CHAPTER 37

Dual Experiences, Multiple Processes

Looking Beyond Dualities for Mechanisms of the Mind

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When considering the vast array of psychological experiences and behaviors, William James noted that "their variety and complexity is such as to leave a chaotic impression on the observer" (1890, p. 1). Indeed. The human mind is so complex that, ironically, it eludes comprehension by our own human minds; to gain insight into the psyche, simplification is needed. It is interesting, then, that psychologists' attempts to explain the human mind and behavior are dominated by theories invoking only two processes. From Descartes' duality of the mind and body and Freud's id and superego (the duality behind the ego) to modern dual-process models of implicit versus explicit processes and automaticity versus control, dualities abound in psychological theory. Why is there such a strong tendency to explain the complexity of the mind in terms of dualities? And, to the extent that dual-process accounts are limited, are there alternative theoretical approaches that provide better explanations of social cognitive phenomena? The first question—on why psychologists are drawn to dualities—is a fundamental philosophical question of the mind, with an answer that is sure to be abstruse and elusive (Dennett, 1991; Levine, 1983). In this chapter, I address the second question of whether there are better alternatives.

At the outset of this chapter, it is useful to distinguish between two general types of dual-process models. One type tends to pertain to a specific question about psychological function; these are typically narrowly focused, well-specified, and, as such, not intended to explain other psychological functions. For example, consider dual-process theories of attribution, which explain the way we form trait inferences about a person from his or her behavior. Several influential theories were developed to distinguish between two components of attribution, such as internal versus external causes (Heider, 1958) or the dual stages of identifying a behavior and then interpreting its meaning (Trope, 1986). Hence, these are described as "dual-process" theories. To the extent that a psychological question pertains to two specific processes, then a dual-process model is entirely appropriate. Indeed, by the same token, several other theories of attribution have specified three processes (e.g., Gilbert, Pelham, & Krull, 1988; Kelley, 1967; Quattrone, 1982; Weiner, 1986) or more (Jones & Davis, 1965), as defined by the theorist's question. The components of these models typically refer to psychological operations—computations of the mind that contribute to the response of interest. Among these highly-specified models, the fact that many include two components does not seem to reflect a special emergent feature of mental structure, but rather the particular way in which a theoretical question is framed.

A second type of dual-process model is more general in its applicability, proposed to encompass a broader set of psychological functions. These include, for example, dual-process models of automaticity versus control (Shiffrin & Schneider, 1977), implicit versus explicit processing (Greenwald & Banaji, 1995), similarity-based versus rule-based processing (Sloman, 1996), System 1 versus System 2 (Kahneman & Frederick, 2002; Stanovich, 1999), and to lesser extents, models of systematic versus heuristic processing (Chaiken, 1980) and central versus peripheral processing (Petty & Cacioppo, 1986). Unlike the highly-specified models I described earlier, this type of dual-process model includes approaches that may be applied to many different psychological phenomena. However—and critically—whereas the more specific dual-process models describe the *operations* of each process, these broader dual-process models often describe *attributes* of a psychological process, such as whether it occurs quickly or is subject to awareness. It is this type of dual-process theory that represents the general theme of dualities in theories of the mind—the same that inspired Descartes and Freud—and is the subject of this chapter.

In this chapter, I discuss two examples of broad, dual-process frameworks that have been influential in the field of social psychology: the implicit–explicit and automatic–controlled dichotomies. After discussing some key limitations of these approaches to understanding social cognition and self-regulation, respectively, I describe alternative, multiprocess theoretical models that provide more precise, more functional, and more generative explanations of social cognition and behavior. My overarching position is that while these broad dual-process frameworks have been successful in providing intuitive descriptions of psychological phenomena and framing broad theoretical questions, a focus on such dualities can obscure the underlying psychological mechanisms we seek to elucidate.

MECHANISMS OF IMPLICIT SOCIAL COGNITION

In recent years, dual-process theories concerning implicit and explicit processes have become prominent and have been applied to a wide range of social cognitive phenomena (Greenwald & Banaji, 1995). The terms *implicit* and *explicit* refer to conscious and nonconscious forms of processing, following research in the memory literature (e.g., Jacoby & Witherspoon, 1982; Schacter, 1987). *Explicit* refers to having awareness of a particular process or response, such as when forming an impression, coming to a decision, or performing an action. *Implicit* simply refers to a lack of awareness regarding a response or its underlying cause. Importantly, the implicit–explicit distinction describes a property of a process but not its operation. Amodio and Ratner (2011a) described implicit processes as "the 'dark matter' of the mind—the mental processes that operate in the absence of conscious awareness." Like the dark matter in outer space, implicit processes are believed to exist only because the causes of so many behaviors are not available to our conscious awareness. In this sense, *implicit* refers to the negative space between explainable behaviors. It is the modern black box that cognitive psychologists have, for decades, sought to illuminate. Thus, to say a process is implicit does not explain its operation or function. Indeed, because the terms *implicit* and *explicit* merely describe a property of a psychological response, and not the process itself, one could argue that the implicit–explicit dichotomy does not necessarily imply a meaningful dual-process framework.

