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# Three Mechanisms of Mind-Body Influence: Feelings, Concepts, and Procedures

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In Lewis Carroll's novel *Alice's Adventures in Wonderland*, the Cheshire Cat's body disappears from time to time. It is a convenient feature that we humans do not have. Our body is always with us. Despite its constant companionship, "the philosophical and religious tradition… cast the body in an inferior and objectified position relative to the disembodied soul, mind, and consciousness" (Falk, 2001, para. 14), a tendency noted by Nietzsche and challenged by Freud and Merleau-Ponty. Behavioral sciences, including consumer psychology, share this tendency to focus on the mind and leave the body in the dark, as if the latter were irrelevant or insignificant to a full understanding of human behavior.

But the field has taken a turn in the past 15 years. Accumulating evidence indicates that bodily processes exert predictable influence on consumers' feelings, judgments, and behaviors, and vice versa. For example, putting people in a warm environment increases their feelings of physical warmth and belief in global warming (for both liberals and conservatives; Risen & Critcher, 2011). Smelling something fishy, which is metaphorically associated with the concept of suspicion, decreases people's investment in trust-based economic games (S. W. S. Lee & Schwarz, 2012). Beyond sensory experiences, motor procedures such as discarding a piece of paper (Briñol et al., 2013) or enclosing it in an envelope (X. Li et al., 2010) not only physically separate it from people's body, but also psychologically separate it from their self, such that their

attitudes and emotions are less influenced by information on the discarded or enclosed paper.

Inspired by findings of this sort, our chapter seeks to direct the spotlight to various modalities of the body and their tractable interplay with mental processes. In so doing, we address a few broad questions:

- What versions of mind-body influence exist? Which versions are more controversial and which less so? What is their overall theoretical significance?
- What are the major theoretical frameworks that describe and explain mind-body influence? What are their strengths and weaknesses?
- What mechanisms underlie mind-body influence? How do they operate? What are their conditions? What predictions do they make?
- What are some exciting future directions?

We will review illustrative work, mostly experimental, which provides causal evidence. While bidirectional causality is generally observed between mental and bodily processes (S. W. S. Lee & Schwarz, 2012), we will devote more space to effects of bodily processes on mental ones, because they pertain to the more stirring claim that the body influences the mind. The primary goal of this chapter, however, is not to provide a comprehensive review of findings, but to offer a theoretical treatment and a multi-process model. We submit that three proximate mechanisms underlie mind-body influence: feelings, concepts, and procedures. They can interact (e.g., feelings triggered by concepts), but they can also operate in tandem. By unpacking these mechanisms, we hope to facilitate empirical and theoretical advances.

## WHAT IS MIND-BODY INFLUENCE AND WHY DOES IT MATTER?

A proper understanding of mind-body influence requires us to be clear about what we mean by *mind* and *body*, what exactly are the kinds of influence that exist between them, and

why such influence deserves scientific and philosophical recognition.

## Definitions

The Oxford English Dictionary (n.d.) defines *body* as "the physical form of a person, animal, or plant." The human physical form affords sensory (e.g., touch, taste, smell, sound, sight), motor (e.g., gesture, posture, locomotion), and interoceptive capacities (e.g., hunger, thirst, muscle tension). These capacities underlie a person's bodily states and action in a present situation ("online experience"); they also support multimodal simulation (i.e., the brain's re-enactment) of sensory, motor, and introspective experience acquired in prior situations ("offline experience"; Barsalou, 2008). We refer to this constellation of entities as *body*. Wherever necessary, we will specify which entity is the most relevant to a theory or finding.

Paralleling the multiplicity of meanings of *body*, the term *mind*, according to the APA Dictionary of Psychology ("Mind," n.d.), refers to multiple mental processes and outcomes, from emotion and motivation to perception and memory to knowledge and reasoning. As such, mind-body influence covers a variety of directional links between both sides. Some of these links are widely accepted; others are more controversial. A brief survey of them will provide the intellectual backdrop against which the significance of mind-body influence can be better appreciated.

## Different Kinds of Mind-Body Influence

That emotional and motivational processes involve changes in bodily states is obvious and uncontroversial. For example, anger involves heightening of physiological arousal (James, 1890; Russell, 2003) and contraction of certain facial muscles (Ekman et al., 1972). Also mainstream is the converse idea that changes in bodily states influence one's attitude and evaluation (Cacioppo et al., 1993; Centerbar & Clore, 2006) and one's perception and

comprehension of emotional information (for reviews, see Niedenthal, 2007; Niedenthal et al., 2005). Such influences have been observed in lab as well as naturalistic conditions. For example, cosmetic use of Botox, which blocks the facial muscles used in frowning, selectively undermines the efficiency of processing sentences that evoke emotions typically expressed by frowning (anger and sadness) without altering the processing of sentences that evoke another emotion typically not expressed by frowning (happiness; Havas et al., 2010).

Unlike emotion and motivation, whose ties to the body seem clear, cognition has traditionally (i.e., since the cognitive revolution in the 1960s) been regarded as phenomena within the brain but not beyond. Sure, thoughts can direct motor action and inform sensory experience, but the latter were ascribed no causal role in cognitive functioning. It is against this intellectual backdrop that the idea of bodily influence on cognition has stirred controversy. This idea, commonly known as embodied cognition, is actually not a singular claim, but a collection of at least six views that are closely aligned with but conceptually distinguishable from each other (M. Wilson, 2002). Of the six views (see Appendix for a summary), two appear most resonant with consumer and social psychologists' use of the term *embodied cognition*.

One view emphasizes that cognitive processes do not occur in a vacuum, but are situated in dynamic, constantly changing real-world contexts. The body's sensorimotor capacities are necessary to perceive and act on these contexts. The constantly changing perceptual inputs and motor outputs are inseparable from and inherent to cognitive functioning (Beer, 2000; Chiel & Beer, 1997).

The other view highlights that off-line cognitive processes, like on-line ones, can be body-based: "Mental structures that originally evolved for perception or action appear to be co-opted and run 'off-line,' decoupled from the physical inputs and outputs that were their original

purpose, to assist in thinking and knowing" (M. Wilson, 2002, p. 633). For example, we can move our fingers to facilitate counting, but we are also capable of mentally running a sensorimotor simulation of finger movements to attain the same goal. Even more subtly, the motor program responsible for finger movements may be covertly activated in the brain without resulting in any overt movement or conscious simulation, while still facilitating counting. These basic attributes of being off-line and body-based are observed in a number of fundamental cognitive activities that serve to represent information and draw inferences from it, such as mental imagery (Kosslyn, 1994; Parsons et al., 1995; Reisberg, 1992), working memory (A. D. Baddeley & Hitch, 1974), episodic memory, implicit memory (N. J. Cohen et al., 1985; Johnston et al., 1985), reasoning, and problem-solving (Glenberg & Robertson, 1999, 2000).

These two views, with their strong focus on the body and sensorimotor simulation, are particularly compatible with consumer and social psychologists' recent wave of interest in a diverse range of phenomena under the label of embodied cognition. The theoretical stance of embodied cognition and the research is has inspired have broad implications for cognitive science and philosophy of mind.

## Theoretical Significance of Embodied Cognition

From the perspective of scientific comprehensiveness, researchers' tendency to focus on processes in the head without taking bodily states or cues of the physical environment into account implies that some of the influences on mental processes and outcomes, including those that matter in consumer contexts (e.g., product evaluation, decision making), are not being captured. It limits the comprehensiveness of our description, explanation, and prediction of the mind and our ability to influence it. In fact, from James to Piaget to Bruner, the history of psychology features a rich tradition of analyzing the interplay between mental and bodily

processes. Ignoring such interplay runs the risk of satisficing ourselves with contrived models of how the mind works.

From the perspective of philosophy of mind, embodied cognition provides a direct response to the symbol grounding problem (Harnad, 1990). Language is symbolic. The sound, shape, and spelling of a word bear symbolic, abstract relations to its referents in reality. The same referent (e.g., an apple) can be denoted by different symbols in different languages (*apple* in English, *pomme* in French, *ping4 gwo2* in Cantonese). For words in a language to have meaning, they have to ultimately refer to something in reality, be it tangible or intangible. They cannot merely refer to other words, for that would constitute a merry-go-round from one meaningless symbol to another. For words to be meaningful, they have to be grounded in something other than just more meaningless symbols. That is the symbol grounding problem.

How does embodied cognition resolve this problem? It posits that abstract symbols are ultimately grounded in physical reality, which we experience and act upon via our body's sensorimotor modalities. Meanings are acquired through modality-based experiences and actions as well as scaffolded through additional mechanisms such as conceptual metaphors (see Mechanism 2: Concepts). Meanings are thus either directly grounded in bodily experience or indirectly grounded through other symbols that are themselves grounded in bodily experience. Shedding light on how symbols may be grounded, there is neural evidence for the key assumption that mental content can be represented in sensorimotor systems, whereas there is no clear evidence for the existence of an additional layer of mental representation called amodal symbols (Barsalou, 1999). There is also behavioral evidence from social and cognitive experiments for bidirectional influence between motor experience and linguistic processing (Mark Chen & Bargh, 1999; Creem & Proffitt, 2001; Glover & Dixon, 2002; Pulvermüller et al.,

2005; Tucker & Ellis, 1998; Zwaan & Taylor, 2006). These findings challenge the prevailing assumption of amodal symbols since the cognitive revolution in the 1960s and favor the stance of embodied cognition.

