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Grounded procedures: A proximate mechanism for the psychology of cleansing and other physical actions

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Abstract

Experimental work has revealed causal links between physical cleansing and various psychological variables. Empirically, how robust are they? Theoretically, how do they operate? Major prevailing accounts focus on morality or disgust, capturing a subset of cleansing effects, but cannot easily handle cleansing effects in non-moral, non-disgusting contexts. Building on grounded views on cognitive processes and known properties of mental procedures, we propose *grounded procedures* of separation as a proximate mechanism underlying cleansing effects. This account differs from prevailing accounts in terms of explanatory kind, interpretive parsimony, and predictive scope. Its unique and falsifiable predictions have received empirical support: Cleansing attenuates or eliminates otherwise observed influences of prior events (1) across domains and (2) across valences. (3) Cleansing manipulations produce stronger effects the more strongly they engage sensorimotor capacities. (4) Reversing the causal arrow, motivation for cleansing is triggered more readily by negative than positive entities. (5) Conceptually similar effects extend to other physical actions of separation. On the flipside, grounded procedures of *connection* are also observed. Together, separation and connection organize prior findings relevant to multiple perspectives (e.g., conceptual metaphor, sympathetic magic) and open up new questions. Their predictions are more generalizable than the specific mappings in conceptual metaphors, but more fine-grained than the broad assumptions of grounded cognition. This intermediate level of analysis sheds light on the interplay between mental and physical processes.

Cleansing behavior permeates everyday life. From morning to evening, people engage in any number of cleansing routines such as washing their hands, cleaning their face, brushing their teeth, rinsing their mouth, taking a shower, clipping their nails, shaving their body hair, clearing the garbage, doing the dishes, laundering the clothes, and vacuuming the house. Data from the most recent American Time Use Survey (U.S. Bureau of Labor Statistics, 2017) indicate that the four categories with the highest percentages of the civilian population engaging in relevant activities per day were sleeping (99.9%), eating and drinking (95.1%), leisure and sports (95.6%), and grooming (80.1%). Among those who engaged in grooming activities (e.g., bathing/showering, brushing/flossing teeth, shaving, washing face, and washing hands), women spent 57 min per day on them, men 44 min. The next major category was household activities (76.2%), which included activities such as interior cleaning (23.1%; 91 min per day among those who engaged in relevant activities), laundry (15.7%; 62 min), and kitchen and food cleanup (22.4%; 34 min). People devote a non-trivial amount of time to personal grooming and household cleansing on a regular basis.

Although norms regarding the form and frequency of cleansing vary between societies and historical periods (Ashenburg, 2007; Hoy, 1995), the existence of hygienic care is a human universal (Brown, 1991). It is understandable, as personal hygiene confers public health benefits and survival value (Lee & Schwarz, 2016). For example, hand hygiene is one of the easiest and most cost-effective mechanisms for reducing risks of many diseases (Boyce & Pittet, 2002; Kampf & Kramer, 2004) and is among the routines most recommended by the World Health Organization (Pittet, Allegranzi, & Boyce, 2009), particularly during contagious pandemics (e.g., COVID-19). But even without pandemics, every year awareness of the benefits of hand-washing is raised on October 15 – the Global Handwashing Day.

Health may not be the only reason for cleansing behavior though. A burgeoning body of work in the past 15 years has revealed a host of psychological antecedents and consequences of physical cleansing. Unlike earlier studies, which tended to be correlational or observational in nature, this recent wave of research was experimental and highlighted causal links between cleansing and various psychological aspects of daily life, such as religion, morality, emotion,

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well-being, and decision-making. The findings provide insight into *what* domains can be influenced by cleansing. But much less is known about *how* cleansing produces these effects. This paper seeks to move the focus from "wow" to "how" (Strack, 2012), from the loosening to the tightening phase in the creative cycle of theory formation (Fiedler, 2004, 2018). The potential to advance theoretical understanding, capture empirical nuances, and generate unique predictions motivates us to offer a mechanistic account for the psychology of cleansing, with generalizability to other physical actions.

This paper is organized as follows: Cleansing effects have been observed across a variety of psychological domains. Empirically, how replicable and robust are these effects? Theoretically, how do they operate? Major prevailing accounts include the conceptual metaphor of Morality Is Cleanliness/Purity (Lakoff & Johnson, 1980, 1999) and, relatedly, the emotion of disgust (Rozin & Fallon, 1987; Rozin, Haidt, & McCauley, 2008). By focusing on the moral domain and on disgusting stimuli, they capture a subset of cleansing effects, but cannot easily handle cleansing effects in non-moral, non-disgusting contexts. To fill the gap, we offer the construct *grounded procedures*. We propose that grounded procedures of *separation* can be a proximate mechanism underlying cleansing effects. This account differs from the prevailing ones in terms of explanatory kind, interpretive parsimony, and predictive scope. Its components are falsifiable. Its unique predictions have received empirical support. The construct of grounded procedures is generalizable to other physical actions of separation beyond cleansing. As a flipside of separation, grounded procedures of *connection* are also observed. Together, separation and connection open up new conceptual and empirical questions. They shed light on cognitive functioning, attitude change, and the interplay between mental and physical processes.

1. Cleansing effects across domains

By "cleansing effects," we mean experimental effects of two kinds: (1) effects of cleansing-related manipulations on psychological outcomes and (2) effects of psychological manipulations on cleansing-related outcomes. That is, the term includes both the psychological consequences and antecedents of cleansing. As an example of the first kind, an experiment manipulated cleansing behavior in the context of risky decision-making driven by luck (Xu, Zwick, & Schwarz, 2012, Experiment 2). Participants who kept losing money in a gambling situation felt unlucky and made smaller bets in a subsequent round. But if they were asked to wash their hands (under the pretense of testing and evaluating a soap product), the impact of their losing streak was eliminated, as if they had washed away their bad luck. Conversely, participants who kept winning money felt lucky and made bigger bets. But washing their hands eliminated the impact of their winning streak, as if they had washed away their good luck. Merely examining the soap, without washing one's hands, did not influence gambling behavior.

As an example of the second kind of cleansing effects, a pair of experiments examined the impact of ostracism on cleansing-related desires (Poon, 2019). Participants experienced cyberostracism by receiving two (as opposed to 10) out of 30 ball tosses in a Cyberball game (Experiment 1) or by receiving one like (as opposed to five likes) from 11 users on a social networking site (Experiment 2). Both manipulations increased participants' willingness to purchase cleansing products, but not their willingness to purchase non-cleansing products (Experiment 2).

Both kinds of cleansing effects have been observed in a variety of psychological domains, be they directly related to morality (e.g., fairness/cheating, sanctity/degradation), indirectly related to morality (e.g., religiosity, empathy), or unrelated to morality (e.g., postdecisional dissonance, information processing). Cleansing-related manipulations range from actual behavior (e.g., washing hands with soap, discarding objects) to mental simulation of behavior (e.g., imagining taking a shower, watching video of someone else using an antiseptic wipe) to conceptual activation (e.g., unscrambling sentences or words related to cleansing). Cleansing-related outcomes also range from actual behavior (e.g., likelihood of washing hands, time spent cleaning an object) to judgment/feeling (e.g., desirability of cleansing products, extent of feeling clean or dirty) to concept accessibility (e.g., number of cleansing-related words completed, reaction time in lexical decisions of cleansing-related words).

1.1. Replicability concerns

Among all the psychological domains involved in cleansing effects, morality has received the most attention (for recent reviews, see Lee & Schwarz, 2016; West & Zhong, 2015). Two early papers on the clean–moral link sparked interest in the field. One paper (Zhong & Liljenquist, 2006) reported that participants who recalled their own immoral (as opposed to moral) behavior or hand-copied a story of someone else's immoral (as opposed to moral) behavior later completed more cleansing-related word fragments (Experiment 1), evaluated cleansing products more favorably (Experiment 2), and were more likely to choose an antiseptic wipe over a pencil as a free gift (Experiment 3). After recalling their own immoral behavior, participants who were (vs. were not) asked to use an antiseptic wipe had lower levels of immoral emotions and became less likely to volunteer to help another researcher (Experiment 4). Another paper (Schnall, Benton, & Harvey, 2008) reported that participants judged moral violations in vignettes to be less wrong if they had unscrambled sentences containing cleansing/purity-related (vs. neutral) words (Experiment 1) or if they had (vs. had not) been asked to wash

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their hands after watching a disgusting film clip and before judging the moral violations (Experiment 2).

These and other cleansing effects have prompted replications and extensions. Some of the replications found non-significant results and/or smaller effects than in the original experiments. For example, regarding Schnall et al. (2008), one paper (Johnson, Cheung, & Donnellan, 2014b) reported direct replications using American samples (as opposed to the original British samples) and found effect sizes (Cohen's *d*s) of 0.009 and −0.016 (as opposed to the original 0.606 and 0.852). Another paper (Huang, 2014) reported extended replications of Schnall et al.'s Experiment 1 by moving the setting from lab to online and by adding a measure (Experiment 1) or a manipulation (Experiments 2 and 2a) of participants' response effort. When response effort was low, the expected effects were observed (*d*s = 0.409, 0.289, and 0.375) though smaller in size than the original (0.606). When response effort was high, the effects trended in the opposite direction (*d*s = −0.186 and −0.173 in Experiments 2 and 2a; data not available for Experiment 1).

Regarding Zhong and Liljenquist (2006), one paper reported direct replications of the original effects using Spanish samples (Gámez, Díaz, & Marrero, 2011) and found effect sizes of 0.088, −0.024, 0.562, 0.269, and 0.716, as opposed to the original 0.290, 0.997, 0.887, 0.443, and 0.777 among North American samples. Another paper reported variations of the original Experiment 2 by adding a measure (willingness to pay for cleansing products; Earp, Everett, Madva, & Hamlin, 2014, Replications 1–3), moving the setting from lab to online (Replications 2 and 3), changing the manipulation from hand-copying a passage to retyping it and inserting punctuation marks (Replications 2 and 3), and testing different populations (United Kingdom in Replication 1 and India in Replication 3). Effect sizes for the desirability of cleansing products were −0.005, 0.130, and −0.223, as opposed to the original 0.997. Yet another paper reported a conceptual replication of the original Experiment 3 by having participants first complete 183 ratings of their own conscientiousness and nominate others to rate their personality (Fayard, Bassi, Bernstein, & Roberts, 2009). This paper also reported a conceptual replication of the original Experiment 4 by changing the design from one-factor (wipe vs. no wipe) to 2 (wipe vs. no wipe) × 2 (scent vs. no scent) × 2 (rubbing vs. no rubbing). Relevant effect sizes were 0.110 and 0.230, as opposed to the original 0.887 and 0.777.

