cognition movement and rightly predicted its lasting impact on social psychology. In doing so, Ostrom argued that an understanding of how humans successfully navigate the social world would necessarily entail an understanding of the core information processing out of which social competency is built; accordingly, he argued that the branch of social psychology that adopts such a cognitive approach should be considered a dominant approach to

understanding the social mind. Interestingly, recent findings from the neurosciences have offered a surprising twist on this proposal. Although Ostrom suggested that its concern with cognitive process made the *field* of social cognition preferable to other approaches within social psychology, these emerging data instead suggest that it is these *cognitive processes* themselves that should be considered “sovereign.” Specifically, researchers using neuroimaging and neuropsychological approaches to understanding the social mind have repeatedly demonstrated that many of the cognitive operations giving rise to human social abilities can lay claim to sovereignty in both senses of that term: (i) by remaining *independent* of the mental operations supporting other, nonsocial forms thought and (ii) by enjoying *privileged status* in the human cognitive repertoire.

This paper reviews the empirical support for this nascent view of the sovereignty of human social thought. Although much of this evidence derives from research using neuroimaging, neuropsychological populations—especially individuals with autism—provide important converging support for this view. Nevertheless, like many “big picture” ideas in science, this review is intended more as provocative food for thought than as an unassailable theory of the social mind.

The independence of social cognition

“Are there processes... that are in some way designed, specialized, and best understood as subserving the perception of socially relevant stimuli and the guidance of social behavior?”

(Adolphs, 2001, p. 124)

On first pass, the mental abilities required for successful interpersonal interaction appear similar to those required by other, nonsocial aspects of everyday life. We are frequently called upon to

make inferences about hidden or implied events or objects (“I wonder what this bottle labeled with the skull-and-crossbones might contain”) in much the same way that we infer the hidden or implied goings-on of other minds (“I wonder what the person who just winked at me is thinking”). We accumulate, store, and retrieve knowledge about the features of objects and categories with which we interact (e.g., canaries are yellow and are used in coal mines, and as birds, likely fly, sing, and have feathers), much as we do for individuals and the social categories to which they belong (e.g., Marcel is intelligent but slightly arrogant, and as a man, likely enjoys watching football more than shopping for shoes). And we encode and recall events about objects and events (“remember the time that house around the block caught fire?”) just as we do for other people (“remember the birthday party where Abby caught her hair on fire?”).

Until recently, researchers were led by these apparent similarities to explain social capacities in terms of general-purpose mental processes common to both social and nonsocial cognition. For example, in their influential early account of social cognition, Wyer and Srull (1986) state explicitly that their “model assumes that the human cognitive system operates the same way in social contexts as in any other context” (p. 322). In his overview of social cognition, Gilbert (1999) notes that “the social cognition movement was predicated on the assumption that social and nonsocial cognition are only superficially distinct, and that a single theory could thus explain both instances quite nicely” (p. 777). And most notably, the very beginning of their canonical text on the field, Fiske and Taylor (1984) explicitly make the case for describing social cognition in terms of general-purpose cognitive processes:

“One of the hallmarks of social cognition is the influence of detailed models from cognitive psychology. These models are important because they precisely describe mechanisms of learning and thinking that apply in a wide variety of areas, including social perception. Because these models are general and

because cognitive processes presumably influence social behavior heavily, it makes sense to adapt cognitive theory to social settings.” (pp. 1-2)

