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Special issue article

The scaffolded mind: Higher mental processes are grounded in early experience of the physical world

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Abstract

It has long been a staple of psychological theory that early life experiences significantly shape the adult's understanding of and reactions to the social world. Here we consider how early concept development along with evolved motives operating early in life can come to exert a passive, unconscious influence on the human adult's higher-order goal pursuits, judgments, and actions. In particular, we focus on concepts and goal structures specialized for interacting with the physical environment (e.g., distance cues, temperature, cleanliness, and self-protection), which emerge early and automatically as a natural part of human development and evolution. It is proposed that via the process of scaffolding, these early sensorimotor experiences serve as the foundation for the later development of more abstract concepts and goals. Experiments using priming methodologies reveal the extent to which these early concepts serve as the analogical basis for more abstract psychological concepts, such that we come easily and naturally to speak of close relationships, warm personalities, moral purity, and psychological pain. Taken together, this research demonstrates the extent to which such foundational concepts are capable of influencing people's information processing, affective judgments, and goal pursuit, oftentimes outside of their intention or awareness. Copyright © 2009 John Wiley & Sons, Ltd.

THE SCAFFOLDED MIND

Beginning in infancy, humans process some events more readily than others. If a toy mouse disappears behind one screen and reappears behind another screen without appearing in the gap between them, infants are surprised (Aguiar & Baillargeon, 1999). The infant's readiness to accept certain features of the natural environment (and subsequent surprise if these expectations are violated) suggests that that humans readily process certain types of information about the natural environment, either based on innate or learned principles (Baillargeon, 2004). These early pre-verbal understandings of the physical environment subsequently serve as building blocks for the development of more abstract concepts.

In this review, we point to *scaffolding* as a process through which humans readily integrate incoming information with extant knowledge structures. Scaffolding processes can have diverse effects upon human judgment and behavior. Scaffolding refers to the passive, natural process through which new concepts are formed, especially in early childhood. Features of abstract or less understood concepts are mapped onto existing and well-understood concepts, such that the structure of the developmentally earlier, primary concept is retained in the newly constructed concept. This structure imbues the newer concept with meaning. When an abstract concept is scaffolded onto a foundational concept, these concepts become associated, much in the same way semantically related concepts are naturally associated in the mind.

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Scaffolded concepts are unique from (normal) concepts because of how their associations are formed, and the manner in which the meanings of the older and newer concepts become intertwined through these associative links.

The human mind is structured by a variety of scaffolding processes. In particular, two streams of scaffolding processes have deep, pervasive influences upon the human mind: ontogenetic scaffolding and phylogenetic scaffolding. *Ontogenetic* scaffolding processes occur either deliberately or automatically, during the course of infants' development. An example of deliberately scaffolding newer concepts onto existing knowledge occurs when people apply their understanding of arithmetic to construct algebraic knowledge (cf. Vygotsky, 1934/1962). Our discussion however centers on those scaffolded concepts which emerge early and automatically in preverbal children as a natural part of human conceptual growth. These concepts are developed unintentionally. These include bodily, physical concepts which are acquired early in infancy/childhood, as well as the concepts which acquire meaning through analogy to them. Conversely, *phylogenetic* scaffolding processes are built into the human cognitive architecture as a result of natural selection pressures operating during the course of hominid evolution. Ontogenetic and phylogenetic scaffolding are theoretically distinct, and they may jointly contribute to the development of a single scaffolded concept or goal. Future research is needed to empirically differentiate the antecedents and consequences of these two types of scaffolding.

Although we focus here on scaffolding processes born from functional interactions with the environment, scaffolding processes are endemic of the general character of human thought. Humans often use the structure inherent in fundamental aspects of their physical worlds to develop higher-level concepts (Tooby & Cosmides, 1992). Scaffolding processes simultaneously broaden the scope of human thought while tethering those thoughts to the physical environment in which they occur. Concepts such as time, temperature, and distance, along with physical-based goals highlight the processes by which sensorimotor resources can structure higher-order cognition. Further, incidental activation of these concepts and goal structures reveals the extent to which human thought is structured by the environment even in domains that are abstracted from or unrelated to the physical environment, and outside of explicit intent or awareness (cf. Bargh, 2006). For example, due to the metaphorical relationship between light and goodness, the relative brightness of a stimulus can bias one's affective responses automatically and unintentionally, such that physically brighter stimuli are automatically evaluated positively and darker stimuli are automatically evaluated negatively (Meier, Robinson, & Clore, 2004).