An implication of embodied cognition—one that has particularly drawn researchers' attention—is that bodily processes predictably influence mental ones. A multitude of body-to-mind effects has been observed. Different subsets of them are described and explained by different theories, to which we now turn.

## MAJOR THEORETICAL FRAMEWORKS

Several theories are most often invoked by consumer psychologists to motivate and interpret bodily influence on mental processes. The names, basic claims, and relevant bodily processes and mental functions of these theories are summarized in Table 1.

| Theory | Basic claim | Entities (other than the brain) to which the theory ascribes mental functions | Typical mental functions the theory focuses on explaining |
|---|---|---|---|
| Conceptual metaphors, scaffolding (Lakoff & Johnson, 1980, 1999; Landau et al., 2010; Williams et al., 2009) | Concrete bodily experience structures and activates conceptual knowledge about abstract domains and experience of them, as reflected in linguistic metaphors | Sensory perception, motor action | Knowledge about and experience of abstract domains |
| Bodily and facial feedback, embodied affect (Cacioppo et al., 1993; Niedenthal et al., 2005; Strack et al., 1988; Wells & Petty, 1980) | Motor states and proprioceptive feedback from them (e.g., gesture, posture, movement, facial expression) are causally involved in the experience/processing of affect typified by the motor states | Motor states, proprioceptive feedback | Affect, emotion, motivation, attitude |
| Somatic marker hypothesis (Bechara & Damasio, 2005; Damasio, 1996) | Marker signals arising in bioregulatory processes (e.g., in feelings) are causally involved in reasoning and decision making | Physiological states | Reasoning, decision-making |
| Grounded cognition (Barsalou, 1999, 2008; Glenberg & Kaschak, 2002) | Bodily states, situated action, and modal simulations implement a fully functional cognitive system (e.g., thought, knowledge, memory, language) | Sensory states, motor action | Knowledge, memory, and language about concrete domains |
| Grounded procedures (S. W. S. Lee & Schwarz, 2020b) | Motor action functions as bodily procedures that structure and activate mental procedures applicable across content domains | Motor action | Processing of concrete and abstract domains |

**Table 1.** Theories of bodily influence on mental processes. Different theories highlight different bodily and mental processes. On the bodily side, some theories broadly encompass all sorts of bodily experience or states, or even simulations of these states by sensorimotor modalities in the

brain. Other theories focus on more specific aspects, such as motor states and proprioceptive feedback, marker signals, and motor action. On the mental side, work that draws on bodily and facial feedback, embodied affect, and somatic marker hypothesis tends to highlight the embodiment of emotion and motivation (as outlined in Different Kinds of Mind-Body Influence) and the role of feelings (mechanism 1 below). Work derived from grounded cognition tends to highlight the embodiment of cognition. Work inspired by conceptual metaphors, scaffolding, and grounded procedures tends to be broader in that it highlights the embodiment of cognition but its effects extend to experiential aspects such as emotion and motivation, often with direct relevance to social and consumer psychology. In grounded cognition, conceptual metaphors, and scaffolding, the role of concepts (mechanism 2) is prominent. In grounded procedures, the role of motor action, or procedures (mechanism 3), is prominent.

Each theory has its strengths and weaknesses. Conceptual metaphors map out a full landscape of specific links between sensorimotor experience in concrete domains (e.g., cleanliness) and conceptual knowledge about and experience of abstract domains (e.g., morality). The former scaffolds the latter. The extensiveness of these links gives the theory tremendous heuristic value, as is evident from the amount of research it has inspired in fields spanning linguistics, philosophy, and psychology. At the same time, these links predict domain-specific effects (e.g., between cleanliness and morality) and cannot account for domain-general effects that are not reflected in metaphorical linguistic expressions (e.g., effects of cleanliness on decision-making, risk-taking, optimism, and more; S. W. S. Lee & Schwarz, 2016).

The tradition of bodily and facial feedback focuses on the embodiment of affective processes such as emotion, motivation, and attitude. It does not seek to explain non-affective, basic cognitive operations. The somatic marker hypothesis highlights the causal role of physiological states in higher-order cognitive processes such as reasoning and decision-making. It does not account for lower-order cognitive processes such as memory and knowledge activation. Those are the meat and potatoes of grounded cognition, which covers all aspects of cognitive functioning, but tends to focus on mental processing of concrete entities (e.g., chair) rather than abstract ones (e.g., justice). Its all-encompassing nature also prioritizes explanation of

general mental processes over specific mental content.

Inspired by the grand perspective of grounded cognition and the specific mappings of conceptual metaphors, the mid-range theory of grounded procedures highlights the role of motor action (e.g., physical cleansing) in cognitive functioning (e.g., mental separation), resulting in predictable domain-general effects. While it emphasizes the psychological power of motor action, it does not address that of sensory perception.

All of these theories are compatible with a fundamental organizational principle of the brain called neural reuse (Anderson, 2010). According to this principle, "it is quite common for neural circuits established for one purpose to be exapted (exploited, recycled, redeployed) during evolution or normal development and put to different uses, often without losing their original functions" (p. 245). To be clear, neural reuse is about the brain; it does not explicitly ascribe cognitive functions to the body. But by noting that brain processes recruited for evolutionarily and developmentally older uses in bodily functioning can be exapted for newer, non-bodily uses, the principle of neural reuse is well-aligned with theories of embodied cognition. And through this lens, findings of embodied cognition become less magical and more sensible.

## THREE MECHANISMS

To unpack findings of embodied cognition, beyond the general principle of neural reuse, we see the need to identify proximate mental mechanisms. Interest in embodied cognition rose in the mid-2000s. Initial work consisted largely of existence proof of metaphorical effects of bodily states on mental processes. Recognizing this trend, theorists called for attention to underlying mechanisms and boundary conditions (Meier, Schnall, et al., 2012) rather than demonstration after demonstration. Some mechanisms have been discussed in particular areas of interest, such as embodied influence on metaphorical social cognition (Landau et al., 2010), on judgment and

decision-making (S. W. S. Lee & Schwarz, 2014), and on information processing (Körner et al., 2015). Here we offer three mechanisms that underlie bodily influence on mental processes in general. They include feelings, concepts, and procedures (Figure 1, solid lines), with predicted moderators (top-down arrows). Other mechanisms may exist as well (dotted lines).

Each of the proposed mechanisms operates according to well-established principles. Each has received experimental support that covers a spectrum of bodily states and mental processes. For each mechanism, we will articulate the principles and review relevant experimental evidence. After introducing all three mechanisms, we will identify general moderators that determine their likelihood of activation and use.

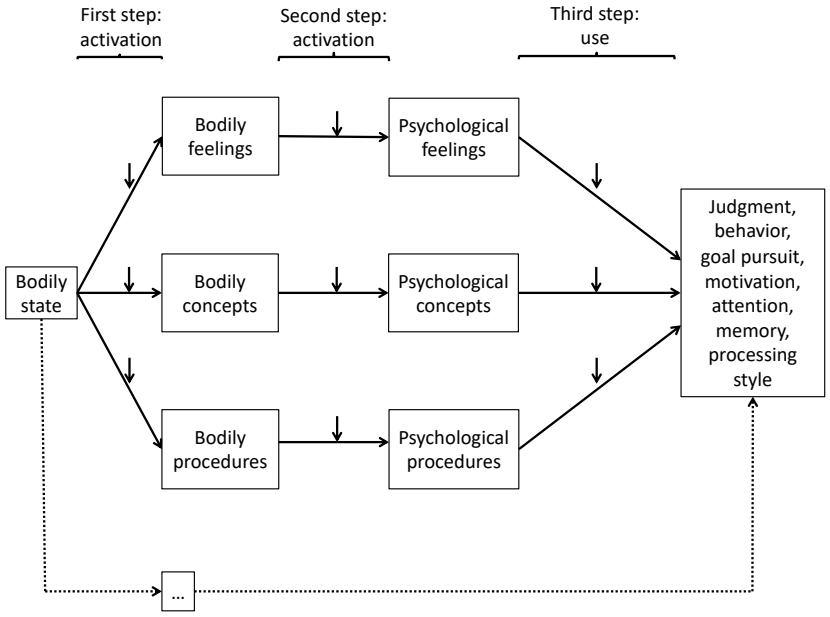


**Figure 1.** Examining bodily influence on mental processes through three mechanisms. Examples of bodily state are arousal, posture, facial expression, tactile sensation, and motor action. Examples of psychological feelings are specific emotions like fear, joy, pride, amusement, and anger, as well as processing fluency in motor action and sensorimotor simulation. Examples of psychological concepts are morality, importance, willpower, agreeableness, and suspicion. Examples of psychological procedures are separation and connection.