However, emerging neuroscience approaches to social cognition have increasingly called these assumptions into question. If social cognition draws on the same mental operations as other forms of cognition, one would expect to observe a common functional neuroanatomy associated with social and nonsocial thought (see below for a review of how researchers use functional localization to address questions about the organization of cognition). That is, making inferences about other minds should recruit brain regions involved generally in reasoning; making use of one’s knowledge of the social world should recruit brain regions involved generally in semantic knowledge; and person memory should recruit brain regions involved generally in episodic recall. However, the results of dozens of neuroimaging studies have now roundly disconfirmed this possibility. Rather than sharing a common neural basis with nonsocial forms of thought, thinking about the mental states of others has consistently been shown to draw on a distinct set of brain regions that differentiate it from other abilities: most commonly, the medial prefrontal cortex (MPFC), the temporo-parietal junction (TPJ), and medial parietal cortex/posterior cingulate (for review, see Amodio & Frith, 2006; Frith & Frith, 2006; Lieberman, 2010; Mitchell, 2009b). To the extent that distinct patterns of neural response indicate the engagement of different cognitive processing (see below), such findings strongly suggest the independence of social cognition from other forms of thought.

This neural dissociation appears ubiquitously across contexts that require participants to reason, use knowledge, or remember information about another person’s mind. For example, researchers have demonstrated that these regions consistently differentiate between reasoning about others’ mental states and reasoning about physical aspects of the environment. In these

studies, participants read a series of short vignettes, some of which can only be understood by recognizing that another person holds an erroneous belief about the world. A character in one such story might be described as having paid a large sum of money for a ring that contains a convincing counterfeit of a ruby; participants would be required to infer that the character must have falsely believed that the ring held a valuable gem (e.g., Saxe, Carey, & Kanwisher, 2003). In contrast, nonsocial scenarios require perceivers to reason about physical—rather than mental—representations, such as a photograph that falsely depicts an object that has since been altered. Despite the fact that the two types of stories have an identical logical structure, making inferences about others' mental states regularly produces greater activity in the MPFC, TPJ, and medial parietal cortex than reasoning about the physical environment, suggesting the independence of the cognitive processes supporting these abilities. The same observations have been reported when perceivers make inferences about the minds of others (i) in cartoons (Brunet, Sarfati, Hardy-Baylé, & Decety, 2000; Gallagher, et al., 2000); (ii) as implied by moving inanimate objects (Castelli, Happé, Frith, & Frith, 2000; Martin & Weisberg, 2003; Wheatley, Milleville, & Martin, 2007); (iii) during competitive games (Gallagher, Jack, Roepstorff, & Frith, 2002; McCabe, Houser, Ryan, Smith, & Trouard, 2001), and even (iv) about historical figures (Goel, Grafman, Sadato, & Hallett, 1995).

Similar dissociations have been observed for semantic knowledge. Cognitive psychologists have often investigated semantic memory using “feature verification” tasks in which participants decide whether a particular characteristic is true of an object or category of objects: for example, whether flamingos can fly or hammers be made of wood. In neuroimaging studies, this kind of task has routinely been associated with a set of left-lateralized brain regions that subserve various aspects of semantic knowledge, notably the inferior frontal gyrus and

inferotemporal cortex (Martin, 2001; Martin & Chao, 2001; Thompson-Schill, Kan, & Oliver, 2006). In contrast, when participants are asked to draw on their everyday knowledge of the social world—for example, verifying whether words denote personality characteristics or judging the characteristics of social groups—a very different pattern of brain activity is observed, again centering on MPFC, TPJ, and medial parietal cortex (Contreras, Banaji, & Mitchell, under review; Mitchell, Heatherton, & Macrae, 2002). Follow-up work has demonstrated that these brain regions do not subserve semantic knowledge of the *physical* characteristics of others, but appear to be engaged specifically when considering descriptions of other minds (Mitchell, Banaji, & Macrae, 2005a, 2005b).

Finally, researchers have demonstrated similar effects for episodic memory. Since the late 1970s, social psychologists have examined how processing information in a social manner affects later recall for that information. In many such experiments, participants read brief descriptions of an unfamiliar individual, such as “he stepped on his girlfriend’s feet while dancing” or “he returned a lost wallet with all the money inside.” Participants were asked to perform one of two tasks with each statement: either to use it to form an impression of the target individual or to perform a task that directed attention away from mental characteristics, such as intentionally trying to memorize the information. Of note, the impression task not only routinely produced *better* memory performance than intentional encoding, but frequently resulted in qualitatively *different* memory performance, such as better recall for statements that were incongruent with the prevailing impression of a target (Hastie & Kumar, 1979).