How does one begin to explore a psychological process that operates implicitly? Although the process may unfold without awareness, it is reasonable to assume that an implicit response reflects a form of cognition that is rooted in existing associations in memory (Greenwald & Banaji, 1995). Indeed, most psychological theories assume that implicit effects reflect associative processes in memory, usually as part of a dual-process model that distinguishes forms of implicit and explicit processes (Smith & DeCoster, 2000; Sloman, 1996). These models propose that implicit processes reflect a single system of symbolic or connectionist representations of information in memory, whereas explicit processes reflect a different system of propositional knowledge (e.g., beliefs) that is consciously accessible (e.g., Gawronski & Bodenhausen, 2006). In these models, information may be stored in a complex network of concepts with associative links varying in strength, along which activity spreads from one concept to others. These models were designed, in part, to explain semantic priming effects in social cognition, such as when a "primed" trait concept influences subsequent impressions of a person without the perceiver's awareness (Higgins, Rholes, & Jones, 1977). Such single-system models of implicit processes have been invoked to account for a wide range of social cognitive effects involving attitudes, semantic concepts (e.g., traits or stereotypes), and affective responses.

Dual-process models of implicit–explicit social cognition have been very influential, generating novel and sophisticated theories of mental processes while providing an intuitive metaphor of the mind. But, the benefits of these dual-process accounts are balanced by some critical limitations. For example, associative models have difficulty explaining noncognitive phenomena, such as emotion and motivation, and few, if any, of the models developed in the field of social cognition correspond with emerging multisystem models of neural function related to implicit learning and memory (Poldrack & Foerde, 2007). Most importantly, because associative models represent a metaphor of information processing that is conceptually disembodied from physiological processes of the brain and behavior, it is difficult for them to address the mechanisms through which mental processes interface with behavior (Barsalou, 2008; Smith & Semin, 2004). A common criticism of the connectionist approach, by comparison, is that connectionist models can explain anything in an infinite regress of processing units, but without necessarily corresponding to how the human mind and brain actually work. For these reasons, current dual-process models of implicit social cognition may be limited in their ability to explain an adequate range of implicitly operating mechanisms and their influences on behavior.

Beyond Dual Processes: The Memory Systems Model of Implicit Social Cognition

An alternative to dual-process models of implicit social cognition is suggested by recent developments in the cognitive neuroscience literature on learning and memory. Early research on the neural basis of learning and memory began with a dual-process, implicit–explicit analysis, most famously with the case of the patient known by the initials "HM." HM suffered an extreme form of epilepsy, and as a last-resort treatment, doctors surgically removed significant portions of the bilateral temporal lobes of his brain, including the hippocampus, amygdala, and parahippocampal gyrus. HM recovered, but with a striking impairment: He could no longer form long-term episodic memories, and he showed severe impairment in recollection of explicit memories from before his surgery (Scoville & Milner, 1957). Nevertheless, he retained intact capacities for several other forms of learning and memory, such as motor skills and habits, as well as some aspects of semantic associations (e.g., factual knowledge). Thus, he lost his explicit memory while retaining many implicit processes. One outcome of HM's case is that researchers paid more attention to the different types of capacities that were spared and that appeared to operate implicitly.

In the wake of cases like HM's, a large body of human and animal research began to identify several different forms of implicit learning and memory associated with distinct neural substrates (Figure 37.1; Squire & Zola, 1996). It is now known that implicit learning and memory processes encompass a wide range of capacities, such as semantic priming, perceptual priming, fear conditioning, instrumental and reward conditioning, and the learning of skills and habits. The dissociations between these processes have been illuminated through studies of neurological patients, selective animal lesions, and careful behavioral experimentation. That is, in most cases, a lesion of a brain region linked to one form of memory causes the specific impairment of that form of memory without affecting other capacities. Not surprisingly, this approach was heavily influenced

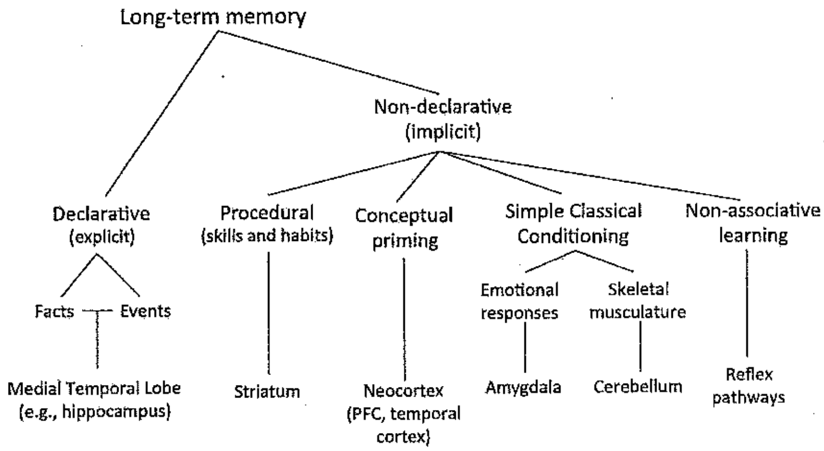

FIGURE 37.1. A memory systems model of distinctive functions and their putative neural substrates. Adapted from Squire and Knowlton (1994). Copyright by The MIT Press. Adapted by permission.

by research on nonhuman animals—a subject model that does not permit inferences about awareness and therefore does not lend itself to consciousness-based explanations. It is for this reason, perhaps, that animal researchers have focused more directly on functional mechanisms than on whether a process is subject to awareness.