## Mechanism 1: Feelings

Many bodily states (e.g., physiological arousal, full-body posture) involve subjective

feelings. Feelings are diverse in kind, ranging from low-level sensations ("bodily feelings" in Figure 1) to generic moods to specific emotions to metacognitive experiences ("psychological feelings" in Figure 1). All of these can influence judgments and cognitive processes according to the logic of feelings as information (Schwarz, 2012; Schwarz & Clore, 2007). Specifically, feelings can serve as a source of information in judgments. They can also inform people about the nature of their current situation (e.g., task, environment), thereby attuning their cognitive processes to the situational demands.

Feelings can provide valid information when they are elicited by the judgment target or the situation at hand. Feelings generally do not provide valid information when they are elicited by unrelated cues. But because people are often unaware of the source of their feelings, they are susceptible to the influence of even invalid and irrelevant feelings. Yet once attention is drawn and attribution made to the source of their current feeling, people often mentally correct for its influence. To illustrate these dynamics, consider first the psychological influence of physiological arousal.

**Physiological Arousal**

Schachter and Singer's (1962) two-factor theory of emotion posited that many emotions are underlay by a general state of physiological arousal due to excitation of the sympathetic nervous system, which turns into specific emotions when labelled, interpreted, and identified by "a cognition appropriate to this state of arousal" (p. 380) in a given situation. For example, arousal experienced while seeing a person with a gun in a dark alley is labelled as fear; arousal experienced while winning a major award is labelled as joy. Their experimental work showed that extraneous arousal induced by epinephrine injection lent itself to alternative interpretations (anger or euphoria), but such malleability in interpretations was eliminated once participants

received clear information about the physiological effects of epinephrine and thus had a clear attribution of their arousal.

Similar effects can result from behavioral, non-medical inductions of arousal. In general, arousal induced in one behavioral context can be transferred to another context to exert its psychological influence. A few classic examples in social psychology attest to this point. Excitation from watching a film led to increased aggressive behavior (Zillmann, 1971). Standing on a fear-arousing suspension bridge increased men's sexual thought on a projective test and their tendency to contact an attractive female interviewer after the experiment, presumably due to transfer of arousal from anxiety to sexual attraction (Dutton & Aron, 1974). Arousal from cognitive dissonance (Festinger, 1957) could be induced by writing essays counter to one's initial attitude (under the condition of free choice; Linder et al., 1967; Waterman & Katkin, 1967), leading to a change in one's subsequent attitude. But once the arousal was attributed to a pill, its influence on subsequent attitude was eliminated (Zanna & Cooper, 1974), consistent with the general principles of feelings as information.

**Proprioceptive Feedback from Posture and Facial Expression**

Proprioceptive feedback from specific full-body postures or facial expressions can activate psychological feelings typically associated with them (Cacioppo et al., 1993), with downstream consequences for judgment and behavior. For example, adopting a slumped (as opposed to an upright) posture increased subsequent helplessness behaviors (Riskind & Gotay, 1982). Adopting an upright (as opposed to a slumped) posture strengthened feelings of pride from performing well on an achievement task (Stepper & Strack, 1993, Experiment 1). Facilitating (as opposed to inhibiting) the facial expression of a smile unobtrusively increased participants' amusement by cartoons (Strack et al., 1988; see Wagenmakers et al., 2016 for failed

replications; Noah et al., 2018 for successful replications and boundary conditions).

Disrupting facial or postural feedback can interfere with their corresponding mental processes. For example, when people experience and express negative emotions, they often frown (contracting the corrugator muscle). Cosmetic use of Botox (botulinum toxin-A) paralyzes the corrugator muscle. In so doing, Botox was found to slow down comprehension of sad and angry sentences, but not happy sentences (Havas et al., 2010). When people feel angry, they often exhibit approach motivation and want to take action (Carver & Harmon-Jones, 2009). A supine posture makes it difficult to take action. Accordingly, approach-motivation neural responses to anger evocation were weaker in a supine than in an upright posture (Harmon-Jones & Peterson, 2009).

When facial or postural expressions contradict mental states, a sense of incoherence results and triggers incoherence-reduction mental processes such as expansion of category boundaries. For example, category inclusiveness was higher when participants maintained a smiling face during sad recall or a frowning face during happy recall than when they maintained a smiling face during happy recall or a frowning face during sad recall (L. Huang & Galinsky, 2011, Experiments 1-2). Likewise, category inclusiveness was higher when participants maintained an expansive posture in a low-power role or a constrictive posture in a high-power role than when they maintained an expansive posture in a high-power role or a constrictive posture in a low-power role (Experiments 3-4). These experiences of mind-body incoherence are atypical in daily life. Thus, experimental instantiations of them can activate an atypicality mindset that enhances creative association, insight, and generation (L. Huang, 2019).

Even in the absence of incoherence with mental states, however, certain bodily states can generate proprioceptive signals of experiential ease or difficulty in and of themselves. For

example, a light smile is typically associated with positive experiences of ease, a furrowed brow with negative experiences of difficulty. Cues of experiential ease tend to sustain or amplify the pre-existing influence of recalled information on judgment, whereas cues of experiential difficulty tend to diminish or reverse it (Schwarz et al., 1991; for a review, see Schwarz, 2015). Demonstrating these principles, recall of a few behavioral episodes of high (vs. low) self-assurance led participants to judge themselves as higher on the trait of self-assurance—if they had been maintaining the facial expression of a light smile (contracting the zygomaticus muscle). But if they had been maintaining the facial expression of a furrowed brow (contracting the corrugator muscle), recall of high (vs. low) self-assurance led participants to judge themselves as *lower* on the trait of self-assurance (Stepper & Strack, 1993, Experiment 2).

While certain bodily states can generate signals of ease or difficulty, all motor actions can be performed with varying degrees of fluency, resulting in diverse effects. We turn to these now.

**Fluency of Motor Action, Motor Simulation, and Sensory Simulation**

People perform motor actions with greater ease and fluency using their dominant than non-dominant hand. That means right-handers experience greater fluency in rightward space, left-handers in leftward space. Because experiential fluency generally serves as a positive signal (Schwarz & Clore, 2007), right-handers exhibit a robust tendency to associate positive ideas (e.g., intelligence, attractiveness, happiness) with rightward space and negative ideas with leftward space, whereas left-handers exhibit the opposite associations (Casasanto, 2009). As evidence that these associations are driven by motor fluency, right-handers who had a unilateral stroke that disabled their right hand would associate good with left, but those who had a stroke that disabled their left hand would associate good with right (Casasanto & Chrysikou, 2011, Study 1). Temporarily handicapping right-handers' right hand, which increased relative motor

fluency with their left hand, resulted in associations of good with left, whereas temporarily handicapping their left hand resulted in associations of good with right (Study 2). Similar effects also resulted from varying degrees of motor fluency in observed actions by others (de la Fuente et al., 2015) or in imagined actions by oneself (de la Fuente et al., 2017).

The association of valence with laterality (e.g., good with right) is observed not only in explicitly performed, observed, or imagined action, but also in implicitly simulated action. Visual ads depicting a product as oriented towards people's dominant (vs. non-dominant) hand enhanced the ease of mentally simulating motor action for consuming the product and resulted in stronger purchase intentions (Elder & Krishna, 2012). These effects generalized across various manipulations of orientation in product depiction—a bowl of yogurt or soup with a spoon oriented to the right vs. left, a burger held in the right vs. left hand, a piece of cake with a fork on the right vs. left, and a coffee mug with the handle on the right vs. left (Experiments 1-4). Highlighting the causal role of motor simulation, if participants had to hold a clamp in their dominant hand, which occupied the manual modality needed for motor simulation, they showed the opposite effect, with stronger purchase intentions for a product depicted as oriented towards their non-dominant hand (Experiment 2). If participants had to hold clamps in both hands, their purchase intention was unaffected by product orientation in its depiction. Further supporting the role of motor simulation, depicting a product as oriented towards the dominant (vs. non-dominant) hand increased purchase intentions if it was a positive product, but decreased purchase intentions if it was a negative product (Experiment 3). Conceptually similar effects of motor simulation have been found across products and extended from purchase intention to product evaluation and choice (Ming Chen & Lin, 2019; Eelen et al., 2013).

Paralleling the psychological effects of motor action, motor simulation, and their fluency

(Körner et al., 2015), there are psychological effects of sensory states, sensory simulation, and their fluency. For example, on days that seemed warmer (as opposed to colder) than usual, participants had stronger beliefs in global warming, greater concerns about it, and donated more money to a relevant charity (Y. Li et al., 2011). In contrast, an unseasonably cold weather decreased belief in global warming (Schuldt & Roh, 2014). Large-scale correlational effects of local weather predicting belief in global warming have been found, particularly among people with high school education or less and people who lean Republican (Egan & Mullin, 2012). Experimentally, inductions of the sensory state of warmth increased participants' belief in global warming, an effect that was significant among both liberals and conservatives (Risen & Critcher, 2011, Experiments 1-3). It was driven by the fluency and clarity with which participants mentally simulated scenes of global warming (e.g., hot and dry desserts; Experiments 6a-6b). In short, sensory states increased beliefs in corresponding states of the world.