Until recently, researchers tended to explain such observations by appealing to cognitive processes of the kind proposed to support memory and attention in general, such as through a “deeper” level of processing, by the creation of greater inter-item associations, or via well-

rehearsed schemas (Hamilton, et al., 1980; Hastie & Kumar, 1979; Wyer & Srull, 1986).

Although parsimonious, this approach has foundered on recent demonstrations that—just as for other types of social-cognitive tasks—impression formation engages a distinct pattern of brain activity that distinguishes it from equivalent nonsocial tasks, once again centered on the MPFC (Mitchell, Macrae, & Banaji, 2004, 2005; Schiller, Freeman, Mitchell, Uleman, & Phelps, 2009). Moreover, this dissociation has helped explain the unusual patterns of memory associated with social cognition: the amount of activity in MPFC when first processing a statement predicts the likelihood of that item being remembered later, but only as long as it was initially encountered during the impression task (Mitchell, et al., 2004). In other words, neither the qualitative nor quantitative changes in memory produced by impression formation can derive from “more of the same” kind of processing as that subserving other forms of memory encoding tasks, but appears instead to result from a distinct set of social-cognitive processes.

These consistent neural dissociations across reasoning, semantic knowledge, and episodic memory help demonstrate the independence—i.e., sovereignty—of social cognition from “general-purpose” cognitive processing. In doing so, such observations have suggested a need to reconsider attempts to describe social cognition in general-purpose terms, and to instead develop a new taxonomy of mental operations unique to social thought. That is, rather than attempting to understand our social abilities as the product of processes that give rise to other forms of reasoning, knowledge, or memory, data of this kind suggest a need for a new cognitive vocabulary with which to explain human social competence. Recent efforts to do so have already produced several novel approaches to understanding the social mind that do not derive from other branches of cognitive science, but instead posit a special class of mental processes specifically designed for understanding other people. Such proposals include the use of

“simulation” to understand other minds (Gallese & Goldman, 1998; Mitchell, Macrae, & Banaji, 2006); the existence of a system by which perceivers “mirror” the intentions and feelings of others (Rizzolatti & Craighero, 2004; Singer & Lamm, 2009); and cognitive representations unique to understanding others’ beliefs and other epistemic mental states (Saxe, et al., 2003).

Such observations also serve to refute two common criticisms, one leveled broadly at social cognition and the other more specifically at brain-based approaches to its study. First, the field of social cognition has occasionally been viewed as a form of “warmed-over” cognitive psychology, in which researchers simply replaced nonsocial stimulus materials with names and faces, but did not offer new insights into the nature of human cognition. Second, the use of brain-based methods to study social cognition has routinely been characterized as little more than a modern form of phrenology that provides attractive pictures the brain but cannot illuminate the true nature of cognition (“mind”) (Cacioppo, et al., 2003; Uttal, 2001; Willingham & Dunn, 2003). However, both criticisms falter on demonstrations of the distinct neural basis of social cognition. To the extent that social competencies cannot be explained in terms of general-purpose mental operations, social stimuli like names or faces are not interchangeable with nonsense words or abstract visual images, but are instead likely to prompt wholly different kinds of processing that must be studied in unique ways. Perhaps more importantly, this conclusion has been reached almost exclusively by examining the brain basis of social cognition. Prior to the such observations, most researchers in this area either assumed explicitly that social cognition relies on general-purpose cognitive processing or else simply neglected to consider the issue altogether. The demonstrations that social cognition relies on distinct brain regions subserving distinct mental operations clearly belies criticisms that neuroimaging and related techniques cannot yield novel insights about the human mind.