Support for Scaffolding From Embodied Cognition

There has been considerable recent interest in the ways in which higher mental processes are intimately related to perceptual and motor processes, such that the mind's activities cannot be divorced from the physical, bodily context in which they occur (Clark, 1998; Niedenthal, Barsalou, Winkielman, Krauth-Gruber, & Ric, 2005; Wilson, 2002). For example, Barsalou's (1999) perceptual symbols system theory holds that cognition is based on modality-specific sensorimotor symbols (for perception and action); thus mental activity is inextricably based on bodily activity. When a concept is called to mind, neural activity associated with the initial formation of that concept is simulated, and thought is based upon these simulations (Barsalou, 1999; Barsalou, Simmons, Barbey, & Wilson, 2003). In the strongest possible characterization of the embodiment hypothesis, human action is determined and constrained by the physical environment (Wilson, 2002).

The embodiment hypothesis has very important implications for concept development. Mandler (1992) suggests that abstract concepts emerge from an infant's understanding of the physical environment through a process she calls *perceptual analysis*. In her view, image-schemas, representing simple aspects of the physical world (i.e., *self-motion*; a schema visually representing the idea that an object is capable of propulsion) serve as the building blocks for the development of more abstract concepts (i.e., agency). Thus, the preverbal infant's understanding (guided by perceptual activity) that some objects (e.g., people, animals) are able to propel themselves through space provides the foundation for the later understanding of the concept of agency. Indeed, in Mandler's view (1992), language itself is scaffolded onto these preverbal image-schemas; before children can understand the words "in" and "out," they must first be able to perceptually process those words' meanings via image-schemas (see also Piaget & Inhelder, 1969, who argue that infants' action schemas serve as the foundation for objective thought).

This view is closely aligned with Herbert Clark's analysis of how children come to develop spatial language and concepts. Clark (1973) argues that before children can produce and comprehend speech concerning spatial concepts, they must first perceptually understand these concepts, an understanding that is constrained by physical properties of humans'

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perceptual apparatus, the human body, and the environment in which they evolved (see also Shepard, 1984). For example, humans develop an understanding that ''forward is good, backward is bad'' because of the nature of the human body and its perceptual apparatus. Humans' sensory and perceptual apparatus (eyes, ears, nose) are oriented almost exclusively toward the front of the body, and motor movements occur more naturally when the body moves forward. From these constraints of the human body, the notion that forward is the positive direction naturally arises because that is the direction of information gain about the uncertain environment (Clark, 1973). For the same reason, humans develop an understanding that ''up is good, and down is bad'' through the properties and limitations of perceiving the world. In the typical case, upward perception of the world is unconstrained, but downward perception is almost immediately blocked by the ground; thus upward perception takes on a positive characteristic, relative to downward perception (Clark, 1973).

As a process, scaffolding is consistent with one of the most important features of human cognition, which is people's natural tendency to obtain new information from what has previously been experienced (e.g., Fiske, 2002). For example, in their classic work on conceptual metaphors, Lakoff and Johnson (1980) argue that abstract concepts such as romantic love and time are built upon people's early (often body-based) understanding of traveling through space. Similarly, Fauconnier (1997; Fauconnier & Turner, 2002) argues that features of abstract concepts are mapped onto specific perceptual features of concrete concepts, and through these mappings, higher-order concepts are constructed. Thus, without involving a person's explicit intent or awareness, the mind uses perceptual, body-based information as the scaffolding for the development of abstract concepts.

Evolutionary Scaffolding

In evolution, building a biological structure occurs through a gradual accretion process, whereby natural selection builds off of existing structures instead of creating entirely new ones each time from scratch (Allman, 2000; Buss, Haselton, Shackelford, Bleske, & Wakefield, 1998; Dawkins, 1976; Dennett, 1995; de Waal, 2002). In this way, structures that have already proven adaptive can provide shortcuts or ''good tricks'' (Dennett, 1995) to address other selection pressures. Biologically, the adaptation (e.g., the incus, malleus, and stapes ear-bones of mammals) retains trace elements of design from its foundational structure (e.g., the three homologous reptilian jaw-bones).