**Summary**

Across these lines of work, feelings from bodily states exert mental and behavioral influences. Physiological arousal increases psychological feelings that are typically high on arousal (e.g., euphoria, anger, aggression, sexual attraction). Attribution or misattribution of arousal changes its effects. Proprioceptive feedback from postures and facial expressions activates psychological feelings typically associated with them (e.g., helplessness, pride, amusement). Disrupting such feedback interferes with the corresponding mental processes (e.g., emotional comprehension, approach motivation). Some bodily states can generate proprioceptive signals of experiential ease (e.g., smiling) or difficulty (e.g., frowning). These feelings amplify or diminish the influence of recalled information on judgment. Feelings of ease and difficulty, or fluency and disfluency, also drive effects of motor laterality on thought valence (e.g., right-

handers' association of right with good) and effects of sensory states on specific beliefs (e.g., global warming).

## Mechanism 2: Concepts

A bodily state can activate concepts of directly relevant perceptual experience (sensory, proprioceptive, or introspective) and concepts of other perceptual experience commonly associated with it. For example, being in a hot room can activate the concept "hot," grounded in the sensory experience of temperature. Grasping a mug can activate the concept "grasp," grounded in the proprioceptive experience of manual action. It can activate the concept "thirst," grounded in the introspective experience of physiological need or desire. It can also activate the concepts "hot" and "coffee," which are experiences commonly associated with grasping a mug.

These examples are intuitive enough to the behaviorally and cognitively oriented. How do they operate neurally? From the perspective of grounded cognition (Barsalou, 1999, 2008), during perceptual experience, components of the full analog experience are extracted and stored by neural mechanisms (e.g., association areas in the brain). The componential patterns of neural activation can later be partially reactivated (e.g., by a bottom-up bodily state or a top-down mental goal) to implement symbolic cognitive functions (e.g., categorization, proposition). In this sense, cognitive processes are grounded in perceptual ones. The broad notion of grounding has inspired research in grounded social cognition (see Semin & Smith, 2008 for an edited book) and sensory marketing (Krishna, 2012; see Krishna et al., 2017 for an edited issue), some of which will be reviewed in this section.

Note that the proposed neural processes hinge on the initial extraction of components from perceptual experience. It is relatively easy to imagine how they work for concrete concepts such as "hot," "grasp," "thirst," and "coffee," which have clear perceptual referents in the

external world that are experienced through sensorimotor modalities of the body ("bodily concepts" in Figure 1). But how about abstract concepts?

Some abstract concepts are associated with specific sensorimotor states, such that putting people in those states can directly activate the corresponding abstract concept (S. W. S. Lee, 2016). For example, head-nodding increases agreement (Wells & Petty, 1980). Many abstract concepts, however, lack direct perceptual referents, such as truth, justice, importance, time, trust, and willpower. These are the kind of concepts that consumer and social psychologists care about. More fundamentally, humans' ability to comprehend them, apply them to specific instances, use them to guide thinking, and generate them in the first place is an impressive set of cognitive accomplishments (Bolognesi & Steen, 2018; Borghi et al., 2018; Brown, 1958; Burgoon et al., 2013; Liberman & Trope, 2008) that has to be accounted for in any comprehensive treatment of mental processes.

Grounded cognition accounts for this by assuming that abstract concepts can be represented directly in perceptual symbols (through technical mechanisms such as framing of event sequences, simulating the events, and mapping them onto perceived situations; Barsalou, 1999). These assumptions were met with immediate resistance (see commentary on Barsalou's target article). Of the various alternative perspectives, conceptual metaphor theory has garnered the most attention in consumer and social psychology.

Conceptual metaphor theory (Lakoff & Johnson, 1980, 1999) assumes that abstract concepts about psychological domains (e.g., morality, emotion, time) are structured and comprehended with the aid of concrete experiences in sensorimotor domains (e.g., cleanliness, force, space). Relative to abstract concepts, concrete ones are easier to comprehend and emerge earlier both developmentally and evolutionarily (Williams et al., 2009). Therefore, concrete

domains (e.g., experience with physical objects) typically serve as a source of image schemas, motor schemas, and relational structures, which are mapped onto abstract domains (e.g., experience with non-physical ideas) to scaffold conceptual understanding and inferences about them (e.g., treating ideas as if they were objects that can be given, taken, sold, bought, kept, lost, thrown out, bounced off). These cross-domain mappings are called conceptual metaphors. They are detectable in systematic patterns of linguistic metaphors (e.g., *let me give you a better idea*, *he stole my idea*, *I lost my train of thought*).

The promise of conceptual metaphors is that they are not just "language-deep" (Boroditsky, 2000, p. 6), but "cognition-deep," i.e., they are the mechanisms by which people conceptualize and thus experience the world. If that is the case, conceptual metaphors should be able to influence mental and behavioral outcomes even in the absence of linguistic cues. Sensorimotor cues should be able to trigger these outcomes. Indeed, research in the past 15 years has documented an impressive array of psychological consequences of conceptual metaphors. Effective non-linguistic manipulations span all sensorimotor modalities (e.g., touch, taste, smell, sound, sight).

**Touch**

Of the multiple human senses, touch is the earliest to develop in a lifetime (Gallace & Spence, 2008). It plays an important role in scaffolding higher-order mental content along metaphorical lines. Examples include Cleanliness–Morality, Weight–Importance, Roughness–Difficulty, Hardness–Stability, and Firmness–Willpower.

Following recall of one's immoral behavior, wiping one's hands clean (vs. no wiping) reduced one's immoral feelings and compensatory prosocial behavior (Zhong & Liljenquist, 2006, Experiment 4). Likewise, a manipulation of hand-washing (vs. no washing) changed

participants' moral sense and led them to judge others' transgressions as more wrong (Schnall, Benton, et al., 2008, Experiment 2). While some exact replications found null effects, others found positive effects (S. W. S. Lee & Schwarz, 2020b). Integrating evidence from all original experiments, exact replications, and conceptual replications, a comprehensive meta-analysis (S. W. S. Lee, Chen, et al., 2020) of over 200 effects of cleansing-related manipulations (e.g., actual cleansing, simulated cleansing) on morality-related outcomes (e.g., moral judgment, moral emotion, moral behavior) estimated overall effect sizes in the small-to-medium range (J. Cohen, 1988) after taking publication bias into account. Effects were robust across manipulations, measures, and populations.

Turning to other dimensions of tactile experience, weight is metaphorically associated with abstract meanings such as importance and profundity. When participants completed a questionnaire on a heavy (vs. light) clipboard, they judged the information in the questionnaire to be more important and processed it more elaborately (Jostmann et al., 2009). Specifically, they judged foreign currencies to be worth more (Experiment 1). They considered it more important for a university committee to listen to student opinions (Experiment 2). They also showed higher correlation in substantively related judgments (Experiment 3) and greater polarization between judgments of strong vs. weak arguments (Experiment 4), indicating more elaborate thinking. As a conceptual replication, shoppers carrying a heavy bag with three bottles of water (vs. empty bottles) assigned greater importance to voicing opinions in public (M. Zhang & Li, 2012, Experiment 2). The weight effect disappeared if participants had been primed with conflicting concepts (by writing down three light objects), but remained significant if they had been primed with neutral concepts (by writing down three familiar brands). It suggests that the metaphorical effect of weight on importance is at least partly driven by the accessibility of "heavy" concepts,

which is why the effect disappears when conflicting "light" concepts are made accessible.

Roughness is metaphorically associated with meanings such as difficulty and harshness. Participants who completed a puzzle with pieces covered in rough sandpaper (vs. uncovered and thus smooth) subsequently perceived an ambiguously valenced social interaction as less well-coordinated (Ackerman et al., 2010, Experiment 3). The same manipulation of roughness also increased compensatory bargaining behavior in the form of making better offers in an ultimatum game to avoid rejection (Experiment 4). Extending the basic idea, other manipulations of roughness have been shown to heighten participants' attention to others' hardship such as pain and need, thereby promoting empathy and helping behavior (C. Wang et al., 2015).

Hardness is metaphorically associated with meanings such as stability, strictness, and toughness. Participants who touched a hard block of wood (vs. a soft piece of blanket) subsequently perceived a target person described in an ambiguous social interaction as having a more rigid and strict personality (Ackerman et al., 2010, Experiment 5). Participants sitting in a hard wooden chair (vs. a soft cushioned chair) were less willing to change their financial offers to a dealer in a hypothetical car purchase situation (Experiment 6). Hardness also activates stereotypically relevant concepts. For example, squeezing a hard (vs. soft) ball and pressing hard (vs. gently) with a pen were found to increase participants' tendency to categorize gender-ambiguous faces as male rather than female (Slepian et al., 2011, Experiments 1-2), faces of politicians as Republican rather than Democrat (Slepian et al., 2012, Experiment 2), and photographs of professors as physicists rather than historians (i.e., hard science rather than soft discipline; Experiment 3).