How functional localization informs psychology

This last point merits a brief review of how experimental psychologists use brain data to explore the nature of cognition. Over the past two decades, researchers have made increasing use of measures—such as functional imaging—that identify the neural substrates associated with different cognitive processes, a project known as “functional localization.” As for all dependent measures employed by experimental psychologists, the usefulness of functional localization for informing the study of the mind depends on making assumptions about how to turn inherently unobservable phenomena—cognitive processes—into effects that can be observed and quantified. Since the earliest days of cognitive psychology, researchers have assumed that differences in cognitive processing will reveal themselves in observable behavior, such as dissociations in how long it takes to perform different experimental tasks (i.e., response latency); how accurately one can perform such tasks; or the downstream consequences on memory for information processed during those tasks. In recent years, researchers using functional localization have developed another strategy for turning cognitive processes into observable effects by assuming that cognitive processes will also reveal themselves as dissociations in the brain regions activated by different experimental tasks. In other words, whereas earlier research often made inferences about cognitive processes on the basis of *temporal* differences between experimental tasks, the functional localization approach to psychology identifies such cognitive processes on the basis of *spatial* differences.

The use of such “where” information to address questions about cognitive process relies on two interrelated assumptions (see Henson, 2005, 2006). First, researchers generally assume that different cognitive processes will rely on different brain regions; accordingly, if two tasks

are associated with distinct patterns of neural activation, they likely draw on distinct kinds of cognitive processing. This *dissociation* logic enables researchers to infer that two seemingly-related psychological phenomena may actually result from different mental operations, to the extent that they are subserved by different underlying neural systems. For example, using this approach, researchers successfully resolved the question of whether explicit and implicit memory phenomena are manifestations of the same underlying memory system. Because each is produced by distinct brain regions, these two superficially-similar phenomena are now known to be products of separable memory systems (Gabrieli, Fleischman, Keane, Reminger, & Morrell, 1995; Schacter & Buckner, 1998).

Second, researchers reason that any given brain region likely subserves a single kind of cognitive process or a small number of highly related processes. Accordingly, if two tasks provoke the same underlying neural response, they likely draw on similar kinds of cognitive processing. Although such *association* logic is often more tentative than that of dissociation (Henson, 2006), it can nevertheless provide evidence that two seemingly-unrelated psychological phenomena may actually result from similar mental operations, to the extent that they are subserved by the same underlying neural systems. For example, researchers have profitably used functional localization to address a debate about whether visual imagery (seeing in one's "mind's eye") relies on the same mechanisms as visual perception (actual seeing). A sizeable number of studies have now demonstrated that visual imagery draws on the same cortical regions as early visual perception (e.g., V1), suggesting that these two very different phenomena may indeed rely on common cognitive operations (for review, see Kosslyn, 1994).

Of course, any model of how cognitive processes will affect observable outcomes may ultimately prove misguided. We may someday realize that the time it takes to make a motor

response across different experimental tasks is simply an inappropriate or unreliable measure of underlying cognitive process, which would challenge many of the conclusions of cognitive psychology. In the same way, we may someday realize that the pattern of neural activity associated with different experimental tasks is an inappropriate measure of cognitive process. However, at present, the correspondence among different localization techniques—functional neuroimaging, neuropsychological patients, animal models, Transcranial magnetic stimulation—as well as converging evidence from more traditional experimental methodologies strongly suggests that the functional localization approach will continue being a useful tool carving up the mind into its constituent parts.

Forms of social processing

The preceding section reviewed data suggesting that one aspect of social cognition—namely, the consideration of others' mental states—may rely on distinct neural and cognitive processes. However, social competence requires more than just the ability to understand the goings-on of other minds. Indeed, our willingness to ascribe mental states to others likely relies on even more fundamental capacities for recognizing which entities are agents with mental states in the first place. Such social *perception* includes the ability to detect the presence of another mental agent and the identification of specific individuals. Interestingly, just as for social cognition, the human brain appears to distinguish social perception from other forms of perceptual processing. For example, the detection of biological motion and animacy—an important cue to the presence of another mental agent—draws on brain regions (e.g., superior temporal sulcus) that are distinct from those subserving the detection of other forms of motion (Allison, Puce, & McCarthy, 2000). Likewise, face perception draws on brain regions (e.g., fusiform gyrus) that are distinct

from those subserving object identification (Kanwisher, McDermott, & Chun, 1997; McCarthy, Puce, Gore, & Allison, 1997). Such findings suggest that, much like social cognition, social perception does not rely on “general-purpose” processing, but instead draws on an autonomous set of mental operations distinct from other, nonsocial aspects of perception.