Critically, for the purpose of this chapter, this body of work illustrates that "implicit" is not one thing. This idea stands in contrast to the tendency of many dual-process models in social cognition to assume that *implicit* refers to a single, associative form of cognitive processing. More importantly, this body of work has shifted the focus from characterizing mental processes as implicit or explicit to understanding the different functional characteristics of these implicit systems. It is notable that although this memory systems perspective is prominent in cognition and cognitive neuroscience, it has not yet been widely incorporated into theories of social cognition (cf. Amodio, 2008; Amodio & Devine, 2006; Amodio & Ratner, 2011a; also see Carlston, 1994, for a related approach). Nevertheless, this perspective may provide an important theoretical advance beyond current dual-process conceptualizations of implicit processes. In what follows, I highlight three distinct memory systems that all operate implicitly yet support very different functions in cognition and behavior.

Semantic Associative Memory

As I noted earlier, most contemporary models of implicit social cognition are based on theories of associative learning and memory (McClelland & Rumelhart, 1985). These associations refer to semantic information that is organized in networks linking cognitive concepts. According to these models, implicit associations are learned slowly over the course of repeated stimulus pairings (Sloman, 1996) and may be extinguished after repeated exposure to a concept in the absence of its prior associate (Smith & DeCoster, 2000). This general form of learning underlies the associative networks that form the basis of most contemporary models of implicit social cognition.

In the brain, implicit semantic processes have been associated with activity in the left prefrontal cortex (PFC) and temporal lobe, in conjunction with broader neocortical networks (Martin, 2007). Complex semantic networks guide actions, such as movement and speech, through a representational hierarchy that connects high-level representations of goals and response contingencies to lower-level motor plans, along a rostral-to-caudal axis of connectivity within the PFC (Badre & D'Esposito, 2009; Fuster, 2004). In social cognition research, semantic memory systems are thought to govern high-level social cognitive processes such as trait impressions and stereotype formation (Smith & DeCoster, 2000), which are often expressed in verbal behavior (Amodio & Devine, 2006). Although the expression of semantic associations may become explicit, the mechanisms producing these responses operate implicitly.

Fear Conditioning

Classical fear conditioning is a widely studied mechanism for learning threat-related associations and affective responses, and it functions very differently than the type of associative learning and memory implicated in most dual-process models of social cognition. *Classical conditioning* refers to the process of learning to associate a neutral conditioned stimulus (CS) with an aversive or rewarding unconditioned stimulus (US). Fear conditioning may be described as a reactive form of aversive conditioning, in the sense that it concerns a learned association between a neutral stimulus and an affectively charged outcome (e.g., as opposed to semantic associative learning, which concerns the association between two concepts). Although this process is often described as a form of association, it is more accurately described as a process of learning an adaptive whole-body response to a potentially threatening outcome. In this way, the fear conditioning process is different than the evaluative conditioning process often examined in social cognition studies of humans.

Fear conditioning is subserved by the amygdala and associated subcortical structures. The amygdala receives sensory input very early in the processing stream and can promote a wide range of responses, including those relevant to fear as well as reward. Fear-conditioned associations, specifically, are processed by the amygdala's central nucleus, and expressed primarily in the form of autonomic arousal, attentional vigilance, and the inhibition of action (e.g., freezing; LeDoux, 2000). In human social interactions, such responses may be manifested in anxious feelings, and in awkward and inhibited behaviors such as averted gaze, disfluent speech, closed body posture, and interpersonal distance (Amodio & Devine, 2006; Dovidio, Kawakami, & Gaertner, 2002; McConnell & Leibold, 2001).

Importantly, key characteristics of classical fear conditioning distinguish it from the learning of semantic associations in social cognition models. For example, unlike slowly learned implicit semantic associations, fear-conditioned associations are acquired rapidly, often after a single CS–US pairing (LeDoux, 2000) and may be expressed independently of explicit awareness or semantic associations (Bechara et al., 1995). Furthermore, the extinction of fear-conditioned associations (i.e., to CS-alone presentations) occurs very slowly with new learning, yet traces of the conditioned association can result in rapid reconditioning (Bouton, 1994; but see Schiller et al., 2010). These properties are very different from those typically ascribed to the learning and unlearning of implicit conceptual associations in traditional sociocognitive models. Furthermore, the fear conditioning literature offers well-delineated pathways for behavioral expression, whereas traditional implicit social cognition models do not typically address the mechanistic link from cognition to behavior.

Instrumental Learning and Memory

Instrumental learning and memory systems concern associations between an action and an outcome; thus, these systems are often linked to theories of motivation and reward processes. Instrumental associations are learned following repeated reinforced stimulus–action pairings, independently of explicit awareness of such pairings. Instrumental responses may reflect goals or habits. Whereas goal-directed (reward) responses are acquired and modified rapidly following changes in feedback contingencies, habit-like responses develop incrementally and may be extinguished very slowly after feedback is decoupled from a particular response (Yin & Knowlton, 2006).

The instrumental memory system has been associated with the striatum and related basal ganglia structures, which have strong recursive connections with the PFC (via the caudate nucleus) and with motor areas (via the putamen) that coordinate goal-directed and habit-based responses (Alexander, DeLong, & Strick, 1986). Hence, as with fear conditioning, the pathways for behavioral expression of instrumental associations are well delineated. Furthermore, the characteristics of instrumental learning and memory differ from those of other learning and memory systems in critical ways.