Non-significant and/or smaller effects of this sort have caused concern about the replicability of cleansing effects, especially considering that the replications typically used larger sample sizes than did the original experiments. Multiple interpretations are plausible. One is that the original effects were statistical flukes. Another is that the original effects were true phenomena limited to specific manipulations, measures, settings, or populations, that is, they had low generalizability. Yet another interpretation requires us to zoom out, situate both the original experiments and the replications in the broader context of all relevant effects, and evaluate the strength of evidence overall. This last interpretive approach is meta-analytic in nature.

1.2. Meta-analytic assessment

A comprehensive meta-analysis (Lee, Chen, Ma, & Hoang, 2020a) has extracted and quantified all identifiable cleansing effects ($k_{effects} > 500$) from true experiments ($k_{studies} > 200$) obtained from peer-reviewed journal articles, doctoral dissertations, conference proceedings, and unpublished reports. All effects and experiments were coded on various moderators (e.g., whether the effect pertained to psychological consequences or antecedents of cleansing, what cleansing-related manipulations and measures were used). Full results are beyond the scope of this paper, but a few observations are relevant and summarized qualitatively here.

At the broadest level, the overall effect estimate was in the small-to-medium range (Cohen, 1988) and highly significant (because of a large total sample size, typical in meta-analyses) regardless of whether a fixed-effect model or a multilevel random-effects model was used. Effect sizes were highly heterogeneous, indicating probable moderation.

The overall effect estimates, however, were likely to be overly optimistic because of concerns about researchers' degrees of freedom and publication bias. Researchers' degrees of freedom were addressed in replications, discussed in the next paragraph. Publication bias was addressed using statistical tools such as (1) fail-safe *n* (Rosenberg, 2005; Rosenthal, 1979), (2) trim-and-fill (Duval & Tweedie, 2000a, 2000b), and (3) normal-quantile plot. (1) The fail-safe *n* estimated that several hundred thousand missing null effects would have to exist in file drawers to bring the overall effect estimate from significant to non-significant. If the fail-safe *n* is larger than ($5k_{effects} + 10$), the overall effect is considered unlikely to be a mere consequence of publication bias (Rosenthal, 1979). Several hundred thousand is larger than $5 \times 500 + 10 = 2{,}510$. (2) Applying the most demanding trim-and-fill adjustments, the overall effect estimate would be in the small (fixed-effect model) or small-to-medium range (random-effects model), remaining highly significant. (3) Examination of the normal-quantile plot suggested that positive bias would be minimized by excluding large positive effects and retaining effects that were small, null, or negative (i.e., contrary to hypothesis). After exclusions, the overall effect estimate remained highly significant in the small range (in both fixed-effect and random-effects models). These patterns indicate that publication bias alone was unlikely to account for the existence of cleansing effects.

Turning to replications, each report was coded in terms of whether the authors presented it as an original experiment, a successful replication, or an unsuccessful replication. Unsurprisingly, the three categories differed in their overall fixed-effect estimates[1]: Medium among original experiments, small-to-medium in successful replications, and null among unsuccessful replications. Consider psychological consequences of cleansing. It is noteworthy that successful replications ($k_{effects} = 32$, $k_{studies} = 9$) exist alongside unsuccessful ones ($k_{effects} = 21$, $k_{studies} = 8$), sometimes of the same original experiment. For example, Schnall et al.'s (2008) findings were unsuccessfully replicated in three replications (Johnson, Cheung, & Donnellan, 2014a, 2014b), but successfully replicated in two other direct replications (Arbesfeld, Collins, Baldwin, & Daubman, 2014; Besman, Dubensky, Dunsmore, & Daubman, 2013) and three extended replications (Huang, 2014). The report of unsuccessful replications has received much more attention (104 citations) than the report of successful extended replications (19 citations), even though the latter had larger sample sizes than the former. Such difference in attention is likely to reflect the zeitgeist of our field as it grapples with replicability issues, but caution is warranted in ensuring balanced coverage of successful and unsuccessful replications.

Beyond replications, how robust are cleansing effects across methods and domains? Cleansing effects have been observed across types of manipulation, measure, population, and publication status of the report. The majority of fixed-effect estimates

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were in the small range. Within the broad domain of morality, the strongest cleansing effects pertained to the sanctity/degradation foundation, presumably because of the substantive overlap between physical cleansing and moral purity. But many cleansing effects have been observed in other domains that are indirectly related or unrelated to morality, with similar effect sizes to those directly related to morality.

These patterns depict the landscape of cleansing effects as a function of original experiments versus replications and other conceptual or methodological variables. A theoretical understanding of the observed variability will benefit from closer consideration of the processes underlying cleansing effects. How do these effects operate?

2. Existing accounts for cleansing effects

Experimental work on cleansing effects is most commonly interpreted in terms of two highly related, mutually compatible accounts: conceptual metaphor theory and the emotion of disgust. Conceptual metaphor theory (Lakoff & Johnson, 1980, 1999) argues that thought about psychological domains (e.g., morality) is abstract, difficult, and aided by experience with sensorimotor domains (e.g., cleanliness), which is more concrete, easier to comprehend, and older ontogenetically and phylogenetically (Williams, Huang, & Bargh, 2009). Because of these differences, sensorimotor domains tend to serve as the source of image schemas and relational/inferential structures, which are mapped onto target psychological domains. A specific sensorimotor domain is linked to a specific psychological domain because of their co-occurrence in early life experience. The resultant cross-domain mappings (e.g., cleanliness ⇒ morality) are known as conceptual metaphors. These cognitive structures have linguistic, affective, and socio-cultural manifestations.

Linguistically, English speakers utter on average six metaphorical expressions per minute in spoken conversation (Gibbs, 1994). They do so effortlessly and unintentionally. The metaphorical expressions show systematic patterns that reflect underlying conceptual mappings of concrete experience to abstract thought; in other words, they are not random, not merely decorative, not just "language-deep" (Boroditsky, 2000, p. 6), but cognition-deep. In fact, "[m]etaphor is so widespread in language that it's hard to find expressions for abstract ideas that are *not* metaphorical" (Pinker, 2007, p. 6, italics original). The existence of conceptual metaphorical structures can be inferred from coherent systems of linguistic metaphorical expressions. For example, reflecting the conceptual metaphor Morality Is Cleanliness/Purity:

> "She's *pure* as the driven snow. He's a *dirty* old man. O Lord, create a *pure* heart within me. Let me be without *spot* of sin. That was a *disgusting* thing to do! If elected, I will *clean up* this town!" (Lakoff & Johnson, 1999, p. 308)

This conceptual metaphor is also apparent in the affective properties of disgust. An experientially powerful, evolutionarily old, and adaptively significant emotion, disgust can be elicited by physically dirty stimuli or morally inappropriate behaviors (Rozin & Fallon, 1987; Rozin et al., 2008). The extension of disgust from the physical to the moral realm is detectable among kindergarteners and continues to develop with age (Danovitch & Bloom, 2009). The precise nature of disgust does differ somewhat as a function of whether it is elicited by physical stimuli (e.g., pathogens and disease cues) or moral violations (e.g., incest and deception; Oaten, Stevenson, and Case, 2009; Tybur, Lieberman, Kurzban, and DeScioli, 2013). The former is closer to fear, the latter to anger (Lee & Ellsworth, 2013; Russell & Giner-Sorolla, 2013). Despite its different shades, disgust is a uniquely common reaction to both physical dirtiness and moral transgressions (Chapman & Anderson, 2013).

Paralleling its linguistic and affective manifestations, the conceptual metaphor Morality Is Cleanliness/Purity is also embedded in sociocultural customs and beliefs across history and societies (Douglas, 1966). Whether it is baptism in Christianity, achamanam in Hinduism, or corpse-rinsing before burial in ancient Egypt, purification rituals are prevalent and imbue acts of physical cleansing with symbolic renewal of body, soul, and spirit (Blackman, 1918; Eliade, 1958/1996; Michael, 1979). Preachers put cleanliness right next to godliness (Wesley, 1778). As a standard part of the Catholic Mass, the priest proclaims, "Wash away all my iniquity and cleanse me of my sin" (Psalm 51:2). Similar ideas and practices are observed across major religions, from Judeo-Christian to Dharmic to indigenous ones. The moral overtones of cleanliness have also been noted in political ideology (e.g., Graham, Haidt, and Nosek, 2009; Herzfeld, 2017; Williams, 2017), English literature (Firestone & Lyne, 2017), and other realms of human endeavor (Duschinsky, Schnall, & Weiss, 2017).

Together, conceptual metaphor theory and the emotion of disgust shed light on the cognitive and affective underpinnings of the psychology of cleansing, evident in systematic patterns of linguistic expressions and sociocultural observations. These accounts offer evolutionary, developmental, and adaptive interpretations. We share their general assumptions, which have inspired our own work. But we also note explanatory gaps.

2.1. Limitations of existing accounts

Both existing accounts focus on the psychology of cleansing within the moral domain. They do not explain or predict cleansing effects in non-moral domains. The emotion of disgust does not explain or predict cleansing effects in non-disgusting situations. Empirically, a variety of cleansing effects have been documented in non-moral, non-disgusting contexts (Lee & Schwarz, 2016; Lee et al., 2020a). That means the existing accounts capture a subset rather than the full range of cleansing effects.

Another gap is in the level of analysis or category of explanation. An integrative understanding of behavior, as the Nobel-winning ethologist Nikolaas Tinbergen (1963/2010) pointed out, includes four categories of explanation: How it evolves in a species (phylogeny), how it develops in an individual (ontogeny), what adaptive problems it solves (function), and what causal processes drive its operation (mechanism). The existing accounts focus on phylogenetic, ontogenetic, and functional interpretations. Proximate mechanisms remain to be fleshed out. There is the conceptual metaphorical association between morality and cleanliness, and there is the emotion of disgust in response to violations of ethical and sanitary norms, but what are the physical or mental processes that mediate the online operation of these links?

Recognizing these gaps, we seek to complement the existing accounts by offering a mechanistic one. For it to be useful, it has to capture a wider range of cleansing effects across domains. It also has to specify a process that explains prior findings and predicts new ones. Drawing on insights from grounded cognition (Barsalou, 2008) and information processing (Wyer, Xu, & Shen,

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2012), we propose the construct *grounded procedures of separation*.

3. Grounded procedures of separation

3.1. Definitions

What do we mean by *grounded*, *procedure*, and *separation*? Inspired by grounded views on cognitive and social psychological processes (Anderson, 2010; Barsalou, 1999, 2008; Glenberg, 1997; Glenberg & Kaschak, 2002; Niedenthal, Barsalou, Winkielman, Krauth-Gruber, & Ric, 2005; Semin & Smith, 2008; Shapiro, 2011; Williams et al., 2009; Wilson, 2002), our guiding assumption is that mental representations and functions are grounded in sensorimotor modalities for experiencing and interacting with physical reality.[2] In other words, mental processes (e.g., knowledge, language, thought) do not reside in a layer of amodal symbols abstracted and detached from sensorimotor capacities for perception and action. Instead, the mental is grounded in the physical (Harnad, 1990).[3] Activating one activates the other.