Interestingly, social cognition has also been associated with a second type of neural response, in addition to the consistent involvement of MPFC, TPJ, and medial parietal cortex in making inferences about other minds. Over the past two decades, researchers have characterized a number of brain regions that support various subjective states, such as the anterior insula for feelings of disgust; a ‘matrix’ of regions involved in registering pain; the amygdala for experiences of fear and apprehension; and the mesolimbic dopaminergic system for reward and subject value. Intriguingly, these same brain regions are engaged when merely *observing* another person experience the same subjective state. For example, the anterior insula is engaged when viewing others’ expressions of disgust (Wicker, et al., 2003); the pain matrix when viewing others in pain (Botvinick, et al., 2005; Lamm, Batson, & Decety, 2007; Morrison, Lloyd, di Pellegrino, & Roberts, 2004; Phillips, et al., 1998; for review, see Singer & Lamm, 2009); the amygdala when viewing or listening to expressions of fear (Breiter, et al., 1996; Morris, et al., 1996; Phillips, et al., 1998; Whalen, et al., 1998; Whalen, et al., 2001); and the mesolimbic dopaminergic system for watching others experience rewarding events (Mobbs, et al., 2009). Similar observations have been made for viewing others being touched (Blakemore, Bristow, Bird, Frith, & Ward, 2005; Keysers, et al., 2004); committing an error (Bates, Patel, & Liddle, 2005; Carp, Halenar, Quandt, Sklar, & Compton, 2009; Miltner, Brauer, Hecht, Trippe, & Coles, 2003; van Schie, Mars, Coles, & Bekkering, 2004); and engaging in goal-directed action (for review, see Rizzolatti & Craighero, 2004). However, these mirroring phenomena

differ from explicit attempts to infer others' mental states in that they involve a wide range of different neural systems rather than a narrowly circumscribed network; in fact, adopting the same pattern of neural activity of those around us seems to be a general feature of the human brain. As such, these observations suggest that in addition to our ability to mentalize explicitly about the thoughts, feelings, and intentions of others, humans may be marked by a broader tendency to vicariously experience others' subjective states (for earlier such insights, see Berger, 1962; Krebs, 1975; Vaughan & Lanzetta, 1980).

The primacy of social cognition

The word “sovereignty” can be used not only to denote the independence of an entity, but also to acknowledge its primacy or dominance (as, for example, when referring to a monarch).

Unexpectedly, neuroscience research has recently demonstrated that this second sense of “sovereign” also applies to social cognition. Even more unexpectedly, this conclusion derives not from social or cognitive psychology, but from basic research on how the human brain consumes energy. Brain regions differ widely in their resting metabolic activity—the amount of oxygen and glucose consumed when individuals lie passively without being asked to perform a specific task—such that some areas settle into a fairly quiescent state during rest, whereas others continue to make heavy metabolic demands (Gusnard & Raichle, 2001; Raichle, et al., 2001). That is, some brain regions are chronically “hungrier” than others, consuming an outsized amount of energy even when one simply rests quietly.

Surprisingly, the brain regions with the highest resting metabolic rates are exactly those most commonly implicated in making inferences about other minds: the MPFC, lateral parietal cortical areas that include the TPJ, and medial parietal cortex (Gusnard & Raichle, 2001;

Raichle, et al., 2001). In other words, when individuals rest quietly with no specific task to perform, the human brain adopts a pattern of activity that looks extraordinarily like that deployed during social-cognitive tasks. What does such overlap indicate? Although researchers have yet to understand precisely how variability in resting metabolism relates to cognitive processing, these observations nevertheless suggest that the human brain is marked by a special proclivity for social thought. Our brains seem wired to approach the world in a state of chronic readiness for thinking about the minds of others.