Closely related to the tactile experience of hardness is the proprioceptive experience of firmness. A variety of muscle firming manipulations have been found to firm one's willpower in

self-control situations for long-term goals (I. W. Hung & Labroo, 2011). For example, grasping a pen tightly (vs. holding it naturally) increased participants' likelihood of donation (Experiment 1). Clasping a pen tightly (vs. supporting it freely) increased participants' duration of keeping their hands immersed in ice-cold water (Experiment 2). Stretching calf muscles (vs. no action) increased participants' consumption of a healthy but awful-tasting vinegar tonic (Experiment 3). Stretching fingers (vs. holding them naturally) increased participants' choices of healthy food at a snack bar (Experiment 4). Contracting biceps (vs. keeping them natural) increased participants' likelihood of choosing an apple over a chocolate bar (Experiment 5). These findings point to the potential utility of firming one's muscles, which can be initiated and attained at will without requiring external tools or stimuli, in self-control situations throughout daily life.

**Taste**

Turning from the physical sense of touch to the chemical sense of taste, metaphorical effects of sweet, spicy, and bitter tastes have been observed. Sweetness is one metaphorical descriptor of kind people ("thanks for the gift, you're so sweet"). Supporting this conceptual association, participants perceived targets to have a more agreeable personality if the targets liked sweet food than if the targets liked bitter, salty, sour, or spicy food (Meier, Moeller, et al., 2012, Experiment 1). The effect was specific to agreeableness and did not emerge for the other personality dimensions examined (extraversion and neuroticism). Individual differences in liking for sweet food correlated with prosocial personality, intention, and behavior (Studies 2-3). As causal evidence, experimental manipulations of sweetness by tasting a sweet chocolate (vs. a tangerine sour, or a water cracker, or no food) led participants to self-report higher levels of agreeableness and longer durations of volunteering to help another researcher (Experiments 4-5). These effects are mirrored in associations between preferences for sweet foods and agreeableness

or prosociality in daily life (Fetterman et al., 2017). Sweetness has also been found to have linguistic, behavioral, emotional, cognitive, or neural associations with other psychological concepts such as gratitude (Schlosser, 2015), revenge (Hellmann et al., 2013; Sjöström et al., 2017), and romance (Chan et al., 2013; Ren et al., 2015; L. Wang et al., 2019; L. Wang & Chen, 2018; Yang et al., 2018).

Inspired by the diverse metaphorical meanings of spicy, researchers have found a range of psychological effects. For example, tasting spicy (vs. non-spicy) potato chips increased variety-seeking in choosing candy bars after a time delay (Mukherjee et al., 2017, Experiment 1). The effect replicated with another manipulation (spicy vs. non-spicy candy) and paralleled the influence of semantic priming of the linguistic metaphor "variety is the spice of life" (Experiment 2), highlighting the role of metaphorical concepts. Less flattering is the metaphorical association between spicy and aggressive. Individuals who prefer spicy food tend to score higher on trait aggression (Batra et al., 2017, Study 1). Tasting a spicy (vs. non-spicy) tortilla chip, or seeing images of spicy (vs. non-spicy) foods, activated aggression-related concepts and increased perception of aggressive intent a target person (Experiments 2-3).

Pitting sweet and spicy against each other in the Israeli cultural context presents a theoretically interesting case (Gilead et al., 2015). Preverbal infants prefer sweet over spicy, i.e., sweet is more positive than spicy. But linguistically and metaphorically, for Israelis, sweet indicates inauthenticity whereas spicy indicates intellectual competence, i.e., spicy is more positive than sweet. If metaphorical effects of sensory experience operate through preverbal mechanisms, sweet (vs. spicy) tastes should result in more positive judgments. If they operate through linguistic concepts (cf. S. W. S. Lee & Schwarz, 2012), spicy (vs. sweet) tastes should result in more positive judgments. Empirically, tasting spicy (vs. sweet) snacks led participants

to perceive a target person as more intellectually competent, less inauthentic, and more positive overall (Gilead et al., 2015), supporting the role of metaphorical concepts.

Although preverbal valence and metaphorized valence sometimes diverge (as in the case of sweet and spicy for Israelis), typically they do converge. Bitter taste, for example, is aversive. Its metaphorical meanings are also negative, a prominent one of which is disgust. The word *disgust* finds its etymological roots in the Latin *dis-* (expressing reversal) and *gustus* (meaning taste). Research has found that tasting a bitter drink, seeing photographs of contaminants, and being treated unfairly in an economic game all activated the levator labii facial muscles, which are responsible for producing an oral-nasal rejection response (Chapman et al., 2009). Directly tapping into the link between taste and morality, drinking Swedish Bitters (vs. the sweet Minute Maid Berry Punch or plain water) led to harsher judgments of moral violations, especially among political conservatives (Eskine et al., 2011). These results suggest a link between gustatory distaste and moral disgust.

Metaphorical meanings of bitter extend beyond the moral realm though. For example, bitter enemies are characterized by hostility and antipathy. Tasting a bitter (vs. sweet or neutral) drink increased participants' self-reported hostile mood (Sagioglou & Greitemeyer, 2014, Experiment 1), hypothetical aggressive feelings and behavioral intentions (Experiment 2), and hostile evaluation of the experimenter as less competent and less friendly (Experiment 3). Bitter taste is also associated with harsh environments and the corresponding motivation to survive (B.-B. Chen & Chang, 2012). Accordingly, tasting a bitter drink or food (vs. neutral drink or sour or sweet food) speeded up participants' responses to survival-related words in a lexical decision task (Experiments 1-2), increased their present focus and thus discounting rate in an intertemporal choice (Experiment 3), and improved their retrieval of survival-related words in a

surprise recall task (Experiment 4).

**Smell**

Like taste, smell is a chemical sense, which can be stimulated in both positive and negative valences. On the negative side, metaphorical associations between smell and suspicion are found in at least 18 languages (Ibarretxe-Antuñano, 2019; Soriano & Valenzuela, 2008). Inspired by these linguistic observations, a series of experiments probed the metaphorical association between social suspicion and fishy smells among English speakers (S. W. S. Lee & Schwarz, 2012), as reflected in linguistic expressions like "something smells fishy." Incidental presentation of fishy smells (vs. non-fishy disgusting smells or no smell) decreased participants' trust-based monetary investment in a trust game (Experiment 1) and a public goods game (Experiment 2). Conversely, inductions of social suspicion increased participants' ability to correctly label fishy smells, but not other smells (Experiments 3a-3c). An experimental causal-chain approach suggested that such enhancement in correct labeling of fishy smells was driven by the accessibility and applicability of metaphorical concepts: social suspicion activated suspicion-related concepts (Experiment 4), which activated fishy concepts (Experiment 5), which were applied to the identification of target smells (Experiment 6). The metaphorical effect extends from the conceptual to the perceptual level, as shown in a signal detection paradigm where suspicion induction improved perceptual sensitivity to low concentrations of fishy smells, but not other smells (Experiment 7).

Follow-up research generalized the effects of fishy smells to suspicion in nonsocial contexts of information processing and reasoning. For example, consider the simple question, "How many animals of each kind did Moses take on the Ark?" The correct answer is not two, but that it was Noah rather than Moses (Erickson & Mattson, 1981). Participants became more

likely to identify the semantic distortion in such trick questions if they were exposed to fishy smells (vs. no smell; D. S. Lee et al., 2015, Experiment 1). Incidental exposure to fishy smells (vs. no smell) also increased participants' likelihood of engaging in hypothesis testing that falsified (rather than confirmed) their initial intuitions (Experiment 2), improving their performance in a classic rule discovery task (Wason, 1960).

These effects have been replicated with extensions. For example, incidental exposure to fishy smells (vs. non-fishy disgusting smells, or no smell) decreased participants' investment in a public goods game (Sebastian et al., 2017). This effect overrode an otherwise observed correlation between individual differences in distrust and reduced investment in the game. Fishy smells also increased participants' likelihood of falsification hypothesis testing and the amount of time they took to complete the experiment, which suggested more information processing. Consistent with that possibility, another lab used the misinformation paradigm in memory research and found that fishy smells (vs. no smell) enhanced discrepancy detection, thereby eliminating interference by misinformation and reducing suggestibility (Sheaffer & Pansky, 2017). All of these findings indicate that fishy smells elicit suspicion, which can both undermine social cooperation and enhance cognitive processing.

Turning from unpleasant smells to pleasant ones, clean scents exert judgmental and behavioral effects along metaphorical lines. For example, participants reciprocated more money in a trust game if they were in a room sprayed with citrus-scented Windex than in an unscented room (Liljenquist et al., 2010, Experiment 1). Clean scents (vs. no scent) also increased interest in volunteering for a charitable organization and likelihood of donating money (Experiment 2). As a conceptual opposite of clean scents, a disgusting odor (fart spray) intensified condemnation of moral violations (Schnall, Haidt, et al., 2008, Experiment 1). In short, participants behaved in

more virtuous ways in the presence of clean scents and judged more harshly in the presence of disgusting smells, consistent with the clean–moral/dirty–immoral metaphorical association.