Sensorimotor capacities can be engaged in multiple ways. Engagement is strongest in online sensorimotor experience (e.g., actual physical movement), weaker in offline simulation of it (e.g., deliberate mental imagery), and weaker still in merely partial offline simulation of it (as typically triggered by, e.g., semantic activation). This gradation in strength implies that contrary to a common misperception of grounded perspectives, cognitive activity does not necessitate online bodily states or full-blown offline simulation of them. Instead, cognition can be grounded in partial offline simulation of physical experience as recreated by sensorimotor modalities in the brain (Barsalou, 2008).

Regardless of the mode of engagement, the influence of a sensorimotor experience depends on its salient attributes in context. Any entity carries multiple attributes, some of which are more salient than others at a given moment. For example, the color and taste of an apple are typically more salient than the fact that it grows on trees. But what is salient is context-dependent (Higgins, 1996). In an agronomy class, the growth history of an apple becomes salient. The principle of context-dependent attribute salience implies that the same sensorimotor experience can be construed differently to highlight different salient attributes, resulting in different effects (Körner & Strack, 2019).

We tie these principles of grounding to the construct of procedure, which refers to "the sequence of steps that can be taken to attain a particular objective" (Wyer et al., 2012, p. 241). Procedures can be "cognitive or motor" (p. 239), that is, mental or physical. An important property of procedures is that once a procedure is activated to attain a particular objective in one situation, it becomes more likely to be used in a later, unrelated situation, even if the original objective is no longer relevant (Wyer et al., 2012; Xu, Schwarz, & Wyer, 2015). A procedure is thus not restricted to a single objective, but applicable across objectives and content domains (Janiszewski & Wyer, 2014), resembling the principle of multifinality (i.e., one means, several ends; Kruglanski et al., 2013).

A procedural view on mental activities is itself a scientific metaphor in that it treats the mind as if it were a physical entity, and mental operations as if they were operations on physical objects, thereby drawing researchers' attention to functionalist, process-oriented properties (Kolers & Roediger, 1984; Watkins, 1981). Much like cognitive capacities in general are grounded in sensorimotor ones, we argue that mental procedures in particular are grounded in physical procedures, exhibiting known properties of grounding and procedures. For example, a mental procedure can be activated by engaging a physical procedure, and vice versa. Once activated, whether physically or mentally, a procedure can be applied across content domains, even in unrelated situations.

The specific category of grounded procedures relevant to cleansing effects is separation. Sensorimotor experience of cleansing involves separating one physical entity (e.g., dirt) from another (e.g., one's hands). This experiential basis can ground mental separation of one psychological entity (e.g., failure) from another (e.g., one's self). Consistent with principles of mental construal (Bless & Schwarz, 2010), this attenuates or eliminates the influence of the separated entity.

3.2. Theoretical differences from existing accounts

Grounded procedures of separation complement rather than challenge the existing accounts. Acknowledging the roles of conceptual metaphor and disgust emotion in cleansing effects, the present account offers additional specificity and generativity in explanation and prediction.

First, a proximate mechanism is specified. Physical separation grounds mental separation, resulting in attenuation or elimination processes. This goes beyond stating that a conceptual metaphorical link exists between morality and cleanliness or that disgust is elicited by both immoral behaviors and dirty stimuli. The mechanistic explanation complements the evolutionary, developmental, and functional explanations.

Second, a procedure is applicable across content domains. The existing accounts are applicable to specific content domains (morality and disgust). They do not explain or predict cleansing effects in non-moral or non-disgusting contexts. A procedural account does.

Third, the procedure of separation generates novel predictions that cannot be derived from the existing accounts (cf. sections 4.1–4.5). For example, separation predicts that the psychological consequences of cleansing are not only domain-general, but also valence-general. Following a negative event, cleansing should separate it from the self to result in positive effects; following a positive event, cleansing should separate it from the self to result in negative effects. In contrast, the existing accounts assume domain-specific links that predict positive but not negative effects of cleansing as it confers a sense of morality or reduces feelings of disgust.

Fourth, separation is compatible with disgust without necessitating it. Disgust involves a powerful avoidance motivation and action tendency, and its signature "ew" facial expression (Ekman, 1993; Ekman & Rosenberg, 1997; Tassinary, Cacioppo, & Vanman, 2007; Vrana, 1993) serves "the function of oral-nasal rejection of aversive chemosensory stimuli" (Chapman, Kim, Susskind, & Anderson, 2009, p. 1223). Both avoidance and rejection help to separate disgust elicitors from the self. In other words, disgust involves the desire to separate, with downstream consequences (e.g., strengthening the desire to separate a product from oneself in economic decisions; Lerner, Small, and Loewenstein, 2004). But separation may or may not involve disgust. Non-disgusting things, whether physical (e.g., a piece of paper) or psychological (e.g., a thought), can be separated from the self (Briñol, Gascó, Petty, & Horcajo, 2013a).

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Fifth, the principle of grounding predicts methodological nuances different from those highlighted by the existing accounts. For example, sensorimotor capacities can be engaged to varying degrees (e.g., online experience, full-blown offline simulation, partial offline simulation). This predicts a gradation of strength in the effects of cleansing as a function of how fully sensorimotor capacities are engaged in the manipulation.

Overall, grounded procedures of separation serve as a "mid-range" account that allows for unique explanations and predictions. The proximate mechanism of separation has broader applicability than the conceptual metaphor Morality Is Cleanliness and the emotion of disgust. It also offers finer-grained specifications than the broad perspective of grounded cognition that inspired the present account. None of these, however, entails that grounded procedures are the only process at work in any given situation (for a discussion of other mental processes such as affect, accessibility, and validation, see section 6.2).

3.3. Falsifiability

For an account to be scientific, it needs to be falsifiable (Popper, 1959/2005). Is the present one falsifiable? Our basic claim is that grounded procedures of separation serve as a proximate mechanism for cleansing effects. As a component of these grounded procedures, separation results in attenuation and elimination processes. All of these specifications can be formulated as falsifiable empirical questions, testable by experiments that sufficiently realize the theoretical independent and dependent variables (Schwarz & Strack, 2014) and function as "forks" to generate alternative possible outcomes that afford strong inferences (Platt, 1964, p. 347).

Are grounded procedures of separation a proximate mechanism for cleansing effects? It would be falsified if, for example, psychological consequences or antecedents of physical cleansing are not driven by a sense of mental separation. By implication, it would be falsified if physical cleansing does not confer any sense of mental separation, or if a sense of mental separation does not influence cleansing-related outcomes, or both. It would also be falsified if acts of separation, such as cleansing, do not result in any attenuation or elimination of an otherwise observed influence.

Are procedures grounded at all? It would be falsified if, for example, online experience of physical separation does not activate any thought or feeling about mental separation. Activation can be quantified behaviorally (e.g., word completion tasks, reaction time measures) and neuroscientifically (e.g., overlapping activation, repetition suppression). Another possible falsification is if the basic claim fails to generalize as expected. On one end of the equation, if mental separation is an active ingredient, it should be applicable to multiple psychological domains, producing domain-general effects. On the other end of the equation, if physical separation is an active ingredient, it should be instantiable not only by cleansing, but also by other physical acts of separation (e.g., discarding, enclosing). Failure to observe such generalizability would call the construct of grounded procedures into question.

4. Empirical support for grounded procedures of separation

Experimental tests of the falsifiable, unique predictions derived from the present account are reviewed in this section. As already noted, if grounded procedures of separation serve as a proximate mechanism for cleansing effects, cleansing should attenuate or eliminate the otherwise observed influence of a prior event (1) across domains and (2) across valences. Given the nature of grounding, (3) cleansing manipulations that engage sensorimotor capacities more strongly should produce stronger effects.

Turning the focus from psychological consequences to psychological antecedents of cleansing, we note the classic observations that avoidance motivation is typically triggered by negative stimuli and approach motivation by positive ones (e.g., Freud, 1920; Kahneman and Tversky, 1979; Mowrer, 1960; Thorndike, 1935; also Festinger, 1957; Heider, 1958; Higgins, 1997). Accordingly, (4) motivation for cleansing as a procedure of separation should be triggered more readily by negative than positive entities. That is, although psychological consequences of cleansing should be domain-general and valence-general, psychological antecedents of cleansing should be valence-asymmetric.

Finally, to ascertain the generalizability of grounded procedures of separation, (5) conceptually similar effects should extend from cleansing to other forms of physical separation.

4.1. Psychological consequences of cleansing are domain-general

Psychological consequences of physical cleansing are not restricted to the realms of morality or disgust, but observed in a variety of non-moral, non-disgusting contexts. For example, in the domain of decision-making, after people make a free choice between two similarly attractive alternatives (e.g., music albums), they often wonder if they have made the right decision, experiencing postdecisional dissonance (Brehm, 1956; Festinger, 1957). Dissonance is aversive and instigates dissonance-reducing mental processes that focus on positive features of the chosen alternative and negative features of the rejected alternative. This results in a more positive evaluation of the chosen alternative and a more negative evaluation of the rejected alternative after choice than before choice, a signature effect called spreading of alternatives. A pair of experiments used this classic paradigm and found that the signature effect disappeared if a manipulation of physical cleansing was added right after choice and before evaluation (Lee & Schwarz, 2010a). After freely choosing between two similarly desirable music albums, if participants were asked to actually use a bottle of hand soap (under the pretense of product evaluation), they showed no spreading of alternatives, but if they were asked to merely examine the hand soap, they did show the signature effect (Experiment 1). In a conceptual replication, participants freely chose between two similarly desirable fruit jams. Using an antiseptic wipe again eliminated the signature effect; merely examining the wipe did not (Experiment 2).

This finding was replicated with a German sample (Marotta & Bohner, 2013). A conceptual replication with an American sample showed the same pattern and also found that it was moderated by individual differences (De Los Reyes, Aldao, Kundey, Lee, & Molina, 2012). Specifically, postdecisional dissonance was "washed away" among participants low on intolerance of uncertainty, ruminative responses, and generalized anxiety, but not among participants high on these variables. A further boundary condition was found in a modified replication, which showed that postdecisional dissonance was not washed away when each participant was given memory cues about their own predecisional evaluation during their postdecisional evaluation (Camerer et al., 2018). A meta-analysis of all replications and original experiments showed a small overall effect ($d = 0.204$, SE = 0.084, $p = 0.015$, 95%

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CI 0.040/0.349) of washing away postdecisional dissonance (Lee & Schwarz, 2018).