Interactions among Memory Systems

So far, I have highlighted distinctions between different forms of implicit memory that underlie social cognition. However, research is beginning to shed light on how these memory systems interact with each other, working in competition or in concert to produce complex behaviors (Foerde, Knowlton, & Poldrack, 2006; Foerde & Shohamy, 2011). Indeed, behavioral tasks used to assess implicit associations likely engage a blend of these systems. For example, implicit attitudes assessed by sequential priming tasks may reflect a combination of semantic associations (e.g., with good vs. bad concepts), threat- or reward-related associations, and instrumental associations (e.g., reinforced and habitual actions). Implicit learning and memory processes also interact with explicit processes. For example, explicit episodic and semantic memory systems play important roles in the formation and representation of complex goals and in the contextual effects that modulate implicit processes (Poldrack & Packard, 2003). Clearly, much of our behavior is guided by explicit goals and information that is communicated explicitly between individuals. But although these goals may be explicit, the mechanisms that guide goal pursuit usually operate implicitly. In this way, most of our behaviors involve the coordination of multiple implicit and explicit processes. A consideration of these processes and their interplay will help to clarify the nature of implicit social cognition and its effect on behavior. By contrast, an emphasis on dual-process frameworks could obscure these efforts.

Role of Memory Systems in Social Cognition

In the previous section, I described some of the chief characteristic functions of different implicit memory systems. But how do these relate to social cognitive phenomena addressed by popular dual-process theories? Although theories of implicit social cognition have historically focused on a single mode of implicit processing, hints of multiple modes of implicit processing have been prevalent in the literature (e.g., Carlston, 1994; Lieberman, 2000; Wood & Neal, 2007). Conceptual distinctions among cognition, affect, and behavior, which roughly correspond to the three implicit memory systems described in the previous section, have guided research on attitudes and social processes for nearly a century. These distinctions are especially pronounced in the intergroup bias literature, in which researchers often use sequential priming tasks to examine associations between social group targets and semantic concepts (i.e., stereotypes), evaluations, affect, and approach/avoidance responses (Amodio & Mendoza, 2010). Although these responses likely reflect different underlying processes, they have traditionally been interpreted as reflecting a single underlying system that corresponds closely with a semantic memory system. For example, implicit evaluation—a complex construct that combines cognitive, affective, and behavioral processes—is often assumed to reflect a single underlying system of semantic association, yet it most likely reflects a combination of the memory system functions described here.

Dissociable Mechanisms Underlying Implicit Social Cognition

The memory systems model posits that implicit social cognitive responses reflect different underlying memory systems, and although these systems typically work in concert and appear blended in overt responses, they should be theoretically dissociable. In an early test of this idea, my colleagues and I proposed that long-held distinctions between implicit attitudes and stereotypes might, in part, reflect different underlying memory systems for affective versus semantic (i.e., cognitive) associations (Amodio, Harmon-Jones, & Devine, 2003). This research was motivated, in part, by findings that claimed to show evidence of "affective priming" using only reaction time tasks that assess the strength of word associations. Although it was clear that such tasks assess semantic associations, including those representing evaluations (e.g., semantic associations between an object and the concept of "good" or "bad"), it was unclear that such tasks could provide evidence for an affective association. Given the long history of considering affective forms of prejudice in the intergroup literature, it was important for us to know whether implicit forms of bias revealed by priming tasks might also have an affective component.

When considering potential affective substrates for implicit racial bias, the fear conditioning system mechanism appeared to be an excellent candidate, as it could respond rapidly to stimuli and did not require conscious awareness. Indeed, soon after we began this line of research, two functional magnetic resonance imaging (fMRI) papers were published that suggested an association between amygdala activity and implicit racial bias (Hart et al., 2000; Phelps et al., 2000). In Amodio et al. (2003), we used the startle-eyeblink method to index the rapid activation of the amygdala's central nucleus—the part of the amygdala that is specifically involved in fear conditioning—and observed larger startle-eyeblink responses among White participants in response to Black than White faces. We argued that this pattern reflected a uniquely affective form of implicit racial attitudes, driven by a fear conditioning mechanism that could not be explained by semantic systems. Subsequent fMRI studies have replicated this pattern of amygdala response and related it to behavioral measures of implicit prejudice (Cunningham et al., 2004).

As a more direct test of the memory systems hypothesis that implicit stereotype and affective responses to race are dissociable, Amodio and Devine (2006) used separate behavioral tasks to assess subjects' implicit stereotyping and evaluative associations with white versus black Americans. The stereotyping measure was designed to assess semantic associations that were equated on valence, whereas the evaluative bias measure was designed to pick up on general affective and evaluative associations that were unrelated to stereotypes. That is, the stereotyping measure was intended to pick up on a semantic memory system but not affective systems (i.e., fear conditioning or instrumental learning systems). By contrast, the evaluative measure was intended to pick up primarily on an affective memory system rooted in fear conditioning (although, given the task structure, it could also pick up on aspects of instrumental learning or semantic associations with valence categories; Gilbert, Swencionis, & Amodio, 2012). Across three studies, these measures of implicit stereotyping and evaluation were not significantly correlated, yet they predicted different types of intergroup behavior (as described in the following section), suggesting independent underlying processes.