In a similar jerry-rigged manner, evolved structures in the human brain are also built from extant cognitive structures, such that representational structures designed for specific functions can be used to process other information for which they were not originally designed (e.g., Barrett & Kurzban, 2006; MacDonald & Leary, 2005a; Wilson, 2002). For instance, one approach to higher-order information processing in humans suggests that structures in the mind responsible for conscious methods of goal pursuit made use of the existing (unconscious) goal pursuit structures in the brain (Bargh & Morsella, 2008). This view can be advanced another step by highlighting how evolved goal structures serve as the foundations for later-acquired goals. We use the term ''goal structure'' to highlight that when a goal is scaffolded on top of another goal via evolution, it involves not only cognitive representations but also the neural mechanisms and specific adaptive actional tendencies useful for reaching the desired end-state.

Foundational Concepts

Why would natural selection scaffold specific goal structures? Genetic change occurs slowly over generations, but organisms themselves must react to changes in a world that operates far more quickly (e.g., a creature needs to flee at the sudden sight of a predator). Motivations provide the crucial link between genetic influences and adaptive behavior (Campbell, 1974; Mayr, 1976; Neuberg, Kenrick, Maner, & Schaller, 2004; Pinker & Bloom, 1990; Popper, 1972; Symons, 1992; Tetlock, 2002; Tomasello, Carpenter, Call, Behne, & Moll, 2005; Tooby & Cosmides, 1992). Specifically, genes can influence behavior through general and specific motivations, which are translated into the nervous system as ''goal programs.'' These goal programs, then, guide behavior in a constantly changing environment (Mayr, 1976). As the evolutionary theorist Ernst Mayr (1976, p. 389) stressed, ''the occurrence of goal-directed processes is perhaps the most characteristic feature of the world of living organisms.'' In this way, organisms can exhibit adaptive behavior that is flexible enough to react when situations change in the blink of an eye.

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An important question then, is which goals might be most fundamental among living organisms, particularly among humans. Existing models feature specific taxonomies or define evolutionarily adaptive interactions with the physical or social environment (e.g., Baumeister, 2005; Brown, 1991; Bugental, 2000; Fiske, 2002; Kenrick, Li, & Butner, 2003; Neuberg et al., 2004; Schaller, Park, & Faulkner, 2003), with fundamental goals sometimes identified through their direct relation to human biological characteristics including sexual reproduction, safety, and bodily comforts (Baumeister, 2005; Brown, 1991). These models are generally driven by the logic that selection pressures from the environment created motivations to act in certain ways, encouraging the development of evolutionarily adaptive goals that conferred fitness-relevant advantages onto ancestral human populations (Mayr, 1976; Tooby & Cosmides, 1992).

Addressing these selection pressures would require the organism to appropriately react to the fitness-threatening situation. The goals that structure these evolutionarily adaptive interactions then, must incorporate components to perceive the environmental situation and then to execute a fitness-enhancing response (e.g., Ohman & Mineka, 2001; Schaller et al., 2003). Indeed, evidence points to sensorimotor processes as being critical for coding information into working memory (Morsella & Krauss, 2004; Wilson, 2001).

For instance, the evolutionarily adaptive goal of mate selection increased the chances that a person might *perceive* and *approach* goal-facilitating stimuli such as an attractive potential partner (e.g., Maner et al., 2003, 2005; Neuberg et al., 2004). Similarly, concepts crucial for motor action within the physical environment (e.g., distance) are among the first that the human child begins to understand, and appear to be understood by nonhuman primates and other animals as well (Mandler, 1992; Cárdenas, Shen, Zung, & Blumstein, 2005). Thus, the goals and concepts that support perception and motor action are prime candidates for serving as the foundation for a fundamental set of scaffolded concepts in the human mind.