These results are consistent with our conceptualization of cleansing as a grounded procedure of separation. Cleansing attenuates or eliminates the residual influence of prior experience by separating it from the present. Similarly, having an opportunity to wash one's hands attenuated the residual influence of a recent academic failure on pessimism about one's future performance (Kaspar, 2012). Similar manipulations of actual or simulated cleansing also attenuated or eliminated the residual influence of recent luck (Xu et al., 2012; also Moscatiello & Nagel, 2014), endowment (Florack, Kleber, Busch, & Stöhr, 2014), ownership (Lee & Ji, 2015), and stress (Kaspar & Cames, 2016), none of which was related to morality or disgust. Instead, cleansing exerts its influence on whatever domain is salient to the person in a given situation.

This context sensitivity of cleansing effects is consistent with situated perspectives on mental processes (Mesquita, Barrett, & Smith, 2010; Smith & Semin, 2004) and parallels the observation that feelings and metacognitive experiences are brought to bear on what is in the focus of attention at the time of the experience (Schwarz, 2010, 2012). One implication is that cleansing prompted by a highly specific concern should have limited influence on unrelated concerns. Writing this paper during the COVID-19 pandemic in 2020, we expect, for example, that frequent hand washing during a pandemic attenuates concerns about infections and reduces the related stress, but does not leave people feeling less worried about unrelated decisions or less guilty about unrelated moral transgressions.

4.2. Psychological consequences of cleansing are valence-general

If cleansing serves as a grounded procedure of separation, and if procedures are applicable across domains, cleansing should be able to separate not only negative, but also positive experiences from the self. By implication, it should attenuate or eliminate the residual influence of experiences across valences. This can be tested empirically within a single domain or by surveying multiple domains.

Within the domain of luck-based risk-taking, as mentioned earlier, a positive experience like a winning streak tends to increase subsequent amounts of betting, whereas a negative experience like a losing streak tends to decrease them. A hand-washing manipulation eliminated the influence of a recent winning as well as a recent losing streak on subsequent betting (Xu et al., 2012, Experiment 2). Within the domain of performance-based self-evaluation, a positive experience like successful performance tends to increase optimism, whereas a negative experience like failing performance tends to decrease optimism. Using a product labeled as a hand sanitizer apparently attenuated the influence of a recent successful or failing performance on optimism (Körner & Strack, 2019, Experiment 1).

Surveying multiple domains, cleansing has been shown to attenuate the residual influence of negative experiences such as immoral behavior (for recent reviews, see Lee and Schwarz, 2016; West and Zhong, 2015), postdecisional dissonance (Lee & Schwarz, 2010a), academic failure (Kaspar, 2012), and social and physical threats (Lee et al., 2020b), as well as positive experiences such as product endowment (Florack et al., 2014), object ownership (Lee & Ji, 2015), and successful performance (Körner & Strack, 2019). These valence-general consequences of cleansing are consistent with the separation account. They complement accounts that assume cleansing is exclusively associated with removing negative influences in the form of moral impurities or feelings of disgust.

4.3. Engagement of sensorimotor capacities tracks strength of cleansing effects

Sensorimotor capacities are most strongly engaged in actual sensorimotor experience, less in mental simulation of it (e.g., imagined experience), and even less in partial offline simulation (e.g., semantic activation). Corresponding to these differences in engagement strength, actual cleansing behavior should exert stronger influence than imagined cleansing than merely conceptual activation of cleansing-related ideas. This prediction was addressed directly in the aforementioned meta-analysis (Lee et al., 2020a). It was found that actual cleansing manipulations produced significantly stronger effects than imagined or recalled cleansing manipulations, which still produced significantly stronger effects than manipulations that merely activated the concept of cleansing.

4.4. Psychological antecedents of cleansing are valence-asymmetric

If cleansing is a grounded procedure of separation, and if people are more motivated to separate negative than positive entities from themselves, cleansing-related outcomes should be elicited more readily by negative than positive entities.[4] Supportive evidence comes from experiments that manipulated negative versus positive experiences and measured cleansing behavior, desirability of cleansing products, or willingness to buy them.

For example, smelling a shirt that belonged to an outgroup (vs. ingroup) member increased participants' speed of walking to a hand sanitizer and likelihood of pumping it multiple times (Reicher, Templeton, Neville, Ferrari, & Drury, 2016, Experiment 2). Telling a lie (vs. telling the truth) with one's mouth by leaving a voicemail message increased the desirability of mouth-cleaning products; similarly, telling a lie (vs. telling the truth) with one's hands by writing a note increased the desirability of hand soap products (Schaefer, Rotte, Heinze, & Denke, 2015). Such evaluative patterns conceptually replicated similar effects in prior studies (Lee & Schwarz, 2010b; also Denke, Rotte, Heinze, & Schaefer, 2014) and were paralleled by heightened activation of somatosensory cortices after lying (vs. truth-telling). Beyond active experiences, passive experience such as being socially excluded (vs. included) in cyberspace also increased participants' willingness to buy cleansing products (but not their willingness to buy non-cleansing products; Poon, 2019, Experiments 1 and 2). These experimental findings highlight that people have stronger motivation for cleansing after negative than positive experiences.[5]

Dovetailing experimental data, superstitious behaviors abound across cultures where positive entities lead people to actively avoid cleansing. British fishermen, during a period of good catches, abstain from washing their nets, lest the luck would be washed away (Radford & Radford, 2013). Chinese folk beliefs specify lucky days (e.g., lunar new year) on which people had better not wash anything (Fong, 2000), or else they would be unlucky throughout the year. Gamblers and athletes keep wearing their unwashed socks and shirts during a winning streak, but do get changed after losses (Gmelch, 1971; Vyse, 2013). The stink of soiled clothes is more bearable than the jinx of lucky essences, which people are disinclined to separate from themselves.

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4.5. Other grounded procedures of separation exist beyond cleansing

Cleansing has been the most extensively investigated form of physical separation. Conceptually similar effects can also result from other grounded procedures of separation, such as movements away from the self or acts of enclosing.

A series of experiments showed that "actions that exert force away from one's representation of self" can reduce perception of misfortune after tempting one's fate (Zhang, Risen, & Hosey, 2014, p. 1171). Participants were prompted to tempt fate by saying that they or their friend would never experience a particular bad outcome (e.g., getting in a horrible car accident during winter, getting sick, getting mugged). This increased participants' estimated likelihood of experiencing the jinxed bad outcome. But the increase was eliminated if participants were prompted to engage in an act of physical separation, whether it carried any cultural meaning (knocking down on a wooden table; Experiment 1) or not (throwing a ball away; Experiments 2a, 2b, 3, and 5). The elimination effect of physical separation was mediated by a reduction in mental image clarity of the bad outcome (Experiment 3). Importantly, the same elimination effect emerged if participants pretended to throw a ball away, which engaged the same motor action and proprioceptive experience as actually throwing a ball away, even though it did not create any spatial distance between the ball and oneself (Experiment 5). Thus, it was the sensorimotor experience of separation, not distance, that drove the effects.

Separation can also be instantiated without trying to throw anything away. Enclosing things in a container is sufficient to separate them from oneself. For example, after recalling and writing about a recent experience of regret, participants who were asked to enclose the written note in an envelope and return it to the experimenter (vs. simply return it to the experimenter without any envelope) felt less negative about the recalled event (Li, Wei, & Soman, 2010, Experiment 1a). The reduction effect of physical enclosure generalized to other negative events, such as an unsatisfied strong desire (Experiment 1b) and a tragic news story (Experiment 2), and was mediated by a sense of psychological closure (Experiment 3).

Similar effects have been found in the context of choice. After choosing a piece of chocolate from a tray of 24 options, participants were (vs. were not) asked to place a transparent lid on the tray (Gu, Botti, & Faro, 2013, Experiment 1). This act of physical enclosure increased their sense of choice completion and their satisfaction with the chosen chocolate after tasting it, an effect that was mediated by less comparison between the chosen chocolate and the forgone ones. Note that even though the forgone options remained visible under the transparent lid, their influence was attenuated after enclosure. Conceptual replications found similar effects when participants chose a tea (Experiment 2) or biscuit (Experiments 3a and 3b) from a menu of 24 options and then closed (vs. did not close) the menu. Acts of physical enclosure enhance mental separation of the enclosed entities from the self.

In other cases, separation of an entity from the self is not initiated by the actor but signaled by features of the environment. For example, participants perceived lower risks of an earthquake about 200 miles away if they happened to be in a different state (vs. the same state), even though the distance was held constant (Mishra & Mishra, 2010, Experiment 1). Similarly, participants perceived lower risks of a radioactive waste facility 165 miles away if they happened to be in a different state (vs. the same state), especially if the state border was salient (Experiment 2). Symbolic borders can cue mental separation of an entity from the self.[6]

Inversely, if a symbolic cue signals to people that they are physically enclosed inside a task environment, the implied separation from the surrounding environment reduces distraction and increases task orientation (Zhao, Lee, & Soman, 2012). For example, customers waiting in line to reach an ATM (automated teller machine) were more likely to stay in line and complete the transaction (i.e., higher task persistence) if they were separated from the wider environment by a queue guide (a bright yellow line on the floor) than if they were not (Experiment 1). They also retrieved their ATM card sooner, indicating more immediate action initiation (Experiment 2). Business-class travelers waiting to check in at an airport counter took out their travel documents sooner if they were enclosed by a carpet that separated the queue from the wider environment (Experiment 2 follow-up). Perception of physical enclosure elicited an implemental mindset and its associated mental states of general optimism and action orientation (Experiment 3).

In short, physical enclosure confers a sense of mental separation between what is inside and what is outside. Consistent with the logic of mental inclusion/exclusion (Bless & Schwarz, 2010), when an entity is enclosed and separated from where people are, its psychological impact is diminished. When an entity is enclosed in the same space as where people are, its psychological impact is amplified. This raises the question: Is there a broader class of physical experiences that generally amplify an entity's psychological impact?

5. Flipside of separation: Grounded procedures of connection

As a flipside of separation, grounded procedures of connection are observable. Physical connection involves linking one physical entity (e.g., a product) to another (e.g., one's hands). This experiential basis can ground mental connection of one psychological entity (e.g., an idea) to another (e.g., one's self), such that the connected entity becomes more representative of the target entity and relevant to it. As a result, the connected entity's influence on the target entity is amplified (if an influence already existed) or created (if no influence existed before).