In a more recent test of the memory systems model (Amodio & Hamilton, 2012), we hypothesized that intergroup anxiety—a response associated with activity in the amygdala and related neural circuits—would selectively increase the activation of some forms of implicit bias but not others. Because implicit affective forms of racial bias have been linked to the amygdala, a substrate of fear conditioning, we predicted that anxiety associated with an interracial interaction would increase white participants' degree of evaluative racial bias. By contrast, the neural systems involved in anxiety are not directly connected to regions linked to associative semantic memory, so we did not expect intergroup anxiety to modulate activity of stereotype-based semantic racial associations.

Indeed, this pattern emerged in our experiment: White participants who thought they were going to interact with a black experimenter reported greater anxiety than those anticipating an interaction with a white experimenter. Importantly, those in the black interaction condition exhibited stronger racial bias on a measure of implicit evaluation than those in the white interaction condition, but scores on an implicit stereotyping measure, which held valence constant, did not differ by condition. Furthermore, self-reported anxiety was associated with implicit evaluation but not implicit stereotyping among participants in the interracial interaction condition. Together, these findings provide additional support for a memory systems model of implicit social cognition, and in doing so, present a novel theoretical analysis of how intergroup social anxiety affects the activation of implicit racial associations. It is notable that, to my knowledge, no existing dual-process model would have predicted this particular pattern.

Predicting Behavior

A limitation of existing dual-process accounts of implicit social cognition is that they do not explain the path from implicit processes to behavior. The memory systems model provides an important advance in this regard by offering specific predictions, based on neural structure and function, for how different types of implicit associations may be expressed in different ways through different channels of behavior (Amodio, 2008; Amodio & Ratner, 2011a). For example, fear-conditioned associations are expressed primarily as increased autonomic arousal, freezing, and passive avoidance. Thus, implicit affective associations linked to threat in a human social interaction should produce similar behaviors, characterized by anxiety-related nonverbals and interpersonal distance. By contrast, semantic effects are typically expressed in higher-level representations of impressions and social goals, and should be expressed in verbal responses and overt judgments, and in more instrumental behaviors. Indeed, this pattern was observed by Amodio and Devine (2006) in a set of double-dissociation studies conducted in the context of interracial interactions. For example, subjects' implicit attitudes toward blacks predicted how far they sat from the belongings of their African American study partner in a row of chairs (significantly above any effect of implicit stereotyping), whereas implicit stereotyping predicted their expectations for their partners' performance on a series of exams (significantly above any effect of implicit attitudes). Interestingly, past findings of implicit effects on behavior generally corroborate the memory systems model's predictions, such that greater implicit evaluative bias predicted more uncomfortable and/or less friendly social behavior (e.g., Dovidio et al., 2002), whereas implicit stereotype associations predicted stereotype-relevant judgments (Devine, 1989). The memory systems approach provides a multiprocess theoretical framework to account for these patterns, whereas existing dual-process models do not.

Changing Implicit Associations

Producing change in implicit associations has been the most challenging goal of implicit social cognition research. A consideration of the distinct learning characteristics among memory systems promises to clarify models of implicit change, and the memory systems model suggests that interventions can be tailored to the specific characteristics of the underlying memory systems. Although such interventions have not yet been tested directly, existing research suggests that repeated exposure to countervailing semantic concepts may be effective in weakening stereotype associations (e.g., Kawakami, Dovidio, Moll, Hermsen, & Russin, 2000), but such associations are more difficult to alter when they involve affect (Rydell & McConnell, 2006). Other research has shown that extensive training of approach behaviors toward outgroup faces, which likely involves instrumental learning, can lessen negative behavioral responses to outgroups (Kawakami, Phills, Steele, & Dovidio, 2007). Furthermore, changes in one system of memory can influence another and, in some cases, compete for expression in behavior (Poldrack & Packard, 2003). These observations are not easily accommodated by existing dual-process models that assume a single system of implicit associations.

Summary

Many dual-process models are, at their cores, theories about implicit versus explicit forms of processing, with awareness being the defining feature of the process. However, awareness refers only to a descriptive attribute of the process; it does not describe a mechanism or function. As such, the implicit–explicit distinction does not truly constitute a dual-process model. My goal in this section has been to present the memory systems model as an example of a theoretical approach that moves beyond a focus on properties of awareness and addresses specific psychological mechanisms and functions. Research on memory systems also illustrates the multiprocess nature of the mind. Although a researcher may choose to focus on a subset of processes to address a particular question, it may be useful to acknowledge the roles of the broader set of processes in the context of a larger integrated model of psychological function.

MULTIPROCESS APPROACHES TO CONTROL

Unlike the concepts of "implicit" and "explicit," which are defined as the property of conscious accessibility (Cohen &

Squire, 1980; Schacter, 1987; Squire, 1992), the concepts of automaticity and control in social cognition refer primarily to intentionality; that is, to the mechanisms that guide intentional and unintentional responses (Bargh, 1994); however, some usages refer to specific operations that occur automatically or with control (Shiffrin & Schneider, 1977). Automatic responses are triggered externally, such as through a subliminal priming procedure, much like the "ideomotor" response described by James and developed most notably by Bargh (1982, 1989). Controlled responses, by comparison, are triggered internally, driven by one's goals and intentions (Wegner & Bargh, 1998).

