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A Memory Systems Model of Implicit Social Cognition

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Abstract

Implicit social cognition refers to the mental processes that influence social perception and behavior independently of conscious awareness. To date, implicit social processes have been explained by single-system models of associations among concepts that, while addressing questions of information processing, are generally silent regarding the interface of implicit social processes with behavior. In this article, we present a multisystem model of implicit social cognition based on emerging cognitive neuroscience research on systems of learning and memory. This model describes how different underlying memory systems, characterized by different patterns of learning, unlearning, and behavioral expression, may contribute to implicit social processes. We describe how the memory systems model differs from previous theories of implicit social cognition and how it makes new and increasingly refined predictions regarding implicit sociocognitive processes and their influences on behavior.

Keywords

implicit, social cognition, memory systems, attitudes, stereotyping

Implicit processes are the "dark matter" of the mind—the mental processes that operate in the absence of conscious awareness (Schacter, 1987). Although hidden from view, implicit processes appear to drive much of our social behavior, particularly when responses are made quickly and spontaneously, without conscious deliberation (Greenwald & Banaji, 1995). The concept of implicit processing has provided a useful explanation for why people sometimes act in contradiction to their explicit beliefs and intentions, such as when responses of self-avowed egalitarians reveal evidence of racial stereotypes (Devine, 1989). But despite the popularity of implicit approaches to attitudes and social cognition, the mechanisms through which implicit social processes are learned, unlearned, and expressed in behavior remain largely unknown.

In this article, we describe a new approach to understanding implicit social cognition that draws upon recent advances in cognitive neuroscience research on learning and memory. We first compare previous single-system approaches with the proposed memory systems model (MSM) and then describe how the MSM advances the understanding of implicit social cognition and its interface with behavior.

Traditional Models of Implicit Social Cognition

Traditional models of social cognition research distinguish between an explicit (declarative, conscious) system and an implicit (nondeclarative, nonconscious) system of mental processing (Smith & DeCoster, 2000). In these dual-system (or dual-process) models, implicit processes reflect a single system of symbolic or connectionist representations of semantic information in memory. According to these models, information is 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 borrowed from cognitive psychology, 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 sociocognitive effects involving attitudes, semantic concepts (e.g., traits or stereotypes), and affective responses.

Single-system models of implicit social cognition have been very influential, generating novel and sophisticated theories of mental processes while providing an intuitive metaphor of the mind. But these benefits are balanced by some critical limitations. For example, single-system associative models have difficulty explaining noncognitive phenomena, such as emotion and motivation, and they do not correspond with emerging,

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multisystem models of neural anatomy and 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, they do not address the mechanisms through which mental processes interface with behavior (Barsalou, 2008). For these reasons, current single-system models of implicit social cognition are limited in their ability to explain the full range of implicit processes and their influences on behavior.

Multiple Memory Systems Model

Modern research on memory systems was inspired in large part by neurological studies of amnesic patients, such as HM. Following temporal lobe resection to treat his epilepsy, HM lost the ability to form new episodic memories but retained other forms of memory, such as existing factual knowledge and motor skills. In the wake of such discoveries, a large body of human and animal research has elaborated on the organization of implicit memory, identifying dissociable forms of learning and memory, linking them to distinct neural substrates (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. Importantly, each system is characterized by somewhat different patterns of acquisition, extinction, and behavioral expression. Although prominent in cognition and cognitive neuroscience, this memory-systems perspective is not yet incorporated widely into theories of social cognition (but see Amodio, 2008; Amodio & Devine, 2006). Nevertheless, we believe that theories of implicit social cognition have much to gain from a consideration of different implicit memory systems, particularly as they relate to social behavior. Here, we highlight a subset of these systems that are especially relevant to implicit social cognition. For the sake of brevity, we focus on the key features of each system; interested readers may consult articles we cite for more detailed descriptions.