SCAFFOLDING AT WORK

The above predictions have been recently supported by a number of empirical investigations, examining the extent to which scaffolding shapes human thought. Without people's intention or awareness, foundational concepts are shown to influence people's information processing, affective states, judgment and decision making, and goal pursuit. In all of these arenas of higher-level thought, priming methodologies, in which concepts or goals are temporarily activated by external cues, have uncovered various ways in which scaffolding processes meaningfully impact people's mental lives, via the relationship between fundamental, perceptually derived concepts and their more abstract, scaffolded counterparts.

Scaffolding and Information Processing

Boroditsky (2000; Boroditsky & Ramscar, 2002) demonstrated that people's spatial orientations influence their understanding of temporal relations. These studies speak to the importance of *time* as one of the earliest scaffolded concepts, founded upon people's early understanding of physical *space* (Clark, 1973; Lakoff & Johnson, 1980). In these studies, participants were primed to either see themselves as moving through space, or to see themselves as stationary, with space (or other objects) moving towards them. They were then asked an ambiguous question about time: next Wednesday's meeting has been pushed forward 2 days – when is the meeting? People who were primed to think of themselves moving through space were more likely to indicate that the meeting was on Friday, compared to those primed to see space moving towards them, who were more likely to indicate that the meeting was on Monday (Boroditsky & Ramscar, 2002). This demonstration empirically validates Clark's (1973) and Lakoff and Johnson's (1980) propositions that temporal concepts (which are abstract and intangible) are scaffolded onto people's perceptually derived understanding of physical space.

Scaffolding has also been shown to influence how people process affective information. For example, judgments about the positive or negative nature of words are facilitated when positive words are presented in the upper half of a computer screen and negative words presented in the lower half, such that when participants saw a positive word in the upper half of the screen, they processed it more quickly, compared to seeing the same positive word presented in the lower half (Meier & Robinson, 2004). Similarly, concepts related to God are encoded more quickly when presented near the top of a screen, and concepts related to the Devil are encoded more quickly when presented near the bottom (Meier, Hauser, Robinson,

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Friesen, & Schjeldahl, 2007). These data are consistent with an ''up is good, down is bad'' analogical structure, support Clark's (1973) proposition that upward direction is more positive than downward, and demonstrate the lasting passive influence of body-based perceptual concepts developed in infancy on higher-order cognition in adults.

Scaffolding and Affective Judgments

Recently, downstream affective consequences of these scaffolding processes have been documented, as foundational physical concepts (e.g., distance, temperature), when primed, can exert a meaningful influence on people's feelings. Physical distance is a fundamental feature of the physical environment. Indeed, Clark (1973) argues that ''*[f]ar–near* and *long–short* are the two most elementary pairs of adjectives'' in the English language (p. 38). Most mammals are motivated to maintain specific distance relations within their environments, to be appropriately close to the herd, while remaining appropriately far from predators and environmental dangers (Bowlby, 1969; Hamilton, 1971; Mooring & Hart, 1992). Along similar lines, Campbell (1956) suggested that vision itself was an adaptation that permitted organisms to safely explore their physical environments, without having to rely on much riskier up-close-and-personal physical contact to distinguish good from bad.

Simple physical-distance cues have been shown to influence people's feelings and affect-based judgments (Williams & Bargh, 2008a). For example, the perceptions and motor actions associated with merely plotting two points on a Cartesian plane influenced people's reports of emotional attachment to their family, such that people who plotted points relatively far from each other reported weaker familial bonds, compared to people who plotted points relatively close to each other. Additionally, when people were primed with physical closeness, they reported a stronger negative emotional response to violence in the media, compared to participants primed with physical distance (Williams & Bargh, 2008a). These results support the idea that the abstract concept of psychological distance (i.e., interpersonal, emotional, cf. Trope & Liberman, 2003) is scaffolded upon the perceptually derived concept of physical, spatial distance.

Physical temperature is another fundamental feature of the environment shown to influence people's affective responses. Like distance, temperature is an aspect of physical properties of the Earth which are structurally invariant over the course of eons (e.g., day/night cycles, climate and seasonal change, tactile sensations; cf. Shepard, 1984). Physical temperature has affective consequences, because for mammals, close physical contact with other living mammals (members of the social world) generates warm sensations (Hall, 1966). Likewise, Lakoff and Johnson (1980) suggest that the notions of affection and warmth are conflated, because as an infant, being held close to a loving caregiver is also associated with bodily contact with a warm object, namely another human being. Indeed, nonhuman primates show a preference for warm caretakers. In his classic research on love and bonding, Harlow (1958) demonstrated that macaque monkeys preferred a warm (via a 100 W lightbulb) cloth surrogate mother to a wire mother, even when the wire mother was their exclusive source of sustenance.