**Sound and Sight**

The physical senses of sound and sight convey rich information about the spatial environment, often in intertwined ways. Consider sound-distance associations. Back vowels (e.g., "oo") were shown to convey a sense of distance, front vowels (e.g., "ee") a sense of closeness, with consequences for spatial judgment, perception, and action (Rabaglia et al., 2016). Because distance (vs. closeness) typically elicits higher-level (vs. lower-level) mental construal (Trope & Liberman, 2010), back vowels tended to evoke higher-level construals than did front vowels (Maglio et al., 2014), resulting in visual and conceptual imprecision (Experiments 1-2). Accordingly, consumer evaluations of products and services with back-vowel (vs. front-vowel) names tended to be driven by high-level rather than low-level considerations (i.e., desirability rather than feasibility, primary rather than secondary features, long-term rather than short-term; Experiments 3-5).

Sound-shape associations also exist. The most well-known example is the *bouba-kiki* effect (Ramachandran & Hubbard, 2001), where a soft-sound word like *bouba* is generally chosen to represent a curved shape, a sharp-sound word like *kiki* to represent an angular shape (for reviews, see Imai & Kita, 2014; Lockwood & Dingemanse, 2015). The effect occurs across languages (Bremner et al., 2013) and even in children under three years of age (Maurer et al., 2006). These sound-shape mappings are driven by phonology and occur automatically prior to conscious awareness of visual shapes (S.-M. Hung et al., 2017).

In addition to the robust sound-sight associations noted above, fundamental dimensions of sight, such as location and shape, are rich in psychological associations. Consider a single

dimension: verticality, or vertical location in space. Experimental work has found that being high up (vs. down low) in space is not only linguistically but also cognitively, affectively, and behaviorally associated with a variety of abstract concepts, such as status (Dannenmaier & Thumin, 1964; P. R. Wilson, 1968), power (Giessner & Schubert, 2007; Schubert, 2005), positive valence (Meier & Robinson, 2004), freedom and abstraction (Meyers-Levy & Zhu, 2007), morality (H. Li & Cao, 2016; Meier, Sellbom, et al., 2007), divinity (Meier, Hauser, et al., 2007), and rationality (Cian et al., 2015), with consequences for consumer behavior (for a review, see Cian, 2017).

Shapes have been extensively studied as well. Sharp contours conveyed a sense of threat and were less preferred than curved contours (Bar & Neta, 2006). Downward-pointing triangles were perceived as particularly threatening and categorized faster as unpleasant than as neutral or pleasant, whereas upward-pointing triangles or circles did not exhibit such affective associations (Larson et al., 2012). Sharp (vs. round) shapes increased perception of aggression in others and aggressive choices in decision-making (Hess et al., 2013). Angular-shaped seating arrangements activated the need for uniqueness and thus led participants to favor self-oriented or minority-endorsing persuasive messages, whereas circular-shaped seating arrangements activated the need to belong and thus led participants to favor family-oriented or majority-endorsing persuasive messages (Zhu & Argo, 2013). Angular-shaped (vs. circular-shaped) brand logos increased perception of company and product attributes such as durability (vs. comfortableness) through visuospatial imagery (Jiang et al., 2016). Finally, square (vs. round) shapes have also been shown in a variety of verbal and reaction-time measures to be associated with competence (vs. warmth; Okamura & Ura, 2018, 2019b), business (vs. dating; Okamura & Ura, 2019a), and male (vs. female; Stroessner et al., 2020).

**Summary**

Across sensorimotor modalities (touch, taste, smell, sound, sight), diverse psychological consequences have been observed along metaphorical lines (Lakoff & Johnson, 1980, 1999). These dynamics matter for effective advertising (Krishna, 2012) and creative thinking (Zhu & Mehta, 2017). The heuristic value of conceptual metaphors lies in the fact that they are manifest in and thus inferable from linguistic expressions, generating specific predictions that map a sensorimotor domain to a psychological domain. These mappings exert predictable affective, conceptual, judgmental, and behavioral influences (Landau, 2017; S. W. S. Lee & Schwarz, 2014).

## Mechanism 3: Procedures

Conceptual mappings underlie many mind-body effects, but not all of them. For example, cleanliness is conceptually associated with morality (Lakoff & Johnson, 1999), especially the moral foundation of sanctity/degradation (Haidt & Graham, 2007), and the corresponding emotion of disgust (Rozin et al., 2008). But psychological consequences of cleanliness extend far beyond the realms of morality and disgust (S. W. S. Lee & Schwarz, 2011, 2016). How do we explain these effects?

An emerging perspective conceptualizes bodily actions (e.g., cleansing) as grounded procedures (S. W. S. Lee & Schwarz, 2020b). Drawing on the research tradition of information processing, a procedure is defined as "the sequence of steps that can be taken to attain a particular objective" (Wyer et al., 2012, p. 241). Procedures can be operationalized at the mental or physical level, i.e., there are "cognitive or motor" procedures (p. 239). The interesting thing about procedures is their generalizable application: Activating a procedure to attain a particular objective renders the procedure more likely to be used in a subsequent context, even if the

original objective is no longer relevant. In other words, a procedure is applicable across content domains (Janiszewski & Wyer, 2014).

Combining these properties of a procedure with the assumptions of grounded cognition (Barsalou, 1999, 2008) gives rise to the perspective of grounded procedures (S. W. S. Lee & Schwarz, 2020b). The core claim here is that physical procedures can ground mental procedures. Representationally, physical procedures can constitute mental procedures. Functionally, engagement of a physical procedure can activate a corresponding mental procedure, and vice versa. Upon activation, a physical or mental procedure becomes more likely to be applied to subsequent tasks and situations, even if they are unrelated to the original procedural objective.

Through this theoretical lens, the bodily action of cleansing can be conceptualized as a grounded procedure of separation. Any act of cleansing involves separating physical entities from each other (e.g., separating dirt from one's hands). Such separative experience can ground mental procedures of separating psychological entities from each other (e.g., separating past behavior from one's present self). Based on mental inclusion/exclusion principles (Bless & Schwarz, 2010), the psychological influence of the separated entity should be reduced.

This mechanism (grounded procedures) generates a number of process-oriented predictions distinct from predictions derived from other mechanisms (concepts and feelings). For example, the physical action of cleansing should reduce the psychological influence of any separated entity, regardless of the entity's (1) domain and (2) valence. In contrast, conceptual metaphor theory only associates cleansing with the moral domain, the emotion of disgust only captures cleansing effects that involve (physically or morally) disgusting stimuli, and both views predict only positive effects of cleansing as it confers a sense of morality or reduces disgust. In addition to generalizability across psychological domains and valences, another prediction of

grounded procedures is generalizability across actions: If separation is the mechanism at work, (3) similar effects should result not only from physical cleansing, but also from other physical procedures of separation. We review support for these and other predictions below, starting with the most specific case of cleansing, then broadening to other grounded procedures of separation, and finally to their conceptual opposite (connection). Other examples of grounded procedures than separation and connection also exist but are beyond the scope of this chapter.

**Cleansing and Separation**

Physical cleansing has been shown to produce psychological consequences in non-moral, non-disgusting contexts. In the context of decision-making, for instance, after making a free choice between two similarly attractive options, people often experience postdecisional dissonance ("did I make the right choice?"; Brehm, 1956; Festinger, 1957). To reduce the aversive state of dissonance, a cognitive process unfolds where attention is directed to positive features of the chosen alternative and to negative features of the rejected alternative. As a result, people tend to evaluate the chosen alternative more favorably after than before choice, and the rejected alternative less favorably after than before choice. This classic effect of postdecisional dissonance was eliminated if participants were prompted to wash their hands using a bottle of hand soap (under the pretense of product evaluation) right after choice and before subsequent evaluation (S. W. S. Lee & Schwarz, 2010a, Experiment 1). Merely examining the hand soap without using it did not eliminate the classic effect. A conceptual replication found the same pattern (Experiment 2): Using an antiseptic wipe right after choosing between similarly attractive fruit jams eliminated postdecisional dissonance, whereas merely examining the wipe did not.

Extended replications found the same phenomenon in a German sample (Marotta & Bohner, 2013) and uncovered individual differences and boundary conditions. Cleansing

eliminated postdecisional dissonance for participants who scored low on generalized anxiety, rumination, and intolerance of uncertainty, but not for participants who scored high on these measures (De Los Reyes et al., 2012). Cleansing also did not eliminate postdecisional dissonance if participants received memory cues about their predecisional evaluation during their postdecisional evaluation (Camerer et al., 2018). Integrating all findings into a meta-analysis estimated the overall effect to be $d = 0.204$, $SE = 0.084$, $p = .015$, 95% CI 0.040/0.349, indicating a small effect of washing away postdecisional dissonance (S. W. S. Lee & Schwarz, 2018).

In addition to reducing the influence of a recent decision on subsequent evaluation, cleansing can also reduce the influence of recent financial luck on subsequent risky choice. After recalling financial good (vs. bad) luck, participants became more risk-seeking (vs. risk-averse) in a vicarious managerial decision, but using an antiseptic wipe reversed this effect (Xu et al., 2012, Experiment 1). Likewise, following a winning (vs. losing) streak in a monetary gambling task, participants were more (vs. less) likely to bet in a final round, but using a hand soap eliminated this effect (Experiment 2).