Despite these conceptual distinctions, the constructs of implicit–explicit and automaticity–control are often used interchangeably. This is likely because the features of these two constructs correspond in some salient ways. For example, automatic responses are often triggered without one's conscious awareness, and, as a consequence, "automatic" is often equated with "implicit." However, an automatic response need not be nonconscious; a person may be aware of what triggered his or her unintentional response (Amodio & Mendoza, 2010; Bargh, 1994; Hall & Payne, 2010). Similarly, control is often described as requiring conscious deliberation; therefore, it is often equated with awareness. This, too, is an inaccurate description, as some forms of controlled processing are known to occur without conscious deliberation (e.g., Amodio, 2010; Amodio et al., 2004; Mendoza, Gollwitzer, & Amodio, 2010; Schmidt, Crump, Cheesman, & Besner, 2007; Shiffrin & Schneider, 1977). For example, using event-related potentials (ERPs) to measure rapid neural responses, Amodio et al. (2004) demonstrated that the initiation of controlled processing occurs rapidly following a cue for control. This activation occurred too quickly to reflect conscious deliberation, and prior research has shown that this neural process operates independently of conscious awareness (Berns, Cohen, & Mintun, 1997; Niewenhuis, Ridderinkhof, Blom, Band, & Kok, 2001). Thus, it is useful to distinguish automaticity and control from issues of awareness when considering their utility as an organizing framework of dual processes.

Automaticity and Control Each Represent Multiple Processes

Automatic and controlled processes are often conceptualized as two components of a dual process. But unlike the implicit–explicit distinction, which refers descriptively to the property of awareness, automaticity and control refer to two sets of complex mechanisms that operate at multiple levels of cognition and are expressed through multiple channels of response. The tendency to view automaticity and control as two sides of a dual process can mask the important mechanisms that underlie their complex functions.

In the previous section, I outlined different types of implicit processes, which are also relevant to different mechanisms through which an automatic response may be triggered and enacted. In this section, I focus on the different mechanisms that contribute to control. The idea that control involves multiple components is not new in social psychology (Wilson & Brekke, 1994; Wegener & Petty, 1997), though it may still be underappreciated. Similarly, research on motivation has long distinguished between stages of goal pursuit that are relevant to the process of action control, ranging from goal formation, commitment, and planning, to effort mobilization and implementation (e.g., Heckhausen & Gollwitzer, 1987; Gollwitzer, 2012).

Models such as these illustrate that control involves multiple components with different functions, and that an understanding of these components provides a clearer account of behavior and the specific ways in which control may succeed or fail. More recently, researchers have begun to investigate more specific cognitive and neural mechanisms involved in the process of control. Here, I briefly describe some of the key components of control that have been examined in this line of research.

Conflict Monitoring

How is control initiated in the first place? This is a long-standing question in social psychology, about which dual-process theories are generally silent (but see Monteith, 1993; Wegner, 1994). I became interested in this question because it promised to elucidate a puzzle in the intergroup bias literature: In prior work, my colleagues and I observed two general patterns of behavior among low-prejudice individuals, which related to their internal and external motivations to respond without prejudice (Amodio et al., 2003; Devine, Plant, Amodio, Harmon-Jones, & Vance, 2002). Although these two groups of egalitarians—one dubbed "good regulators," the other dubbed "poor regulators" by Amodio, Devine, and Harmon-Jones (2008)—held similarly positive attitudes toward black Americans and showed genuine internal motivation to respond without prejudice (Plant & Devine, 1998), they differed in their ability to regulate their implicit behavioral and physiological responses to black outgroup members. This pattern was not easily explained by existing dual-process models and, as such, we could not begin to develop intervention strategies to enhance control among those who were less effective.

At the time I was thinking about these issues, new theories were emerging in the cognitive neuroscience literature that directly addressed the question of how control is initiated. These theories noted that corrective control is needed when behavior begins to deviate from one's intentions. Such cases reflect a conflict between one's intended response and some alternative tendency or bias. In order for corrective control to be engaged, this conflict must be detected as the response unfolds. Cognitive neuroscience research on response conflict tasks, such as the color-naming Stroop (1935) task, had observed characteristic patterns of brain activity during high-conflict trials, such as when the meaning of a word (e.g., *red*) conflicts with one's goal to name the ink color in which the word appears (e.g., the color blue), in comparison to low-conflict trials (*red* appearing in the color red; Carter et al., 1998; MacDonald, Cohen, Stenger, & Carter, 2000). These studies revealed that activity in the anterior cingulate cortex (ACC) was particularly strong during response conflict trials. In light of these findings, Botvinick, Braver, Barch, Carter, and Cohen (2001) proposed that the ACC supports a *conflict monitoring* function, such that it is involved in detecting conflict between alternative motor impulses. Furthermore, when conflict arises, the ACC signals structures in a different region of the brain, the PFC, which is involved in implementing one's intended response over other competing tendencies (Kerns et al., 2004). Thus, these researchers posited a distinction between neural processes involved in detecting the need for control (vis-à-vis response conflict) and the implementation of control—two distinct components of controlled processing.

This model of conflict monitoring was adapted by Amodio et al. (2004) to address the question of why egalitarians vary in their control of intergroup responses. Measures of brain activity (electroencephalography [EEG]), collected while participants completed a stereotype priming task, revealed that ACC activity was stronger on task trials that required greater control than on trials that did not require control (Amodio et al., 2004). Furthermore, these results dissociated the neural detection of conflict from the process of implementing control in behavior. That is, we observed significant activation of the ACC, indicating the detection of conflict, independent of whether subsequent response control was successful or unsuccessful (i.e., on both the N2 and error-related negative ERP components, respectively). This suggested that the process of detecting the need for control was independent of the implementation of control.