Semantic associative memory

As noted above, existing models of implicit social cognition developed largely from research on semantic learning and memory (McClelland & Rumelhart, 1985). Semantic associations refer to links between cognitive concepts. The 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 pattern of learning and unlearning forms the basis of most traditional 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 speech and movement, through a representational hierarchy that connects high-level representations of goals and response contingencies to low-level motor responses, 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 sociocognitive 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 be explicit, the mechanisms producing these associations operate implicitly.

Fear conditioning

Classical fear conditioning is a widely studied mechanism for the learning of threat-related associations and affective responses. Classical conditioning involves the association of a neutral conditioned stimulus (CS) with an aversive unconditioned stimulus (US). Unlike slow-learning semantic systems, fear-conditioned associations are acquired rapidly, often after a single CS–US pairing (LeDoux, 2000), and are expressed independently of explicit awareness or semantic associations (Bechara et al., 1995).

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 involve the amygdala's central nucleus and are expressed as autonomic arousal, attentional vigilance, and behavioral inhibition (e.g., freezing; LeDoux, 2000). In human social interactions, such responses may be manifested in anxiety, awkward and inhibited behaviors such as averted gaze, disfluent speech, closed body posture, and interpersonal distance (Dovidio, Kawakami, & Gaertner, 2002).

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 at al., 2009). These properties are very different from those typically ascribed to the learning and unlearning of implicit semantic 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 behavior.

Instrumental learning and memory

Instrumental learning and memory systems are involved in approach-related behavioral and affective 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

Table 1. A Comparison of Multiple- and Single-System Models of Implicit Social Cognition

Model	Memory systems involved	Learning rate	Extinction rate	Behavioral expression	Major physiological substrates
Multiple-systems model (selective)	Classical fear conditioning	Fast	Very slow (CS-alone), rapid (in context of reconsolidation)	Behavior inhibition, social distancing, affective arousal	Amygdala (Ce), autonomic nervous system
	Semantic	Slow	Slow	Verbal expression of social judgments, stereotype application	Prefrontal cortex, temporal cortex
	Instrumental	Slow for habits, fast for reward associations	Slow	Habitualized action, reward-guided action	Basal ganglia (caudate, putamen)
Single-system model	Associative semantic network	Slow	Slow	Unspecified	Unspecified

Note: CS = conditioned stimulus; Ce = central nucleus.

contingencies, habit-like responses develop incrementally and may be extinguished very slowly after feedback is decoupled from responses (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 and differ from those of semantic memory and fear conditioning.

Interactions among memory systems

Although we have emphasized distinctions between implicit memory systems, these systems typically act in concert to produce complex social behaviors. 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 affective associations, and instrumental associations (e.g., reinforced and habitual actions). Implicit systems of memory also interact with explicit processes, despite the frequent emphasis on implicit–explicit dissociations. For example, explicit episodic and semantic memory systems play important roles in the formation and representation of complex goals and contextual factors that modulate implicit processes (Poldrack & Packard, 2003). A consideration of these different mechanisms and their interplay may help to clarify the nature of implicit sociocognitive processes and their effects on behavior.

Memory Systems Model of Implicit Social Cognition

The MSM suggests a new perspective on implicit social cognition, whereby implicit processes reflect different mechanisms for learning, unlearning, and behavioral expression. The MSM suggests *at least* three general mechanisms underlying implicit social cognition, pertaining to semantic, classically conditioned, and instrumental associations (with traditional implicit social cognition models sharing properties of the semantic memory system; Table 1).

Memory systems in social cognition

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. Conceptual distinctions between 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, or affective responses (Amodio & Mendoza, 2010). Although these responses likely reflect different underlying processes, they are traditionally interpreted as reflecting a single underlying semantic memory system and its associated characteristics for learning, unlearning, and expression. Furthermore, the concept of implicit evaluation—a complex construct that combines cognitive, affective, and behavioral processes—is often assumed to reflect a single underlying memory system, yet it most likely reflects a combination of the memory system functions described here.