Perhaps as a consequence, humans demonstrate a curious affinity for mental states. We naturally understand the behavior of others in terms of thoughts and feelings rather than as the result of external forces, despite the fact that such internal states are inherently private and unobservable (Dennett, 1987). Moreover, we routinely perceive mental states where none actually exist. People in every culture ascribe human-like mental states to inanimate objects, animals, or dead ancestors (Boyer, 1996). Experimentally, Heider and Simmel (1944) examined the bias to perceive spurious thoughts and feelings with their now-classic “social illusion”: although their physical stimulus consists solely of moving geometric shapes, healthy adults obligatorily perceive a social interaction among purposeful agents motivated by complex beliefs, desires, and emotions. The emerging neural approach to social cognition suggests that such anthropomorphization may occur because brain regions that allow us to understand the minds of others have continuous priority over those that subserve other cognitive abilities. We possess brains that appear chronically prepared for social thought, and as such, remain ever watchful for the presence of other minds, presume that other entities have thoughts and feelings until proven otherwise, and generally traffic in mental states more readily than not.

Converging evidence for these ideas comes from the study of individuals with autism, whose pathology is defined by pronounced social impairments. Experimentally, such individuals do not demonstrate a bias to perceive mental states; indeed, many autistic patients describe the events in the Heider and Simmel video in purely physical terms, as the complex motion of geometric shapes across a computer screen rather than as an illusory social interaction (Castelli, Frith, Happe, & Frith, 2002). Although the brain basis of autism remains incompletely understood, MPFC activity during social-cognitive tasks commonly distinguishes autistic individuals from neurotypical controls (for review, see Di Martino, et al., 2009). More importantly for the current claim, researchers have repeatedly reported evidence of decreased brain metabolism in autistic individuals, localized most commonly to medial frontal cortex and including reduced glucose metabolism (Hazlett, et al., 2004; Haznedar, et al., 2000), regional cerebral blood flow (George, Costa, Kouris, Ring, & Ell, 1992; Zilbovicius, et al., 1995), and receptor binding of both dopamine (Ernst, Zametkin, Matochik, Pascualvaca, & Cohen, 1997) and serotonin (Makkonen, Riiikonen, Kokki, Airaksinen, & Kuikka, 2008; Murphy, et al., 2006). In some cases, the extent of these resting abnormalities have been shown to correlate with the severity of autistic social impairments, suggesting that unusually low metabolic rates in medial frontal cortex may be one root cause of the disorder (Kennedy & Courchesne, 2008; Kennedy, Redcay, & Courchesne, 2006; Ohnishi, et al., 2000). This perspective suggests that autism may result, in part, from an absence of the chronic readiness for social thought that marks normal cognition. Consistent with this possibility, some recent data have suggested that some forms of the autistic syndrome may result from a failure to instinctively engage in social processing when interacting with other people, but normal performance when explicitly instructed to do so—suggesting that such individuals may simply not experience the chronic impulse to view

most events through a social lens (Senju, Southgate, White, & Frith, 2009; Wang, Lee, Sigman, & Dapretto, 2007).