Separation and connection share the structural properties of "grounding" and "procedure," generating parallel predictions. As observed for grounded procedures of separation, different forms of physical connection should result in similar psychological effects. They should exert influence across domains and across valences, consistent with the domain- and valence-general applicability of procedures. Whereas acts of separation are more likely to be triggered by negative entities, acts of connection are more likely to be triggered by positive entities, reflecting the influence of avoidance versus approach motivation. The limited available findings support these predictions.

5.1. Psychological consequences of various grounded procedures of connection are domain- and valence-general

Physical connection can be instantiated in various forms, from visual continuity to motor approach to direct contact. For example, visually connecting several years of college experience into a continuous journey on a physical path accentuated students' sense of mental connection between their current and possible academic identities, thereby enhancing their academic intention,

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efforts, and final exam performance (Landau, Oyserman, Keefer, & Smith, 2014). Moving from the domain of academic motivation to that of health-related attitude, after participants wrote down positive or negative thoughts about the Mediterranean diet on a piece of paper, physically connecting the piece of paper to themselves (e.g., folding it and putting it in their pocket) amplified the influence of the written thoughts on their attitude toward the diet (Briñol et al., 2013a, Experiment 2). Relative to control conditions, positive thoughts resulted in even more positive attitudes, and negative thoughts resulted in even more negative attitudes. Similarly, touching a robot (as opposed to merely looking at it) amplified pre-existing positive or negative attitudes toward robots (Wullenkord, Fraune, Eyssel, & Šabanović, 2016).

Further attesting to the valence-general consequences of physical connection, consider sympathetic magic effects of contagion. Inspired by anthropological observations (Frazer, 1890/1990; Mauss, 1902/2001), contagion is the notion that "people, objects, and so forth that come into contact with each other may influence each other through the transfer of some or all of their properties" (Nemeroff & Rozin, 1994, p. 159). Physical contact results in psychological transfer of unseen "essence" from one entity to another. Early research on contagion focused on negative entities (e.g., disgusting and contaminating stimuli, immoral people's possessions; Rozin, Millman, and Nemeroff, 1986), but contemporary research has also found contagion effects of positive entities (Huang, Ackerman, & Newman, 2017).

In the context of product evaluation, participants evaluated a product less favorably if it had been touched by other shoppers (because of contamination concerns; Argo, Dahl, and Morales, 2006), but more favorably if it had been touched by a highly attractive person of the opposite sex (Argo, Dahl, & Morales, 2008). Similarly, in the context of object valuation, positive contagion of invisible essences can drive people's willingness to pay a fortune for objects once owned by significant individuals (e.g., celebrities, politicians, religious leaders), an effect that is amplified by prior physical contact between the object and its owner (Bloom & Gelman, 2008; Newman & Bloom, 2014; Newman, Diesendruck, & Bloom, 2011).[7] In the context of self-perception and behavior, touching a ball that had been touched by an outstanding athlete increased participants' perception of their own athleticism (Kramer & Block, 2014), and using a golf club that had been used by a professional golfer increased participants' golf performance (Lee, Linkenauger, Bakdash, Joy-Gaba, & Profitt, 2011).

Theorists have typically assumed contagion of positive entities to be driven by the transfer of essence and contagion of negative entities by the behavioral immune system (Huang et al., 2017; Murray & Schaller, 2016; Schaller & Park, 2011). Although these approaches offer valence-specific accounts, the perspective of grounded procedures interprets positive as well as negative contagion effects as a valence-general influence of the same underlying process. Acts of physical connection such as physical contact can ground mental connection between entities, thereby amplifying the influence of one entity on another, regardless of whether the influence is positive (e.g., the influence of John F. Kennedy on bidders' valuation of his golf clubs) or negative (e.g., the influence of Adolf Hitler on people's reaction to his sweater).

5.2. Psychological antecedents of connection are valence-asymmetric

Whereas the consequences of physical connection are valence-general, its antecedents are valence-asymmetric, paralleling the case of grounded procedures of separation. Reflecting the desire to approach the positive and avoid the negative, people are more motivated to connect with positive than negative entities and to separate from negative than positive ones.

For example, participants responded faster to positive stimuli by pulling a lever toward themselves and faster to negative stimuli by pushing the lever away (Chen & Bargh, 1999). Participants preferred a choice set in which objects were close to (rather than far apart from) each other if one unidentified object in the set possessed a positive quality, but preferred a choice set with the more distal spatial arrangement if the unidentified object possessed a negative quality (Mishra, Mishra, & Nayakankuppam, 2009). Culturally, every lunar new year, many traditional Chinese visit the temple and enact an elaborate routine: They receive a commemorative coin, touch the gold ingot, walk around the incense burner clockwise three times, touch the beard of the god of wealth, and leave the temple blessed with traces of financial luck for the rest of the year (Dai, 2018; Wang, 2018). They are taught to hold their hands above the incense burner for purification and sanctification prior to touching their favorite god (Liao, 2018). In other words, they need to separate the bad luck before connecting the good luck to themselves.

Motivation for connection can also be triggered by a combination of two negatives, as in the desire to connect a negative attribute to a negative target. For example, a voodoo doll gives a non-present hated target a material form, allowing knives and needles to damage his specific organs. Throwing darts at photos of an enemy accomplishes similar goals. So does "villain hitting," a cultural heritage in Hong Kong (TOPick, 2016), most commonly targeted at detested colleagues and business partners. After putting the name, date of birth, and photo or clothing of the target on what is called the villain paper, a professional villain-hitter is paid to beat the paper with a shoe, incense sticks, or other symbolic weapons, while pronouncing the following (translated into English; "Villain Hitting," 2018):

> "Beat your little hand,
> Your good luck comes to the end.
> Beat your little eye,
> Very soon you die.
> Beat your little foot,
> Everything is no good.
> Beat your little mouth,
> You always have bad result."

5.3. Interplay of physical and mental connection

By conferring a sense of mental connection between two entities, physical connection can amplify a pre-existing influence (as seen above), or it can create an influence where none existed. Because people typically see themselves in a positive light (Baumeister, 1999), physically connecting a neutral entity to oneself creates positive evaluation of it. Consider examples of motor approach, which can occur in oral, visual, and manual modalities.

Articulating words that start with a consonant at the front of the mouth (e.g., B, M) and end with a consonant at the rear of the mouth (e.g., G, K) resembles oral muscle movements during deglutition (oral approach), as opposed to expectoration (oral avoidance). Participants preferred such inward words over their outward counterparts (which start with G or K and end with B or M), even though the consonants were neutral on their own and identical in both conditions (Topolinski, Maschmann, Pecher, & Winkielman, 2014). The effect generalized across

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nonsense words, company names, and person names (Experiments 1–8) and was found among English and German speakers – but not among aphasia patients who lacked subvocalizations (Experiment 9), highlighting the role of oral sensorimotor processes (for a review of further evidence, see Topolinski, 2017).

Positive effects can result not only from an entity moving toward the self (e.g., inward words), but also from the self moving toward an entity. In the visual modality, cues of forward movement (vs. non-forward movement or no movement) increased participants' implicit positivity toward the concept of achievement (Natanzon & Ferguson, 2012, Experiment 1) and improved their performance on word puzzles (Experiment 2). In the manual modality, mere flexion (vs. extension) of arm muscles generated proprioceptive feedback of motor approach (vs. avoidance) and increased participants' favorable evaluation of neutral ideographs (Cacioppo, Priester, & Berntson, 1993) and neutral nonwords (Priester, Cacioppo, & Petty, 1996). Actually touching an object (i.e., direct physical connection) or seeing imagery that encouraged touching it (i.e., simulated physical connection) increased both buyers' and sellers' perceived ownership of the object (i.e., psychological connection), which increased its valuation (Peck, Barger, & Webb, 2013; Peck & Shu, 2009).

Similarly, online shopping on touch-based devices (e.g., tablet), as opposed to non-touch-based devices (e.g., laptop), elicits a higher degree of perceived ownership of products, again increasing their valuation (Brasel & Gips, 2014). Perceived ownership and valuation also tend to be higher for physical than digital goods (Atasoy & Morewedge, 2017). Extremely high valuation (e.g., millions of dollars) is ascribed to objects once owned and touched by beloved significant individuals, but not to replicas that look identical but have not been touched by the owner (Bloom, 2010; Newman et al., 2011). Valuation decreases if the original object has been cleansed and sterilized (Newman & Bloom, 2014). In contrast, valuation increases if people have experienced social exclusion (Newman & Smith, 2016), which increases the desire for social connection.

These patterns are compatible with the notion that physical connection between two entities forges mental connection between them. Physical connection can occur in multiple modalities. One entity can be the self or a public figure. The other entity can be a word, an ideograph, or an object. Mental connection can create or amplify the influence of one entity on the other.

6. Some open questions raised by grounded procedures of separation and connection

Grounded procedures of separation and connection constitute a proximate mechanistic account for findings from studies that were motivated by multiple perspectives, such as conceptual metaphor, disgust emotion, sympathetic magic, positive contagion, and embodied attitude. Beyond offering interpretive parsimony and predictive scope, grounded procedures open up conceptual and empirical questions for investigation.

6.1. Do different forms of cleansing differ in their psychological consequences?

In most experimental manipulations of cleansing (e.g., handwashing), the self is both the agent and patient of cleansing. In real life, other agent–patient combinations are possible (Table 1). Which combination exerts the most robust effects? Theoretically, effects should be more robust when self (vs. other) is the agent, because self-initiated cleansing directly engages sensorimotor capacities recruited for separation, whereas observing other-initiated cleansing may activate mirror neurons (Rizzolatti & Craighero, 2004), with likely weaker effects than taking the action oneself (Barsalou, 2008). Effects should also be more robust when self (vs. other or the environment) is the patient, because physical entities are saliently separated from one's body.

These predictions have only been addressed indirectly. For example, wiping one's hands was more effective than watching someone else wipe their hands, which in turn was more effective than a neutral control, in attenuating the influence of one's prior immorality on one's guilt and compensatory prosociality (Xu, Bègue, & Bushman, 2014). Wiping one's hands also eliminated the influence of one's prior success and failure on one's signature size; wiping a board did not (Körner & Strack, 2019, Experiment 2). Comprehensive tests of the agent–patient combinations will add useful data to fill the empirical gaps in Table 1.

Even with the same physical action, however, different construals can highlight different salient attributes, resulting in different effects. For example, when a white emulsion was presented to participants as a hand sanitizer (thus evoking the notion of cleansing), using it attenuated the influence of prior success and failure on present optimism; but when it was presented as a hand lotion (thus lacking cleansing connotations), using it had no psychological effect (Körner & Strack, 2019, Experiment 1). Outside the lab, mental construal of cleansing is manifest in fascinating ways. For example, the Ganga River in Allahabad, India is one of the five most polluted rivers in the world, receiving over a billion liters of raw sewage every day (Zerkel, 2013). Yet it remains one of the holiest destinations for Hindus, which "plays host every dozen years to the Kumbh Mela, the biggest gathering of humanity on Earth, when tens of millions of pilgrims come to wash away their sins" (Morrison, 2011). The sacred power of a disgusting river cannot be underestimated. Neither can the role of mental construal in physical cleansing.