In his seminal work on impression formation, Asch (1946) found that the mere presence of the single word ''warm'' or ''cold'' dramatically altered people's impressions of an ambiguously described person, such that the person described as ''warm'' was seen as being more generous and more sociable while the otherwise identically described ''cold'' person was seen as being less generous and antisocial. More recently, Susan Fiske and her colleagues have identified warmth as being one of two central components of all of the world's stereotypes (the other being competence; Fiske, Cuddy, Glick, & Xu, 2002; Fiske, Cuddy, & Glick, 2007). Although in his initial paper Asch (1955) said surprisingly little as to *why* warm and cold were central traits, he later looked to *metaphor* (presaging Lakoff and Johnson) to account for the dual (physical and psychological) nature of words such as warm and cold.

In our view, people's use of the physical temperature terms to indicate whether someone is friendly reflects the scaffolding relationship between the sensations of physical temperatures and psychologically ''warm'' or ''cold'' feelings. In line with this view, recent investigations have shown that when people feel socially excluded, they also feel that their surroundings are physically colder, and report a stronger desire for warm, comforting products such as hot soup and coffee (Zhong & Leonardelli, 2008). Brief exposure to physical warmth or coldness alters people's social perceptions and behaviors as well (Williams & Bargh, 2008). Participants who briefly held a cup of hot coffee judged an ambiguous person as having a warmer personality (e.g., more generous, sociable, and friendly), compared to participants who held a cup of iced coffee, and people who briefly held a warm object (compared to a cold object) were more likely to choose a gift for a

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friend over a gift for themselves. These findings strongly support the premise that the concept of psychological warmth is scaffolded onto a fundamental understanding of physical warmth concepts.

Goal Scaffolding

The operations of certain goals, which are critical for navigating the physical environment, exemplify the systematic and wide-spread influence of scaffolding on higher-order judgments and motivated behavior. As previously stated, when a newer concept is scaffolded on top of an already existing concept, these concepts become associated, much in the same way semantically related concepts are associated in the mind. Building newer concepts from existing concepts such as goals, however, creates unique consequences for how people act. Social cognition researchers define a goal as a mental representation of a desired end-state that impacts evaluations, emotions, and behaviors, and includes the means through which to attain that state (Aarts & Dijksterhuis, 2000; Bargh, 1990; Kruglanski et al., 2002; Fishbach & Ferguson, 2007; McCulloch, Ferguson, Kawada, & Bargh, 2008). People who are primed with a goal (as opposed to when primed with a nonmotivational, purely semantic concept) exhibit the classic behavioral indications of being in a motivational state, including resumption of goal-relevant behaviors after interruption, persistence in the face of obstacles, and post-fulfillment decrease in motivation after goal fulfillment (Bargh, Gollwitzer, Lee-Chai, Barndollar, & Troetschel, 2001; Chartrand & Bargh, 2002; Fishbach & Ferguson, 2007; Forster, Liberman, & Friedman, 2007).

Activating the Features of a Goal

A goal's desired-end state and its associated means (e.g., Kruglanski et al., 2002; Fishbach & Ferguson, 2007) can directly influence people's subsequent goal-relevant judgments and behavior. Recent research suggests that priming people with a core, fundamental goal affects their judgments and behaviors in abstracted, higher-order goal domains (and vice versa), highlighting the ways that priming methodologies support a model of an evolved scaffolded mind. The general notion that pursuing one goal can affect how an individual pursues another goal is shared by other perspectives on motivation (e.g., Carver & Scheier, 1998; Kruglanski et al., 2002); but to the extent that certain goals were built upon pre-existing, evolutionarily adaptive goals, there should be evidence of cross-domain goal activation, in which the associative links between goals are the result of scaffolding processes.