Cleansing oneself (vs. no cleansing, or cleansing an object) has also been found to reduce the influence of an academic failure on subsequent pessimism and compensatory effort (Kaspar, 2012), the influence of successful and failing performance on subsequent optimism (Körner & Strack, 2018), the influence of product endowment on subsequent desire for product exchange (Florack et al., 2014), the influence of effort on subsequent feelings of ownership (A. Lee & Ji, 2015), and the influence of physical and social threats on subsequent affect and physiology (S. W. S. Lee, Millet, et al., 2020). These findings highlight that cleansing effects are observed in a variety of non-moral, non-disgusting contexts, for both positive and negative entities (e.g., good and bad luck, successful and failing performance, endowment, threat).

Beyond cleansing, various grounded procedures of separation can reduce the influence of the physically separated entity. For example, leading participants to tempt fate by saying they or their friend would never encounter a specific bad situation (e.g., accident, theft) increased their perceived likelihood of encountering the bad situation (Y. Zhang et al., 2014). This effect of tempting fate was reduced by both culturally symbolic actions of separation (knocking on wood, which involves moving one's hand away from one's body; Experiment 1) and non-symbolic actions of separation (e.g., throwing a ball away; Experiments 2a-2b), due to reduced clarity of mental imagery about the bad situation (Experiment 3). Even pretending to throw a ball away, which engages the motor muscles of actual throwing without distancing the ball from oneself, eliminated the effect of tempting fate (Experiment 5), suggesting that it was the motor procedure that mattered, not the spatial distance.

Furthermore, writing about a regretful experience on a piece of paper elicited negative feelings, but enclosing the piece of paper in an envelope reduced subsequent negative feelings (X. Li et al., 2010, Experiment 1a). The same manipulation reduced the affective impact of writing about an unsatisfied desire (Experiment 1b) and reading about a sad event (Experiment 2). Enclosure can also influence choice satisfaction. Specifically, after a free choice of one out of 24 pieces of chocolate on a tray, if participants were instructed to cover the tray with a transparent lid, it reduced their mental comparison between the chosen and forgone options, thereby increasing their feelings of choice completion and satisfaction (Gu et al., 2013, Experiment 1). Closing a menu after choosing one out of 24 options of tea (Experiment 2) or biscuit (Experiments 3a-3b) produced similar effects.

From cleansing to enclosure, grounded procedures of separation reduced the psychological influence of the physically separated entity. Opposite to separation, grounded

procedures of connection also exist and produce conceptually parallel effects.

**Connection**

Acts that connect physical entities to each other (e.g., connecting a product to one's hands) can ground mental procedures of connecting psychological entities to each other (e.g., connecting an idea to one's self), such that the psychological influence of the connected entity is amplified (in cases of pre-existing influence) or created (in cases of no pre-existing influence). These patterns have been observed across psychological domains, across their valences, and across operationalizations of physical connection, from spatial continuity to approach movement to actual contact.

Visualizing four years of college experience as a spatially continuous journey increased college students' experience of psychological connection between their present and future identities, in turn increasing their academically relevant motivation and performance (Landau et al., 2014). Jotting down thoughts about the Mediterranean diet on a piece of paper and then physically connecting it to oneself (folding and putting it in one's pocket; vs. control conditions that involved no physical connection) increased the psychological influence of the jotted thoughts on subsequent attitudes towards the Mediterranean diet, such that positive thoughts led to even more positive attitudes and negative thoughts led to even more negative attitudes (Briñol et al., 2013, Experiment 2). Actual contact with (vs. mere examination of) a robot increased existing attitudes towards robots, regardless of whether they were positive or negative (Wullenkord et al., 2016).

Actual contact also amplifies contagion effects, which occur for negative as well as positive entities (J. Y. Huang et al., 2017). Objects that had been in contact with disdained individuals were perceived as retaining essences and properties from the individuals and thus

disliked (Nemeroff & Rozin, 1994). Products that had been in contact with previous shoppers were evaluated as worse (Argo et al., 2006), but products that had been in contact with attractive opposite-sex others were evaluated as better (Argo et al., 2008). Items that had been in contact with celebrities commanded especially high prices at auctions (Bloom & Gelman, 2008; Newman et al., 2011; Newman & Bloom, 2014). Sporting goods (e.g., golf club, ball) that had been in contact with successful athletes increased participants' athletic self-perception and performance (Kramer & Block, 2014; C. Lee et al., 2011).

In cases of no pre-existing influence, connecting otherwise neutral entities to the self tends to create a positive influence, because people generally evaluate the self positively (Baumeister, 1999). Even subtle cues of physical connection can produce these effects. For example, company names, person names, and nonsense words beginning with front consonants (e.g., B, M) and ending with rear consonants (e.g., G, K) were favored over their counterparts (beginning with rear consonants and ending with front consonants), because front-to-rear articulation involves oral approach movement whereas rear-to-front articulation involves oral avoidance movement (Topolinski, 2017). In another modality, flexing (vs. extending) arm muscles resembles manual approach (vs. avoidance) movement and created favorable evaluation of otherwise neutral stimuli (Cacioppo et al., 1993; Priester et al., 1996).

Grounded procedures of connection have applied consequences in the marketplace. Actual contact or mentally simulated contact with objects confers a sense of ownership among buyers and sellers alike, increasing valuation (Peck et al., 2013; Peck & Shu, 2009). When the same product is available in physical and digital forms, a stronger sense of ownership and higher valuation are ascribed to physical than digital forms (Atasoy & Morewedge, 2017). With digital shopping interfaces, touch-based devices like tablets give consumers a stronger sense of

ownership and result in higher valuation than do non-touch-based devices like laptops (Brasel & Gips, 2014).

All in all, physical acts of connection, mental simulation of them, or platforms that facilitate them tend to confer a sense of psychological connection, with downstream consequences for attitude strength, perceived ownership, and monetary valuation.

### Across Mechanisms: Predicted Moderators

The three mechanisms predict a range of moderator variables, some of which are mechanisms-general and others are mechanism-specific. Together, the predicted moderator variables tap into contextual, individual, cultural, and other group differences. A brief overview of select moderators is provided below (for a full treatment, see S. W. S. Lee & Schwarz, 2020a).

With reference to the first step in Figure 1, the starting point of all mechanisms is the bodily state, both the modality and processing of which matter. For example, cleanliness can be attained in different bodily modalities such as manual (hands), oral (mouth), and facial (whole face). The relative salience of these modalities moderates metaphorical effects between cleanliness and morality. Participants evaluated mouthwash more favorably after telling a malevolent lie on voicemail (using the mouth) than on email (using the hands), but evaluated hand sanitizer more favorably after telling a malevolent lie on email than on voicemail (S. W. S. Lee & Schwarz, 2010b). Paralleling such situational salience, chronic salience of modality produces similar effects. East Asian cultures are known as *face* cultures (Leung & Cohen, 2011), where one's face metaphorically represents one's public image. Given this cultural background, immoral recall heightened East Asian participants' desire for face-cleaning products, and wiping the face clean (vs. wiping hands, or no wiping) was the most effective for reducing their moral guilt (S. W. S. Lee et al., 2015).

Processing of a bodily state involves attributes such as awareness, subjectivity, and simulation. Drawing on principles of social cognition, if participants are highly aware of a bodily state manipulation and its irrelevance to the task at hand, mental correction is likely to occur (Bless & Schwarz, 2010; Greifeneder et al., 2011) to eliminate its otherwise observed influence. Bodily states are subjective to some extent. A 1.5 kg shopping bag felt a little heavy on the arm if participants expected the bag to contain bags of potato chips but the same objective weight felt a little light if participants expected the bag to contain a dozen cans of Coke, and this subjective experience of heavy (vs. light) increased the metaphorically associated perception of importance (M. Zhang & Li, 2012). Related to subjectivity is the power of mental simulation of a bodily state. Compared with actually experiencing a bodily state, mentally simulating it can produce qualitatively similar (though often quantitatively weaker) metaphorical effects. For example, detailed imagination of being physically clean (vs. dirty) led participants to see themselves as morally cleaner and judge others' transgressions more harshly (Zhong et al., 2010). First-person imagination of holding a cup of iced (vs. hot) coffee also led participants to judge a target person as socially colder (Macrae et al., 2013).

As for the second step in Figure 1, moderation is easiest to illustrate with the mechanism of concepts. For bodily activation of psychological concepts to occur, the conceptual association needs to be both available and accessible. Certain associations are available in specific cultures, not in others. For example, in different cultures, the same gesture can have different meanings (e.g., thumbs up indicating approval in North America but insult in the Middle East), and different gestures can have the same meaning (e.g., agreement indicated by nodding in America but head bobbling in India). Some conceptual metaphorical associations seem to have culture-general structures but culture-specific contents. For example, suspicion is metaphorically

described as bad smell across languages, but some languages specify a particular bad smell (e.g., fishy in English), other languages specify a different bad smell, and yet other languages leave it unspecified (S. W. S. Lee & Schwarz, 2012). Temporal relations are metaphorically described in spatial terms across cultures, but the specific spatial dimension differs between cultures. The past/future is in the back/front for English speakers ("I look forward to meeting you," "let's put this behind us"; Boroditsky, 2000), but front/back for Aymara speakers (Núñez & Sweetser, 2006), top/bottom for Mandarin speakers (Boroditsky, 2001), and East/West for Pormpuraawans (a remote Australian aboriginal culture; Boroditsky & Gaby, 2010). Experiments have confirmed these culture-specific conceptual associations, with cognitive and behavioral consequences.