Closer to home, a cluster of popular beliefs and practices ride on the mental construal of *inner* cleansing. From tea and capsules for "Detox & Cleanse" (https://amzn.to/2PzThKQ) to recipes of "juice fast" and "clean eating" (https://amzn.to/2Pyb7hm), consumers construe these as whole-body events, flushing toxins out of their biological system.[8] As a parallel, inner cleansing of the immaterial soul is key to penitence among the religious. A 35-day Bible reading plan called Soul Detox (Life.Church, n.d.) is introduced thus: "While the world rightly teaches us to detox our bodies, sometimes we need to detox our soul…. You will learn from God's Word how you can neutralize these damaging influences and embrace clean living for your soul."

Do construals of inner cleansing exert stronger effects than outer cleansing, because they separate negative entities from a person's inner essence and offer more thorough purification of the whole being? Are these cultural beliefs and practices more popular among adults and children high on psychological essentialism (Gelman, 2004; Medin & Ortony, 1989)? Do they predict religiosity, or are they predicted by it? Is inner cleansing more appealing to those who subscribe to an ethics of convictions ("Gesinnungsethik"; Weber, 1919), which emphasizes thoughts and intentions, than to those who subscribe to an ethics of responsibility ("Verantwortungsethik"), which emphasizes the consequences of actual behavior? Would these differences be observable as differences between religions that put differential emphasis on thoughts versus acts (Cohen, Siegel, & Rozin, 2003)? Empirical answers await.

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Table 1. Examples of cleansing involving different agents and patients

Agent doing the cleansing	Patient being cleansed		
	Self	Other	Environment
Self	Wiping your own hands	Wiping someone else's hands	Wiping a table
Other	Someone else wiping your hands	Someone else wiping their hands	Someone else wiping a table

6.2. What further mental processes can result from cleansing as a procedure of separation?

The studies we reviewed indicate that physical cleansing can attenuate or eliminate – that is, partially or fully reduce – the otherwise observed influence of a prior experience. Such effects have been observed across diverse domains (section 4.1) and for influences of positive and negative valence (section 4.2). Many authors assume that cleansing reduces the intensity of an affective response, such as the intensity of one's guilt in response to recalling a moral transgression (e.g., Zhong and Liljenquist, 2006), one's doubts after a decision (Lee & Schwarz, 2010a), or one's concern after performing poorly on an academic test (Kaspar, 2012). Reduction in affective intensity can occur by separating the eliciting event from the psychological present. This predicts that cleansing should reduce transfer of affective value from the separated entity to the judgment target (cf. Clore and Schnall, 2005), reduce cognitive accessibility of the separated entity (cf. Higgins, 1996), reduce concreteness or vividness of its mental representation (cf. Kross, Ayduk, and Mischel, 2005; Libby and Eibach, 2011; Trope and Liberman, 2010), and reduce feelings of certainty (cf. Clore and Parrott, 1994) or confidence/validity (Briñol et al., 2011, 2017b) about the separated entity. It should also help people move on with a fresh start (Dai, Milkman, & Riis, 2014; Price, Coulter, Strizhakova, & Schultz, 2017).

In most examples of attenuation and elimination effects, both the eliciting event before cleansing and the outcome variable after cleansing are closely related to each other and to an important facet of the self (e.g., guilt about one's unethical act is related to the moral self, concern about one's poor performance is related to the competent self). When the eliciting event and outcome variable are less closely related to each other and to an important facet of the self, separating them by cleansing can result in contrast effects. For example, recalling a past episode of personal financial bad (as opposed to good) luck decreased MBA students' subsequent tendency to choose a risky option in a vicarious managerial investment decision. However, a hand-wiping manipulation reversed this influence, resulting in more risky choices on the vicarious managerial task after recalling previous bad luck on a personal task (Xu et al., 2012, Experiment 1; for a conceptual replication, see Moscatiello & Nagel, 2014, Experiment 2).

Cleansing experiments thus far have demonstrated many more attenuation and elimination than contrast effects. From the perspective of mental inclusion/exclusion (Bless & Schwarz, 2010; Schwarz & Bless, 1992), contrast effects are particularly likely to emerge when the eliciting event is used as a standard of comparison ("that was just bad luck, but this is good investment"). Progress in understanding the process conditions under which cleansing facilitates comparisons and reverses (rather than attenuates or eliminates) the influence of a prior experience will also enhance our general understanding of assimilation and comparison effects in judgment.

6.3. What are the psychological antecedents of various forms of physical separation?

Separation can take different physical forms. Little is known about what variables favor the selection of some grounded procedures of separation over others. In other words, what antecedents determine which procedure comes to mind and is turned into action in a particular context? We offer some conjectures.

Different physical procedures involve different salient attributes that lend themselves to different shades of meaning and function (Table 2, column 3). We expect that a particular physical procedure is most likely to be activated and enacted when its salient attributes fit the person's current motivational condition (Table 2, column 4). Different physical procedures also differ in the extent to which they hinge on visible representation of the separated entity. For example, people can cleanse themselves of invisible germs (e.g., taking a shower), but can only destroy or enclose something with a material form (e.g., burning a letter, shattering a memento). Accordingly, mental separation of invisible psychological entities (e.g., painful memory) is likely accomplished either by cleansing or by first visualizing them as tangible representations (as in the popular pseudoscience "neuro-linguistic programming"; Bandler and Grinder, 1975) before enclosing or destroying them.

Furthermore, some physical procedures have strong content associations with specific emotions. For example, cleansing is closely related to disgust (Landau, 2017; Lee & Schwarz, 2016; Rozin et al., 1986; West & Zhong, 2015). Destroying may be seen as a form of aggression, which is linked to anger (Averill, 1983; Berkowitz, 1990). Situational and individual differences in these emotions (e.g., anger proneness, disgust sensitivity, obsessive concerns with contamination) are likely to predict the activation and enactment of the corresponding grounded procedures of separation.

6.4. Does separation contribute to religious and political associations with cleanliness?

If separation plays a key role in cleansing effects, it may contribute to associations of cleanliness with morality and related sociocultural phenomena such as religiosity and politics. For example, the apostle Paul exhorted Christ-followers to "cleanse ourselves from all defilement of flesh and spirit, perfecting holiness in the fear of God" (2 Corinthians 7:1, NASB). To be holy, tellingly, is to be "set apart" (Hebrew 10:10, GW) – to be separate – from failing ways of the world, for pursuing higher orders of God's kingdom. The sense of separation is also reflected in other biblical characterizations of religious purity (e.g., "put off your old self" and "put on the new self"; Ephesians 4:22 and 4:24, NIV).

Closely related to such religious striving for nobility is the concern about sanctity/degradation, which is a more important moral foundation for political conservatives than for liberals (Graham et al., 2009). Sanctity conceptualizes the human body as a temple

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Table 2. Different grounded procedures of separation, their examples, salient attributes, and motivational conditions for activation and enactment

Grounded procedures of separation	Examples	Salient attributes	Motivational conditions under which the grounded procedure of separation is likely to be activated and enacted
Cleansing	Wash something down the drain, erase it, or remove it	You never see the entity again and you do not care where it is	Desire for permanent removal (e.g., revulsion of unwanted sexual encounter)
Destroying	Burn, melt, or tear something	You have transformed the entity and it is no longer recognizable	Desire for damage, revenge, or permanent removal (e.g., hatred for ex)
Enclosing, distancing	Put something in an envelope, a container, or a locker	The entity remains intact and you may retrieve it anytime; likely to see it in a more abstract construal	Desire for temporary relief (e.g., sadness of breakup) or broader perspective (e.g., anger about rejection letter)
Avoiding contact	Stay away from something	You try not to have any interaction with the entity	Desire to manage negative memory or expectations (e.g., fear of emotional pain)
Changing context	Move yourself to a different space	You are in a new context	Desire for any of the above as well as desire for novelty

that can be desecrated by physical contaminations or moral violations (Graham et al., 2013). It is thus construed through the lens of disgust. For example, copying a passage from the Qur'an or from Richard Dawkins' *The God Delusion* induced a disgust response in Christian participants, which impaired their enjoyment of a tasty drink in a subsequent taste test (Ritter & Preston, 2011). However, this disgust response was eliminated when participants cleaned their hands prior to the taste test.

Such findings are consistent with interpretations of the role of cleansing in religiosity through the lens of sanctity and disgust, both of which invoke ideas of separation (cf. section 3.2). Separation may also contribute to an association of cleansing with political conservatism. As Jost, Glaser, Kruglanski, and Sulloway (2003) noted, the cognitive style of conservatives, relative to liberals, is characterized by a higher need for order, structure, and closure, which is aligned with clear separation between entities. The extent to which such pathways contribute to sociocultural meanings of cleanliness in political and religious arenas will be fruitful avenues for future research.

7. Concluding remarks

This paper proposes the construct *grounded procedures* as a proximate mechanism for the psychology of cleansing, with generalizability to other physical actions of separation and connection. It complements existing accounts by offering a distinct kind of explanation, organizing prior findings, generating nuanced predictions, and opening up new questions. In so doing, it intersects with multiple perspectives (e.g., conceptual metaphor, disgust emotion, sympathetic magic, positive contagion, embodied attitude). Overall, these theoretical and empirical implications are more general than the specific mappings in conceptual metaphors, but more fine-grained than the broad assumptions of grounded cognition that inspired our perspective. At this intermediate level of analysis, grounded procedures shed new light on the interplay between mental and physical processes, such as those in cognitive functioning and attitude change.

If physical separation and connection ground mental separation and connection, then basic cognitive tasks that hinge on mental separation should be facilitated (vs. undermined) when relevant entities are physically separated (vs. connected). For example, choosing one object from a set of objects involves mental separation, a task that is completed faster, more easily, and with greater confidence when the objects are physically far apart (vs. close together; Schneider, Stapels, Koole, and Schwarz, 2020). Similarly, assigning entities to different categories entails mental separation, a task that is completed faster when response keys corresponding to different categories are physically far apart (vs. close together; Lakens, Schneider, Jostmann, and Schubert, 2011).

By the same logic, basic and higher-order cognitive tasks that hinge on mental connection should be facilitated (vs. undermined) when relevant entities are physically connected (vs. separated). For example, assigning entities to the same category entails mental connection, a task that should be completed faster and more accurately if response keys are close together (vs. far apart). Implicit associations (Greenwald & Banaji, 1995) between two constructs (e.g., race and valence) should be stronger if the constructs are displayed close together (vs. far apart). Biases in judgment and decision-making driven by associative heuristics that connect entities in the mind (e.g., anchoring and adjustment; Tversky and Kahneman, 1974) should be strengthened by acts of connection but weakened by acts of separation (e.g., enclosing the anchoring information in an envelope before making judgments).