In addition to their high resting metabolic rate, the brain regions associated with social cognition demonstrate a second unusual feature that suggests the priority of social thought: when individuals engage in tasks that do not require social cognition, these regions typically “deactivate” relative to baseline (Gusnard & Raichle, 2001; Raichle, et al., 2001; Shulman, et al., 1997). That is, when asked to perform a task that requires processing of a nonsocial kind—such as perceptual discriminations, motor tasks, linguistic judgments, and the like—our brains tend to suspend the otherwise high metabolic activity in MPFC, TPJ, and medial parietal cortex. However, such suspension of baseline activity during periods of nonuse is highly unusual for brain regions. Areas that subserve other aspects of cognition (object recognition, language, attention, executive function, episodic memory, etc.) do not typically demonstrate a change from baseline when a task does not require their particular form of processing; when not “in use” the activity of such brain regions simply remains at its relatively low baseline levels. In contrast, deactivations below baseline routinely appear in MPFC, TPJ, and medial parietal cortex even when individuals perform tasks that differ only in the lack of requirement to make sense of another mind (such as those reviewed in the preceding section).

Why would the areas implicated in social cognition show this unusual tendency to deactivate during nonsocial tasks? At first blush, one might assume that the brain simply needs to redirect resources away from areas with otherwise high metabolic rates to those with more immediate energy needs (the “vascular-steal” hypothesis). But task-related changes in local blood flow are so small (no more than a few percent of total metabolic activity) and the capacity for increased cerebral blood flow so large, that there is little reason for the brain to engage in

such metabolic rationing during periods of transient task performance. Moreover, deactivations can occur at considerable distance from metabolic increases or even in their complete absence, further undermining the plausibility of a “Robin Hood” account in which the brain steals vascularily from the metabolically rich (for an extended discussion of these issues, see Gusnard & Raichle, 2001; Raichle, et al., 2001).

Although it is unlikely that the elevated activity of MPFC, TPJ, and medial parietal cortex interferes *physiologically* with other neural areas, the cognitive processing carried out by these regions may well interfere *functionally* with nonsocial forms of thought. A chronic readiness to encounter other agents who act on the basis of their thoughts and feelings poses an acute challenge for understanding nonsocial aspects of the environment in which entities are governed not by internal mental states, but by external physical forces. Certainly, the use of most human artifacts would be impossible if we insisted on trying to understand their thoughts and feelings (think: hammers, hot plates, and door mats) or expected them to behave on the basis of internally-motivated mental states. The solution to this cognitive problem may require interruption of the spontaneous mental processes that otherwise induce a readiness for social thought. In other words, if humans are naturally predisposed towards a social-cognitive mode of processing in which mental states abound, we may need to actively “shut off” our natural social inclinations in order to interact appropriately with other, nonsocial aspects of our environment.

Autism again provides important evidence in support of this proposal. To the extent that autistic individuals are unencumbered by the intensive social processing in which neurotypical brains engage, they should be “freed up” to attend more readily to objects and other nonsocial aspects of the environment. And indeed, autism has long been marked by unusual aptitudes in visuospatial and other nonsocial domains (for review, see Treffert, 2009). These so-called

“savant” skills include exceptional musical or drawing talent, puzzle-solving aptitude, or the capacity to perform complex mathematical or calendrical calculations mentally (for example, being able to report the day of the week on which any future date will fall). Although certainly not a universal feature of autism, most researchers agree that about one in ten autistic individuals demonstrate at least one such savant skill and that a majority show less pronounced, but nevertheless enhanced, abilities in at least one nonsocial domain of performance, such as being able to complete jigsaw puzzles particularly well (Happé, 1999; Mottron & Belleville, 1993; Rimland & Fein, 1988). It seems that minds free from the constant demands of social cognition may be at special liberty to pursue nonsocial processing in an unusually intensive manner.

Social cognition and the default network

Partly on the basis of their high resting metabolic rate, the brain areas most closely associated with thinking about other minds—the MPFC, TPJ, and medial parietal cortex/posterior cingulate cortex—have recently been described as forming a “default network” of neural regions (Raichle, et al., 2001). Recently, researchers have implicated this same network in a number of tasks beyond understanding other minds. Intriguingly, such tasks generally require participants to richly envisage themselves in situations other than the “here-and-now”: for example, by imagining what they might think and feel during some future event or by recalling their experiences during a past episode (e.g., Addis, Wong, & Schacter, 2007; Schacter, Addis, & Buckner, 2007; Szpunar, Watson, & McDermott, 2007). One emerging perspective suggests that these abilities share the requirement to disengage from the immediate perceptual environment and instead “simulate” alternative events (Buckner & Carroll, 2007; Hassabis & Maguire, 2009; Mitchell, 2009a). This mode of thought would give rise to the capacity to ponder experiences