In subsequent work, we addressed our original question about why the two types of egalitarians—good regulators and poor regulators—differed in their ability to control their expressions of intergroup bias. Examining ACC activity as an indicator of conflict monitoring, we found that the "poor regulators" often failed to control because they had trouble detecting the need for control, and not because they had trouble implementing control (Amodio et al., 2008; see also Study 2 in Amodio et al., 2003). This finding suggested that interventions designed to enhance control among these individuals should focus on strategies for detecting the need for control rather than on strategies for selecting or implementing an intended response. In a separate line of research, we examined responses that are made in response to social pressure, in which external social cues moderate the regulation of bias. We found that detecting the need for control on the basis of an external social cue requires additional neurocognitive processes, linked to the medial frontal cortex and its role in mentalizing (Amodio & Frith, 2006), in addition to the ACC-based mechanism for detecting conflict based on internal cues (Amodio, Kubota, Harmon-Jones, & Devine, 2006). This finding helped to explain why externally motivated behaviors can be especially difficult to regulate.

Implementation of Control

Once conflict is detected, controlled processes must be implemented. Cognitive neuroscience research suggests that when conflict is detected, the ACC signals regions of the PFC involved in response control (Miller & Cohen, 2001). These PFC regions primarily target motor responses—indeed, the PFC is thought to be an extension of motor cortex that evolved to support higher-level cognitive representations (e.g., of complex goals), and PFC subregions are connected in a hierarchical fashion that feed back to motor structures (Badre & D'Esposito, 2009). Although the PFC is interconnected with regions throughout the brain, the predominance of its connections with motor regions comports with research showing that people are often most effective in controlling their behavioral responses, yet often ineffective at directly regulating their emotions and thoughts (e.g., Gross & Levenson, 1993; Wegner, Schneider, Carter, & White, 1987; see Amodio & Ratner, 2011b, for a review of this topic). Thus, a consideration of PFC function and connectivity can shed light on the specific mechanisms of control.

Cognitive neuroscience research on PFC function suggests at least three forms of motor control linked to separate underlying neural mechanisms. One form of control concerns the implementation of goal-directed actions—motor responses that reflect an intended action. The implementation of goal-directed behaviors involves bidirectional connections between the PFC and the striatum (i.e., the frontostriatal loop), which operate in concert with thalamic and midbrain processes (Middleton & Strick, 2000; Yin & Knowlton, 2006). This type of goal-directed action control tends to involve left-lateralized PFC activity, at least among right-handed research subjects. Left PFC activity has also been associated with action control in contexts such as regulating intergroup behaviors (Amodio, 2010; Amodio, Devine, & Harmon-Jones, 2007), obtaining rewards (Pizzagalli, Sherwood, Henriques, & Davidson, 2005), and instrumental aggression (Harmon-Jones & Sigelman, 2001).

A second form of motor control is active inhibition—the intentional stopping of a response. Active inhibition has been linked to right PFC activity, particularly in the right inferior frontal cortex (Aron, Robbins, & Poldrack, 2004). Much of the research on this form of control has examined responses on the stop-signal or go/no-go tasks (for a review, see Aron, 2011). Tasks such as these include simple cues for action and stopping, and they are designed to probe basic domain-general mechanisms of inhibitory control. However, response-stopping tasks have also been used to probe responses to social stimuli. For example, the Go/No-Go Association Task of the Implicit Association Test (IAT) has been used to assess implicit social attitudes, and behavior on this task likely relies on inhibitory control processes. Furthermore, in fMRI studies of social perception, greater activity in the right inferior PFC is sometimes observed (e.g., when responding to an outgroup member, in comparison with responding to an ingroup member); thus, one can speculate that responses to outgroup faces, as compared with ingroup faces, in these studies might reflect participants' attempts to withhold a potentially race-biased response (Lieberman, Hariri, Jarcho, Eisenberger, & Bookheimer, 2005; Mitchell, Ames, Jenkins, & Banaji, 2009). It is notable that inhibitory control may be involved in what I described earlier as "implemental control" (i.e., goal-directed action), in the sense that a prepotent response may be inhibited while the intended response is implemented (as in "override" models of control). However, in "race" models of control (Logan, Cowan, & Davis, 1984), in which two response tendencies compete for expression in behavior, inhibitory control is not necessary for the successful implementation of a controlled response. Thus, it is useful to distinguish between these two forms of control.

A third form of motor control pertains to eye movements, although it is rarely discussed in the social cognition literature. Oculomotor networks constitute an important interface between perception and action in the context of control, and the control of eye movements is associated with activity in dorsal regions of the PFC (Brodmann's Area 8) that are referred to as the "frontal eye-fields." Given the field's renewed interest in the role of attention and perception in mechanisms of control (e.g., Amodio, 2010; Ofan, Rubin, & Amodio, 2011), I expect that this form of control will receive greater attention from social cognitive theorists in the near future. Importantly, these three forms of motor control usually operate in concert, as suggested by their integrated neural connections and complementary functions.