Just because a metaphorical association is available in memory does not mean it is accessible in context; availability is a necessary but not sufficient condition for accessibility (Higgins, 1996). A highly accessible metaphorical association increases the likelihood and strength of bodily activation of psychological feelings, concepts, and procedures. For example, drinking a cup of iced (vs. hot) tea led participants to feel physically cold and increased their liking for romantic movies—but only if they had a highly accessible association of romantic movies with warm feelings (Hong & Sun, 2012). Using the right (vs. left) hand in physical actions activated positive concepts such as "goodness" and "victory" (vs. negative concepts such as "badness" and "loss")—but only if participants were right-handed and thus had a chronically accessible association of right-side with positive valence (Casasanto, 2009, 2011).

Accessible psychological contents (feelings, concepts, or procedures) have to be used or applied to specific outcomes (third step in Figure 1). If the accessible psychological contents include multiple domains (e.g., verticality activates both powerfulness and valence), in which domain will an effect be observed? An important determinant is attention, i.e., to which domain

participants pay attention (for a related view on priming, see Bargh, 2006; on metacognitive experience, see Schwarz, 2010; on metaphor, see Santiago et al., 2011). To illustrate, when a task required participants to judge groups as powerful or powerless, they made more efficient judgments (fewer errors) for powerful (vs. powerless) groups appearing at the top (vs. bottom) of the screen, but the groups' valence had no influence at all (Schubert, 2005, Experiment 5a). When a task required participants to judge groups as good or bad, they made more efficient judgments (shorter response latencies) for good (vs. bad) groups appearing at the top (vs. bottom) of the screen, but the groups' power had no influence at all (Experiment 5b). Whichever domain participants attended to, the metaphorical effect was observed, suggesting a manner in which multiple contents get channeled into specific outcomes.

These patterns of moderation reflect a small subset of the full range of moderators, which will be a fruitful avenue for investigation. Together with the basic operation of the three mechanisms, they open up exciting future directions for theoretical and empirical work.

## FUTURE DIRECTIONS

Teasing apart the mechanistic roles of feelings, concepts, and procedures in mind-body influence will be important next steps. The reviewed evidence suggests that a bodily state can activate the three mechanisms in general, but at a given moment does it activate all three mechanisms simultaneously? Or sequentially, i.e., one at a time? Our stance is that simultaneous activation is generally plausible (e.g., physical cleansing can confer feelings of purity, prime concepts of cleanliness, and instigate procedures of separation all at once), such that different dependent measures (e.g., self-report feelings, reaction time in lexical decisions, motor movement, behavioral intentions) will capture manifestations of different mechanisms. Meanwhile, different bodily states may activate the three mechanism to different extents. For

example, in a state of high physiological arousal, feelings and procedures may be more potent than concepts. Spatial relations may cue temporal relations more strongly than specific feelings or procedures. Such subtlety can be empirically addressed by identifying and testing mechanism-specific moderators.

Much of consumer psychology research on mind-body relations has focused on experimental demonstrations of situational influence (of bodily on mental states and vice versa) over short timespans (e.g., minutes). Long-term effects remain unexplored. Furthermore, individual differences in mind-body relations, their within-person fluctuations, and their chronic influence are less well-understood, even though many constructs in consumer psychology lend themselves to interpretation through the lens of mind-body interplay. Consider dimensions of brand personality (Aaker, 1997) as an example. Drawing on research illustrating metaphorical conceptualizations of human personality, we expect brand sincerity to be associated with warm temperature, brand excitement with physiological arousal, brand competence or reliability with proprioceptive firmness, brand sophistication with high verticality, and brand ruggedness with tactile toughness. As another example, mental accounting involves psychologically separating money into different categories (Thaler, 1985). Are mental accounting effects stronger among individuals high on obsessive-compulsive tendencies and need for order, structure, and closure?

More generally, various domains of consumer behavior involve mind-body relations. As work in sensory marketing has illustrated, subtle and incidental cues of bodily states—whether directly experienced or mentally simulated—can influence consumer judgments and decisions, often without their attention or awareness (Krishna, 2010). The diversity of such influence creates opportunities for marketers to shape consumers' minds and behaviors without requiring conscious focus, which is particularly useful in an era with ever-increasing competition for

consumers' limited attentional resources. Technological advances have also led to more sophisticated user interfaces that go beyond the traditional focus on visual modality (e.g., touchscreen devices, voice assistants). There needs to be a better understanding of what psychological consequences result from these modalities (e.g., on affect-laden choices; Shen et al., 2016) and how to leverage their unique affordances to enhance consumer well-being.

Finally, the pervasiveness of bodily influence on mental processes raises a broad theoretical question: What is a good model of the human mind? Evidence reviewed in this chapter indicates that bodily states can influence feelings through physiological arousal, proprioceptive feedback, and metacognitive experience. They can activate concepts that are directly, symbolically, or metaphorically related. They can involve procedures such as separation and connection, with process implications across content domains. Clearly, the body cannot be ignored in a comprehensive model of mental functioning. The model may be stretched even further, as mental functioning in the wild involves dynamic interactions with tools in the environment (e.g., paper, calculator, laptop, smartphone; Clark & Chalmers, 1998) and transactive cognitive processes with other minds (e.g., romantic partner, group members; Wegner, 1987; Wegner et al., 1991). A fully contextualized model of the human mind will require proper delineation of the cognitive loops among mind, body, and external reality.

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## APPENDIX: A BRIEF SUMMARY OF SIX VIEWS OF EMBODIED COGNITION (M. WILSON, 2002)

Embodied cognition can mean that (1) cognitive processes do not occur in a vacuum, but are situated in dynamic, constantly changing real-world contexts. The body's sensorimotor capacities are necessary to perceive and act on these contexts. The constantly changing perceptual inputs and motor outputs are inseparable from and inherent to cognitive functioning (Beer, 2000; Chiel & Beer, 1997). Because of its situatedness in dynamic real-world contexts, (2) cognitive functioning needs to be analyzed under realistic time pressure, through the lens of real-time interactions with the environment, rather than under experimental conditions of unrealistic time pressure or leisure (Brooks, 1991; van Gelder & Port, 1996).

In addition to posing temporal challenges to cognition, (3) the environment can also be recruited to facilitate cognition. Given our limited information-processing capacities (e.g., attentional span, working memory; A. Baddeley, 1992; Miller, 1956), humans routinely off-load cognitive work to the environment, as when we do complicated math with the aid of paper and pencil, constantly off-loading information onto the paper and accessing it when needed, freeing our working memory for manipulation of information rather than overburdening it with mere storage of information (Clark, 1997). Recognizing the continuous flow of information between the human mind and the environment (and the bodily capacities required for such flow), some theorists go one step further and argue that (4) the environment is part of the cognitive system proper. In other words, cognition needs to be analyzed not as phenomena exclusive to the human mind, but as activities distributed across a system that includes mind, body, and environment (Beer, 1995; Clark, 2017; Greeno & Moore, 1993; Thelen & Smith, 1994; Wertsch, 2017). This position, called *extended cognition* (Clark & Chalmers, 1998), is highly controversial in

cognitive science (Menary, 2010; Rupert, 2004).

Another facet of embodied cognition focuses on the ultimate functions of cognitive processes: (5) Cognition is for action in context. It is argued, for example, "that memory evolved in service of perception and action in a three-dimensional environment, and that memory is embodied to facilitate interaction with the environment" (Glenberg, 1997, p. 1). Similar claims have been made of "lower-level" cognitive processes. "Vision, like other sensory functions, has its evolutionary rationale rooted in improved motor control" (Churchland et al., 1994, p. 25), compatible with the ecological approach to perception (Gibson, 1966, 1979). From this perspective, the primary goal of cognition is *not* to create veridical representations of external entities ("what they are"), but to conceptualize them in ways that prioritize their functional relevance for us ("what to do with them").

The final aspect of embodied cognition, as noted in the main text, turns the focus from the environment and on-line cognitive processes of the sort above to the body and off-line cognition. It highlights that (6) off-line cognition can be body-based. "Mental structures that originally evolved for perception or action appear to be co-opted and run 'off-line,' decoupled from the physical inputs and outputs that were their original purpose, to assist in thinking and knowing" (M. Wilson, 2002, p. 633).

Not all of the six views have enjoyed similar research attention. The first and last views, with their strong focus on the body and sensorimotor simulation, appear most resonant with consumer and social psychologists' use of the term *embodied cognition* and their recent wave of interest in phenomena under this label. To minimize risks of confusion and maximize chances of knowledge accumulation, we recommend that researchers be clear about which specific view is espoused in their work or assessment of others' work.