other than those provoked by one's immediate surroundings. Of course, this is precisely the skill needed to infer the mental states of others, whose experiences are by definition distinct from one's own immediate thoughts and feelings. As such, this account suggests an overlap between processes that give rise to our understanding of other minds and those that support predictions of our own potential experiences at some temporal or spatial remove. In other words, transcending the here-and-now may be intimately related to our ability to transcend our own experience to understand those of others. If so, the high resting activity demonstrated by regions involved in these functions suggests that the human mind might naturally prefer such simulated realities over the immediate external environment. Likewise, the regular deactivation of such regions may mark the suspension of such virtual reveries as a condition for orienting to the actual, concrete world around us.

Why a sovereign social cognition?

Although the findings discussed in this review suggest that social cognition may enjoy both independence from and priority over other forms of thought, they provide fewer clues as to the basic reasons that the human mind operates in this way. Why are social-cognitive processes segregated from those used to address seemingly similar cognitive challenges in other domains? Why do such processes enjoy special prominence in the human mind? One possibility is that these features of social cognition reflect its recent addition to the human cognitive repertoire; that is, as a set of processes appended by natural selection to an existing supply of mental operations and not yet optimized to minimize metabolic demands on the brain. This speculation is supported by observations that many of the most obvious anatomical differences between the brains of humans and other primates brains occur in the neural regions subserving human social

cognition; for example, macaques appear to have no homologue for the medial prefrontal region most commonly linked to mentalizing (specifically, paracingulate sulcus; Ongur, Ferry, & Price, 2003) and the putative monkey homologue of the temporo-parietal junction (Tpt) is oddly circumscribed in extent compared to human TPJ (Galaburda & Pandya, 1983; for review, see Passingham, 2008).

At a minimum, the distinct cognitive basis of our social abilities suggests that when evolution equipped our ancestors with new capacities for understanding the minds of their neighbors, it could not do so by simply repurposing existing mental processes. This need to introduce new forms of information-processing dedicated to social cognition may be unsurprising, given the unique cognitive challenges posed by other minds. Unlike objects in the physical environment, mental states cannot be perceived directly and must be inferred from oblique clues about what others are feeling or thinking (such as their behavior or emotional expressions). Mental states change continuously and nonlinearly; whereas the location of an inanimate object at any particular time is an easily-described function of where it was a moment earlier, the thoughts and feelings of another person can flit from state to state with much higher degrees of freedom. And, unlike the properties of other objects, the mental states of others can be appropriately understood in terms of one's own subjective experience: the behavior of other people is guided by thoughts and feelings that we ourselves can experience, and our understanding of others' internal states may therefore draw on introspection about our own phenomenology (Goldman, 1992; Heal, 1986). Identifying which of these challenges drove the development of the human social-cognitive system and describing how the mind meets the information-processing problems posed by each continue to provide exciting avenues of research across the psychological sciences.

In the final analysis, the sovereignty of social cognition may have been entirely predictable. The ecology of our species centers around sociality, such that its success derives primarily from the ability to channel individual thoughts and feelings into collective effort and cultural know-how (Tomasello, 1999, 2009). Certainly, our social behavior is the most obvious difference between *Homo sapiens* and our simian cousins: we communicate with each other in a qualitatively distinct way from other animals (i.e., through language); we alone create social institutions and evince cumulative culture; and we cooperate with and help each other on a scale unparalleled among other mammals (Hrdy, 2009). Although the centrality of such proclivities to human life have long hinted at the special nature of interpersonal cognition, only recently have cognitive scientists had the tools available to chart the full distinctiveness of the social mind.

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