It is notable that other recent theories of control have implicated multiple processes. In particular, the quadruple-process (quad) model of automaticity and control distinguishes between two components of controlled processing (Conrey, Sherman, Gawronski, Hugenberg, & Groom, 2005; Sherman et al., 2008). According to this model, one component is *discriminability* (D), which refers to the ability to determine a correct (i.e., intentional) response. A second component is *overcoming bias* (OB), which refers to success at overcoming a countervailing automatic tendency. Some efforts have been made to relate the quad model to underlying neural processes (e.g., Beer et al., 2008; Gonsalkorale, Sherman, Allen, Klauer, & Amodio, 2011), but more research is needed to determine the relation between parameters of the quad model and specific neural systems governing automaticity and control.

Models of PFC anatomy and function also highlight the effects of control on sensory and perceptual processes—aspects of control that have only recently begun to receive attention in social psychology (e.g., Amodio, 2010; Ratner & Amodio, 2013; Ofan et al., 2011, 2013). Through dense connections to the thalamus and other sensory structures (Barbas & Zikopoulos, 2007), the PFC is believed to play a role in selecting motivationally relevant sensory signals while suppressing irrelevant information, in the service of task goals. The PFC continues to modulate the perception of sensory inputs through connections to visual and auditory association cortices (Medalla, Lera, Feinberg, & Barbas, 2007). For example, in an fMRI study of visual processing, efforts to ignore a visual stimulus were associated with reduced activity in the visual association regions, and this effect was driven by activity in the left PFC (Gazzaley et al., 2007). Additionally, studies of pain regulation revealed that PFC activity is associated with changes in the perception of pain (Salomons, Johnstone, Backonja, Shackman, & Davidson, 2007; Wager et al., 2004). These findings suggest that control regions of the PFC function to regulate sensory and perceptual processes, presumably in the service of facilitating goal-driven responses. These aspects of control represent promising directions for future social cognition research on control.

In summary, findings from the cognitive neuroscience literature have helped to expand and refine social cognitive models of control, already far beyond the single-system view of control assumed in many dual-process approaches. This expanded view of control has begun to shift the field's attention away from phenomenological properties of automaticity and control, such as their degree of implicitness or intentionality, toward functional accounts of these processes that are more useful for understanding social cognitive mechanisms and behavior (Amodio & Ratner, 2011b; Henke, 2010).

CONCLUSIONS

Classic dualisms in psychology, such as those proposed by Descartes and Freud, have been largely discarded by contemporary psychologists, yet dualistic thinking is alive and well in the form of many modern dual-process theories. It is true that dual-process theories have been enormously successful in framing general patterns of psychological responses and in generating much research. Dual-process models that describe the operations of specific processes, selected from a broader set of processes, have been particularly useful in comparison with general dual-process frameworks that refer only to a characteristic property of a process. However, nearly all dual-process models are limited in a critical regard: The mind is not composed of dual processes. Indeed, the brain comprises several different interacting systems with uniquely different functions, and the range of human behaviors cannot be explained by a simple dual-process account.

A focus on dualities places an unnecessary constraint on how we think about the mind and behavior. Given the emerging knowledge on multiple systems in the mind and brain, general dual-process theories may be limited because they are misspecified—that is, they do not correspond well with known behavioral patterns or neurocognitive systems—or because they are too highly specified, concerned with a particular process in a circumscribed context. In order to advance our understanding of the mechanisms that drive human behavior, theorists will likely need to move beyond dualistic frameworks to consider the multisystem models that more closely comport with neural structure, psychological function, and behavior.

One nevertheless continues to wonder: Why is there a preponderance of dual-process theories in the psychological literature? Why have ancient philosophers and contemporary psychologists alike viewed the mind as operating in terms of dualities? These are interesting questions, regardless of whether they can be answered. At the outset of this chapter, I noted that the dualism of consciousness dominates the human experience. Just as it dominates our experience, it likely dominates our attempt at understanding the inner workings of our minds and the causes of our behaviors. Rather ironically, psychologists themselves are subject to the limitations of the very thing they hope to elucidate. Given the eminence of consciousness in human experience, it is not surprising that psychological theories are also dominated by the divide between what we can observe and what we cannot (i.e., *the explanatory gap*; Levine, 1983). Indeed, in a recent *word cloud* analysis of the most common phrases used in social and personality psychology, the term *implicit* was among the most prominent, following only *behavior* and *perception* (Hirsch, 2010). The irresistible tendency to see the world in terms of awareness may indeed explain the continued popularity of dual-process models in psychology. However, if neurocognitive function is not organized in terms of dualities, then dualistic constructs, such as those built on the conscious–nonconscious dichotomy, may prove to be red herrings—diversions away from the true mechanisms of the mind we hope to discover.

While the limitations of the dual-process approach are increasingly recognized, they are being addressed by emerging multiprocess models of the mind and brain. In this chapter, I have described two major research areas—implicit social cognition and self-regulation—in which multiprocess models offer more refined explanations than prior dual-process explanations. As our understanding of psychological function advances, and as findings from social psychology are increasingly integrated with those in neuroscience and other related fields, multiprocess models may begin to replace the dual-process approaches that are still prominent today. Dual-process views are unlikely to disappear completely, though—after all, psychologists are still humans, and the conscious–unconscious duality will continue to loom large in our theories of the mind, just as it does in our everyday experiences. Although the tendency to see dualities will likely persist as long as humans are still doing psychology, the emergence of brain-based multiprocess theories of social cognition are enabling psychologists to look beyond dualities to understand mechanisms of the mind.

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