At the core of grounded procedures are physical actions, which move through space. Proper use of physical actions and spatial relations is known to support language and thought (Goldin-Meadow, 2005; Kendon, 2004; Krauss, 1998; McNeill, 2000, 2008), including non-spatial, abstract thought (e.g., temporal cognition, causal inference; Gattis, 2003; Gattis & Holyoak, 1996; Tversky, Morrison, & Betrancourt, 2002). The role of actions in cognitive functioning may have been underappreciated in social psychological explanations for the power of behavior in bringing about attitude change (Olson & Stone, 2005). Classic explanations for the influence of behavior on attitude change include cognitive dissonance (Aronson & Mills, 1959; Festinger, 1957; Festinger & Carlsmith, 1959) and self-perception (Bem, 1967, 1972; Calder & Staw, 1975), which highlight the role of mental processes such as motivation and inference (Fazio, Zanna, & Cooper, 1977). If attitudes, similar to other mental representations, are grounded in sensorimotor modalities and dynamically constructed on the spot (Schwarz & Lee, 2018), then enacting a behavior should influence attitudes at least in part because it engages their sensorimotor underpinnings (e.g., nodding in agreement; Wells and Petty, 1980). Unpacking such

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influence will advance our theoretical understanding of attitude change and our ability to enhance it through physical actions.

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Notes

1. The fixed-effect model produced smaller effect estimates, which are summarized here, even though the random-effects model, which produced larger effect estimates, is more statistically appropriate for our research question.
2. This guiding assumption is compatible with a pragmatist and functionalist stance (Dewey, 1903/1968; James, 1907, 1909; Peirce, 1878, 1877/2017), where mental processes – attention, perception, memory, impression, interpretation, judgment, language, reasoning, planning, and prediction – operate in the service of motivated action and goal-directed behavior (Anderson, 2003; Barsalou, 1999; Glenberg, 1997; Huang & Bargh, 2014; Kruglanski et al., 2002; Kunda, 1990; Proffitt, 2006). It is also compatible with research showing that action can trigger cognition, as when gesture facilitates thought and communication (McNeill, 2008) or when stereotypic movement activates stereotypic concepts and judgments (Mussweiler, 2006). Mental and physical processes constitute a dynamic interplay.
3. We note a subtle difference between conceptual metaphor theory and other grounded views on cognitive and social psychological processes. In a conceptual metaphor, thoughts about an abstract domain (e.g., morality) are assumed to be comprehended and communicated with the aid of sensorimotor experiences in a concrete domain (e.g., cleanliness). It involves "inter-conceptual" processes (Landau, Meier, & Keefer, 2010, p. 1054) such as cross-domain metaphorical structuring and association (Lee & Schwarz, 2012). Other grounded views tend to assume that mental representations and functions are themselves grounded in sensorimotor modalities. As such, the sensorimotor modalities directly constitute mental contents and operations (Denke et al., 2014; Schaefer, Denke, Heinze, & Rotte, 2013, 2015). Notwithstanding these differences, conceptual metaphor theory and other grounded views share their recognition of the role that sensorimotor processes play in mental ones. On this critical point, grounded procedures are in full agreement.
4. Like motivation for any behavior, the motivation to cleanse is multiply determined. In general, people are motivated to separate negative events from the self. But if people have another source of motivation that imbues a negative event with positive meanings, they may have little motivation to separate it from the self or even be motivated to connect it to the self. For example, some people are intentional about keeping their house a little dirty because they prioritize other things in life (e.g., family harmony, quality time with kids) over concerns about whether the bathroom is sparkling (McCarthy, 2014). Such prioritization imbues the otherwise undesirable messiness with positive meanings, weakening the motivation to separate it from oneself.
5. To date, the available studies compare a single negative experience (e.g., telling a lie) to a single positive one (e.g., telling the truth). Future research would benefit from multiple gradations of valence.
6. Similarly, actual borders can cue mental separation of an entity from the self. For example, a wall that separates an object from a person – despite no increase in absolute spatial distance – renders the object less relevant for action and less accessible in the mind (Rinck & Bower, 2003).
7. Although physical contact is not always required for contagion of (negative or positive) essences to occur (Huang et al., 2017; Kim & Kim, 2011; Savani, Kumar, Naidu, & Dweck, 2011), it does tend to amplify contagion effects.
8. Reflecting the lay appeal of inner cleansing, at the height of the COVID-19 pandemic, U.S. President Donald Trump "pondered whether [disinfectants] could be used to fight the virus inside the human body. 'I see the disinfectant where it knocks it out in a minute, one minute…. And is there a way we can do something like that by injection inside, or almost a cleaning? Because you see it gets in the lungs and it does a tremendous number on the lungs, so it would be interesting to check that'" (Chiu, Shepherd, Shammas, & Itkowitz, 2020).

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Open Peer Commentary

Cleansing and separating: From modern agriculture and genocide to post-separation era

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Abstract

We propose that the metaphor of cleansing was a by-product of modernization processes. Based on cultural and historical evidence, we claim that the activation of cleansing metaphor triggered positive associations in times when separation was a positively regarded element of human culture and agriculture, but it should not exert the same effect in times when separation became culturally anachronistic.

Cleansing effects are widely replicated in embodied social cognition research. Lee and Schwarz propose that these effects could be interpreted as a proxy of more basic procedures of separation, in line with Semin and Smith's (2008) view on embodied grounding, which suggests that psychological processes could be rooted in motoric and physical actions.

In this commentary, we would like to propose that the practice of psychological separation is embedded in human social activities that are created in historical realities. Acknowledging the primacy of action in attitudinal and cognitive processes (Harmon-Jones, Harmon-Jones, & Levy, 2015), we perceive evaluations and cognitions as means in organized social practices that were developed in historical realms. The evaluation of basic social practices, such as separation, is determined by what is valued in the given socio-cultural context. In this commentary, we would like to interpret human actions of separation and cleansing as a consequence of agricultural practices and intergroup relations developed in modern societies.

Modern modes of agriculture have been developed with a goal of increasing effectiveness in pest management and weed control. They involved plant and animal selection, crop rotations, crop sanitation, and the use of agrochemicals. All these practices could be seen as acts of separation and cleansing. The prevalence of this approach in agriculture was accompanied by tendencies in Western societies to value separation and cleansing also in other life domains.

In their most extreme forms, these processes are reflected in segregationist social ideas, ideologies, and developments such as hygienism, eugenics, ethnic cleansing, and genocide. The ideas of crop control and selective breeding of animals were developed in late eighteenth and early nineteenth century Britain, as part of the Second Agricultural Revolution (Mazoyer & Roudart, 2006; Mingay, 1977), which followed the first revolution involving the elimination of fallowing and mechanization. The trend toward crop and animal selection and farm specialization was drawn by the need of increased productivity of agriculture. This process was based on the development of fertilizer industry. The careful selection of crops and animals and the deepening of farm specialization (which led to separation of grain-producing farms from animal farms) served the goal of ever growing productivity. These innovations in agriculture are considered as being important sources of eugenic and hereditarian ideas, as well as sterilization policies in many countries (Gibbons, 2014; Kevles, 1995; Kimmelman, 1983). From the eugenic standpoint, agriculture and raising children on a farm represented also a crucial factor in supporting the wellbeing of the population (Cook, 1916).

The principle of "social gardening" (Bauman, 2000) – a perception of society as an object of designing, cultivating, and weed-poisoning, was apparent in most modern genocides. Metaphors

related to cleansing accompanied many mass atrocities that involved radical forms of social separation (e.g., the concept of "Jundenrein" and "Rassenhygiene" in Nazi Germany during the Holocaust; phrases such as "inyezi" and "cutting trees" used in the Rwandan Genocide propaganda, etc.; Bilewicz, 2019). Sanitizing language, involving such terms as "wasting people," "surgical strikes," "servicing the target" are used as means of moral disengagement by the perpetrators of mass violence (Bandura, 1999; 2016; McAlister, Bandura, & Owen, 2006). Bandura (2012, p. 2) notes that "people behave more cruelly when detrimental practices are sanitized than when they are called aggression."

The modern approach to agriculture has been questioned in recent decades. Some current trends of more sustainable agriculture emphasize integration rather than segregation. This includes, above all, permaculture, understood, in general as agriculture modeled on natural, "unclean," ecosystems. Permaculture is realized, among others, by using a variety of inter- and multi-cropping methods or "forest gardens" (Bilewicz, 2020; Holmgren, 2002; Veteto & Lockyer, 2008). Also post-genocide human intergroup relations have gravitated toward desegregation and reconciliation in many societies worldwide – most prominently in the United States and post-apartheid South Africa. Anti-segregationism is the prominent theme of contemporary collective action (e.g., Black Lives Matter movement, Wilson, 2016), as well as the key psychological strategy of conflict resolution and reconciliation (Durrheim & Dixon, 2005). Nuanced narratives and desegregated collective memories form and important aspect of post-genocide reconciliation, where atypical moral exemplars are used (Čehajić-Clancy, 2019; Čehajić-Clancy & Bilewicz, 2020; Witkowska, Beneda, Čehajić-Clancy, & Bilewicz, 2019). Such narratives focus on individuals who acted morally in times of genocide and transgressed intergroup boundaries (e.g., Oskar Schindler or Chiune Sugihara in times of the Holocaust), offering a desegregationist account in collective memories after mass atrocities.

These visible symptoms of changes occurring in contemporary culture suggest that the general value of segregation is decreasing in today's world. It is visible also in the meta-analytic effects of studies looking at immorality-cleansing effects (Lee & Schwarz, 2018; Siev, Zuckerman, & Siev, 2018) showing that the cleansing effects are systematically decreasing in time. It could be seen both in case of the effects of post-decisional dissonance after physical cleansing (Lee & Schwarz, 2018; suppl.) as well as in the case of "Macbeth effect," the relation between immorality and cleansing (Siev et al., 2018), where more recent studies show smaller effects than the early studies. Although relatively short time since first studies of these phenomena does not allow to draw far-reaching conclusions from this process, it is possible that we are witnessing a significant cultural change that might affect this basic metaphor in human cognition.

To summarize, in this commentary we propose that the metaphor of cleansing was a by-product of modernization processes in human culture and agriculture. Lee and Schwarz suggest that the effects of cleansing are valence- and domain-general, as they are grounded in basic motoric action of segregation. Based on cultural and historical evidence, we claim that the activation of cleansing metaphor triggered positive associations in times when separation was a positively regarded element of human culture and agriculture, but it should not exert the same effect in times when separation became culturally anachronistic. More systematic cross-cultural, meta-analytic, and historical studies would be needed to determine whether such social change could affect basic human metaphors and embodiments.