For instance, a person who has an academic success goal scaffolded on top of an athletic competition goal might then implicitly apply an understanding of a footrace (e.g., only one finish line exists, first to cross that line wins) to academics areas, such that she might be more likely to perceive fellow classmates as competitors instead of collaborators; or conceptualize academic success as a zero-sum game where only one person can ''win.''

The literature on the emotion of disgust provides evidence for this scaffolded goal design. Disgust has been implicated in both physical reactions to objects (Rozin & Fallon, 1987; Haidt, McCauley, & Rozin, 1994) and reactions to more abstract moral spheres (Rozin, Lowery, Haidt, & Imada, 1999; Wheatley & Haidt, 2005; Schnall, Haidt, Clore, & Jordan, 2008).

In our view, physical cleanliness is a foundational goal which developed from human concerns with the natural environment. The desired end-state of the physical cleanliness goal is to avoid physical impurities such as dirt and other contaminants, and the means through which to attain this state include specific avoidance behaviors and emotions such as disgust (Rozin & Fallon, 1987; Rozin, Millman, & Nemeroff, 1986). When people speak of moral reputations as ''dirty'' or of ''washing away their sins,'' they are doing more than merely importing terminology from physical cleanliness pursuits to describe transgressions in the moral domain; they are demonstrating how the goal of achieving moral purity (avoiding association to morally damaging events such as sins) is structured by the goal of staying physically clean (Haidt, 2007; Rozin et al., 1999).

To the extent that an understanding of physical cleanliness preceded and structures an understanding of moral purity, the way people achieve one goal should resemble their pursuit of the other. Indeed, research confirms that people react similarly to violations in both goal domains. Moll et al. (2005) found that experiences of moral disgust activated neural systems that overlapped with the neural systems implicated in physical disgust – specifically, the medial and lateral orbitofrontal cortices (OFC).

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The actions to maintain physical cleanliness have been shown to directly affect how people pursue behaviors in the moral domain. Specifically, priming participants with the physical cleanliness goal activates the means to attaining purity in the more abstract moral domain. Research suggests that when participants are primed with core disgust, their subsequent moral judgments become more severe (Wheatley & Haidt, 2005). Further, this relationship between disgust and moral judgment became more pronounced if participants were especially sensitive to their own bodily sensations (Schnall et al., 2008), thus suggesting the direct role of bodily feedback in influencing judgments in the more abstract goal domain (see also Tetlock, Kristel, Elson, Green, & Lerner, 2000).

Goal scaffolding is further supported by experiments establishing that completing one goal affects goal pursuit in the other domain. Typically, after an individual completes a goal, that goal is no longer as accessible as it was during the pursuit stage (Atkinson & Birch, 1970; Forster et al., 2007; Forster, Liberman, & Higgins, 2005). If scaffolding produces associative links between two desired end-states, completing a foundational goal may inadvertently mark the completion of the scaffolded goal.

In Zhong and Liljenquist's (2006) experiment on goal fulfillment, experimenters activated participants' moral purity goals by asking them to recall a time they performed an unethical behavior; these participants show the reverse directionality in goal behavior compared to Wheatley and Haidt's (2005) research. Participants made to feel unsuccessful in maintaining moral purity nonconsciously increased their compensatory behaviors in the physical domain, such that cleanliness related words more readily came to mind, and cleaning products were more desirable. In another study, participants who were primed with the moral purity goal were given the opportunity to complete their physical cleanliness goals by performing the motor actions of washing their hands, while some participants were not given this opportunity. Those who performed motoric cleansing behaviors turned off the moral purity goal – and were less likely to reaffirm their moral status by helping a stranger, compared to participants who had not washed their hands.

In another instance of goal scaffolding within the human mind, the evolved goal of bodily self-protection provides the foundation for a psychological self-protection goal. In order to navigate the natural environment, an organism has to learn how to maneuver through it and simultaneously minimize threats to its physical body, which is a functional motivation for all animals (e.g., Dijksterhuis & Aarts, 2003; Ohman & Mineka, 2001). When people use terms describing these bodily integrity violations (e.g., the pain of an object penetrating the flesh) to describe events relevant to psychological self-protection (e.g., offensive words "cut like a knife"; feelings can be "hurt," and a "broken" heart will "heal") they do so because a connection (whether on an explicit or an implicit level) exists between these domains.