There have been some exceptions to single-system accounts of implicit social cognition. For instance, researchers have invoked properties of the instrumental memory system to explain intuition (Lieberman, 2000) and the role of habits in consumer decisions (Wood & Neal, 2007). Findings connecting approach–avoidance body movements with attitudes also likely rely on instrumental and reward-learning systems (Cacioppo, Priester, & Berntson, 1993). Past studies such as

these have already pointed to the idea of multiple systems of implicit social processes.

Dissociable mechanisms underlying implicit social cognition

The MSM posits that implicit sociocognitive 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, Amodio, Harmon-Jones, and Devine (2003) suggested that long-held distinctions between implicit stereotypes and attitudes might, in part, reflect different underlying memory systems for affective versus semantic (i.e., cognitive) associations. The fear-conditioning mechanism provided an excellent candidate system for implicit negative affective responses to racial outgroups because it could respond rapidly to stimuli and did not require conscious awareness. Amodio et al. (2003) used the startle-eyeblink method to index the rapid activation of the amygdala's central nucleus, the structure specifically involved in fear conditioning, and observed larger startle-eyeblink responses among White participants to Black faces than to White faces. The authors 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. Replications using functional magnetic resonance imaging (fMRI) have related this pattern of amygdala response to behavioral measures of implicit racial attitudes (Cunningham et al., 2004).

As a more direct test of the MSM 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. Across multiple samples, measures of implicit stereotyping and evaluation were not significantly correlated, yet they uniquely predicted different types of intergroup behavior, as described in the following section.

Predicting behavior

The broader goal of research on implicit sociocognitive processes is to understand their expression in behavior. The MSM provides an important advance in this regard by offering predictions for how different types of implicit associations may be expressed (Amodio, 2008). For example, fear-conditioned associations are expressed 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 nonverbal behavior 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. 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 uniquely predicted how far they sat from the belongings of their African American study partner in a row of chairs, whereas implicit stereotype associations uniquely predicted their expectations for their partners' performance on a series of exams. Interestingly, past findings of implicit effects on behavior generally corroborate the MSM'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 MSM provides a theoretical framework to account for these patterns.

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/unlearning characteristics among memory systems promises to clarify models of implicit change, and the MSM suggests that interventions can be tailored to the specific characteristics of the underlying memory systems. Although such interventions have not yet been tested directly, extant 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 explained by previous models that assume a single system for implicit associations.

Future directions

The MSM provides a promising new framework for how implicit social associations are learned, expressed, and potentially changed. We briefly outlined three major memory systems that are particularly relevant to implicit social cognition, yet other aspects of learning and memory are also likely involved. Furthermore, our analysis focused on very basic aspects of learning and memory; an important goal for future research is to understand how these basic mechanisms give rise to the more complex cognitive and emotional processes often involved in social cognition and behavior.

More broadly, the memory systems approach is changing the way scientists think about the role of awareness. That is, memory systems models are organized by function, neuroanatomy, and behavior, rather than by degree of awareness, and thus the implicit/explicit distinction may not be necessary for understanding the operations of these systems (Henke, 2010). We expect that as these approaches develop, the implicit/explicit distinction that is currently dominant in social cognition will become less so. We also expect a movement toward hierarchical models of memory systems, organized in terms of function, neuroanatomy, and channels of behavioral expression, similar to recent hierarchical models of cognitive control (e.g., Badre & D'Esposito, 2009). The model outlined here integrates these advances in cognitive neuroscience with the broader goal of illuminating the mechanisms of implicit social cognition and its relation to behavior.

Recommended Reading

Amodio, D.M. (2008). The social neuroscience of intergroup relations. *European Review of Social Psychology*, *19*, 1–54. A theoretical review that discusses a memory systems approach to implicit social cognition in the context of intergroup processes.

Henke, K. (2010). A model for memory systems based on processing modes rather than consciousness. *Nature Reviews Neuroscience*, *11*, 523–532. Presents the argument that a consideration of function provides a more fruitful theoretical analysis of memory than a focus on the implicit versus explicit distinction.

Poldrack, R.A. & Packard, M.G. (2003). Competition between memory systems: Converging evidence from animal and human studies. *Neuropsychologia*, *41*, 245–251. Describes interactions among different systems for learning and memory.

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