Accordingly, multiple models posit associations between physical pain and social pain systems (e.g., Eisenberger, Lieberman, & Williams, 2003; MacDonald & Leary, 2005a, 2005b; Panksepp, 2003, 2005). These overlapping systems operate within a scaffolded motivational system, recruited for the pursuit of different goals. When the psychological self-protection goal is violated, people experience noncorporeal, "psychological pain" (i.e., social loss). Protective goal-congruent behaviors that may not directly address the source of the threat are prime sources of evidence for the view that psychological protective goals are scaffolded upon the fundamental goal of maintaining self-integrity.

If events relevant to protecting the bodily self provide a metaphorical bridge to clarify safeguarding the ego, a person's behavior in one domain may overlap onto his or her experiences in the other realm – similar to the relationship between physical cleanliness and moral purity goals. The neural overlap between physical pain and social pain systems (cf. Eisenberger et al., 2003; Panksepp, 2003) suggests that potential threats in both goal domains are processed similarly. Additionally, people who are made to feel rejected while playing a computerized ball-toss game ostensibly with other participants exhibited increased activity in the dorsal anterior cingulated cortex (dACC), an area also implicated in the body's pain response system (Eisenberger et al., 2003). Further, people who were more chronically sensitive to physical pain reported greater levels of psychological distress after being socially rejected compared to control participants (Eisenberger, Jarcho, Lieberman, & Naliboff, 2006).

Evidence exists for reverse directionality in overlapping goal behavior as well: research suggests that priming the psychological self-protection goal (via rejection-related feedback) activates bodily self-protective means. DeWall and Baumeister (2006) measured the effects of psychological distress on physical pain sensations. The experimenters theorized that if psychological pain is tethered to the experience of physical pain, socially painful experiences might trigger the body's pain system, which would then act defensively to minimize distress from physical injury by going numb. And this is indeed what they found. Participants were told they were predisposed to have a future filled with either social acceptance or loneliness, or they were not informed of any predispositions. Afterwards, they put their fingers into a pressure algometer that measured their sensitivity to and tolerance for physical pain. Participants who were exposed to

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psychological pain via social rejection were more physically numb afterwards – less sensitive to and able to tolerate more physical pain.

These examples of goal activation and completion across different evolutionarily adaptive domains suggest that priming of scaffolded goals impact judgment and behaviors in ways that are consistent with our current understanding of a scaffolded human motivational system. If higher level cognitive processes cannot be divorced from the foundational processes underlying them, then people may activate, pursue and fulfill one goal while concurrently activating, pursuing, and fulfilling another. These instances of goal scaffolding due to natural selection demonstrate how the passive construction of newer concepts can have widespread influences on human judgment and behavior.

CONCLUSIONS

The existing research suggests that higher mental processes are grounded on experience of the physical world, and develop through scaffolding processes. Embodied cognition is an example of how scaffolding occurs in human development, such that priming people with fundamental sensory and perceptual experiences (e.g., physical distance cues or touch) has downstream effects on higher-order judgments. Additionally, scaffolding occurs in evolution as well, where goal structures such as physical cleanliness or bodily self-protection serve as the foundation for newer, more abstract goals. Research supporting this assertion finds that priming people in one goal domain has consequences for how they pursue the other goal.

The highlighted phenomena contribute to the literature on how concepts develop, and the way in which the scaffolded design of the human mind influences people's judgments and behaviors. Based on embodied accounts of human cognition and evolutionary theory, this work assumes that concepts deriving from functional interactions with physical world are likely to have a pervasive impact on people's mental lives. These foundational concepts (e.g., physical space, physical temperature, bodily self-protection goals) provide meaningful guides for more abstract, newer concepts that are developed afterwards.

Starting as infants and reinforced by evolutionarily bestowed motives, humans are naturally responsive to the environment. Foundational concepts developed during infancy, and goal structures formed over the course of evolution, are capable of influencing people's thoughts, feelings, and behaviors when primed by natural physical experiences. The subtlety of these effects of the physical environment and hardwired goals on higher-order cognition calls into question how much control human beings actually have over their mental lives. Explorations into the scaffolded design of the human mind can shed light on why and how the environment has such a powerful influence over human behavior.

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