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The impact of grounded procedures can vary as a function of perceived thought validity, meaning, and timing

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Abstract

Cleansing (separation) inductions reduce the impact of negative and positive reactions, whereas connection manipulations magnify them. We suggest that grounded procedures can produce these effects by affecting the perceived validity of thoughts. In accord with the self-validation theory, we also note the importance of considering how moderators, such as the meaning of the action and the timing of inductions, affect outcomes.

Physical-cleansing procedures can lead people to psychologically wash away their recent thoughts, reducing their impact on judgment. Lee and Schwarz (L&S) explain this and related phenomenon with an impressive unifying framework which organizes a diverse set of embodied inductions under the psychological processes of separation versus connection from one's thoughts. Across multiple procedures and paradigms, cleansing and related inductions are found to mitigate the impact of negative reactions (e.g., the guilt from transgression), but also reduce the impact of positive thoughts. In contrast, connection inductions (e.g., physically touching) magnify (rather than undermine) the influence of both positive and negative thoughts.

In making this separation-connection distinction to account for the impact of diverse operations on thought use, the authors join a number of prior frameworks that address the important distinction between having thoughts and using them (i.e., primary vs. secondary cognition; Briñol & DeMarree, 2012; Jost, Kruglanski, & Nelson, 1998). For example, Alter and Oppenheimer (2009) brought together a wide array of manipulations related to the fluency/disfluency dimension, and showed how they could affect thought use. Huntsinger, Isbell, and Clore (2014) organized a diverse set of treatments related to the positive/negative emotion dimension and showed how they could influence the use of thoughts and thought processes. Bernstein et al. (2015) integrated a variety of approaches that use mindfulness and distance inductions to reduce the impact of thoughts. Our own self-validation theory (SVT; Briñol & Petty, 2009; Petty, Briñol, & Tormala, 2002) is an even more general framework that brings together a broad coalition of variables capable of affecting thought reliance, including fluency (Briñol, Tormala, & Petty, 2013b), emotion (Petty & Briñol, 2015), mindfulness (Luttrell, Briñol, & Petty, 2014), and most relevant to this comment, embodied inductions (Briñol, Petty, & Wagner, 2012).

In brief, SVT holds that having thoughts is not sufficient for them to have an impact on judgment and behavior. Rather, one must also think that those thoughts are valid to use either because the thoughts seem correct (called *cognitive validation*) or people feel good about or like them (*affective validation*; Briñol et al., 2018). As thought validity increases, so too does the influence of those thoughts on subsequent judgments. In our view, SVT can accommodate many of the separation-connection effects reviewed by L&S, but importantly, it also points to several potential moderators not previously considered in this domain. This comment illustrates how some of the general findings from SVT can be usefully applied to and potentially advance the separation-connection theory.

First, consider how grounded procedures can affect perceived thought validity. In the initial study on cleansing, the presumption was that because of the strong link between cleansing and removing dirt, cleansing would be especially likely to wash away negative thoughts and states (Lee & Schwarz, 2011; Zhong & Liljenquist, 2006). However, because SVT views cleansing as a general invalidating action (associated with disliking something), it can be applied to positive and negative thoughts alike. Subsequent research on cleansing confirmed this prediction (Florack, Kleber, Busch, & Stöhr, 2014). Similar to any other embodied action linked to invalidation such as head shaking (Briñol & Petty, 2003), postural slumping (Briñol, Petty, & Wagner, 2009), frowning (Paredes, Stavraki, Briñol, & Petty, 2013), or throwing something away (Briñol et al., 2013a), cleansing procedures can reduce the effect of virtually any thought (or goal, or memory, and so on) if they operate by undermining thought validity.

Second, SVT holds that the meaning of an action is critical for determining its impact, not the action itself. For example, although cleansing is typically seen as removing something bad (e.g., dirt), it is possible for the same action to be viewed as adding something good (purity). If so, according to SVT, the impact would be reversed. In an illustrative study, Kim, Lee, Duhachek, Briñol, and Petty (2018) had participants think about a recent time they did something wrong and then gave them the opportunity to wash their hands. When the action of washing was framed as removing dirt (the default meaning), the results showed that guilt over the wrong action decreased, replicating the original effect of hand washing. In contrast, when the same action was framed as *adding* purification to the body to help listen to one's mind, the experienced guilt increased, reversing the original effect.

Beyond the meaning of particular actions, the meaning of the self as an origin or destination to which thoughts are connected or separated is also important. Although the self tends to be associated with high validity by default, changing its meaning (from high to low validity or vice versa) can change the effect of grounded procedures on thought usage (Gascó, Briñol, Santos, Petty, & Horcajo, 2018).

Third, consistent with SVT predictions (Briñol et al., 2013a), L&S propose that separation and connection manipulations produce stronger effects when they involve physical actions rather than simulations. Briñol et al. (2017a) offered several reasons to explain why effects can be stronger when inductions involve actual bodily responses. For example, having the body engaged in any induction can activate a link to the self. The active-self account of prime-to-behavior effects suggests that primes can change the content of one's self-concept and linking the prime to the self-concept increases the impact of primes on judgments and behavior (Wheeler, DeMarree, & Petty, 2007). Perhaps

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performing physical actions such as washing one's hands makes a stronger link to the self and thus people feel cleaner compared to merely seeing or imagining cleaning.

By focusing on the particular procedures of separation-connection, L&S have developed useful but rather specific rationales for why the particular inductions of interest (e.g., cleansing) would matter. Using SVT as a more general framework, we noted the importance of considering how moderators can contribute to specifying when separation and connecting procedures would be expected to operate by affecting perceived validity. We highlighted how the meaning of the action can matter, but SVT also points to other moderators such as the timing of the inductions (e.g., does cleansing precede or come after thought generation?). As was the case for other variables (e.g., ease, emotion, and power), we hope that SVT can contribute to understanding and advancing separation-connection effects.

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Psychology of cleansing through the prism of intersecting object histories

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Abstract

We link cleansing effects to contemporary cognitive theories via an account of event representation (intersecting object histories) that provides an explicit, neurally plausible mechanism for encoding objects (e.g., the self) and their associations (with other entities) across time. It explains separation as resulting from weakening associations between the self in the present and the self in the past.

Lee and Schwarz (L&S) present a compelling case for a grounded account of the connection between cleansing and separation of experiences. As the authors point out, separation is not possible without prior association between the self and the thing to be separated. The intersecting object histories account of object and event representation (Altmann & Ekves, 2019) provides an explicit, neurally plausible mechanism for explaining the relationship between association and separation. Under this account, which is predicated on contemporary approaches to semantics (e.g., Yee & Thompson-Schill, 2016) and to the neurobiology of memory (e.g., Moscovitch, Cabeza, Winocur, & Nadel, 2016), the representation of an object is more than a region in a semantic space abstracted across episodic experience; it is a "history" – a trajectory through time and space across which an object (animate or inanimate) may change state (its intrinsic and/or extrinsic

*The first two authors contributed equally to this commentary.

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properties). Each trajectory is grounded, through associations between the object and others with which it co-occurred, in the episodic contexts specific to different points along the trajectory. Finally (for present purposes), objects are associated with their past selves through space and time – the increased overlap between an object and itself (relative to that between the object and another) creates strong associations through time such that the object in the here-and-now cues retrieval of itself in the past and, crucially, past episode-specific associations with that past self.

Consider the following example. For Bill, the representation of his wedding ring may include its current state as well as knowledge about its past state (it needed to be enlarged) and history (it was his grandfather's). The ring's history intersects with Bill's history, creating an association that strengthens with time as the ring and its wearer (Bill) co-occur. The ring has strong associations with Bill's grandfather and to his wedding. Removing the ring changes Bill's current self so that his current self no longer evokes the same strength of association with things from the past that the ring was associated with (in effect, the overlap between current Bill and previous Bill has been lessened by removing the ring, so *everything* associated with previous Bill is a bit more weakly activated). In contrast, the association between Bill and, for example, one of his shirts is weaker – they co-occur less frequently. Thus, although removing Bill's shirt also causes less overlap with previous states of (shirt-wearing) Bill, the separation between past Bill, and present Bill is weaker than the one produced by removing the ring.

We now have the ingredients necessary to reinterpret the separation effects discussed by L&S. For example, in a gambling scenario, hand washing eliminated participants' perception of the perseverance of a losing or winning streak, as if they had washed away their bad or good luck (Xu, Zwick, & Schwarz, 2012, Experiment 2). In the context of object histories, this can be explained as follows: removing one component of the current self (e.g., dirt on one's hands) weakens association with the past self and in turn with objects and events associated with that past self (e.g., luck). One might argue that the association between the self and the dirt that accumulates on the hands is insignificant because it co-occurs for only a short period of time (i.e., between hand washing events). However, hand washing is highly intentional and indeed, often ritualized, signaling a desire for decontamination, elimination of social hazard, and the removal of unwanted substances (cf., Boyer & Liénard, 2006). It is a highly salient separation from the self.

As discussed by L&S, the manifestation of grounded separation can take many forms, for example, burning a photograph or walking into a different room (a phenomenon that has been studied in the context of event cognition; e.g., Radvansky & Copeland, 2006; see also Zacks, Speer, Swallow, Braver, & Reynolds, 2007). In the context of intersecting object histories, we would predict that any event which reduces the overlap between the current and the prior self will have consequences for one's perception of objects and events associated with that past self: even moving into a different room in the gambling experiment should reduce the influence of a losing/winning streak.

Notably, the graded nature of association strength means that, on our account, more dramatic and intentional acts of separation should have greater impact on mental states: graded association strength explains why, for example, destroying an object associated with an episode of loss is more effective at limiting the perceived perseverance of losing streaks than is enclosing the object (separating it from oneself; see L&S for discussion). Equally, the intersecting object histories account predicts that breaking stronger associations between the current and previous self that took part in those episodes (e.g., removing a wedding ring) should be more effective at eliminating the sense of a streak than breaking weaker associations (e.g., removing a shirt). Our account also explains why washing one's own hands can produce larger separation effects than watching another person wash their hands, and importantly, it predicts that the effect of watching someone else will be graded: the more history the person you are watching shares with you (is it your partner, your friend, or a stranger?), the stronger the effect should be on you. And although watching a stranger does not separate anything directly from the self, it will not be totally ineffective: it can cue one's own proprioceptive experiences of hand washing (see Lee & Schwartz discussion of pretend separation).

We have claimed that cleansing and other physical actions of separation perturb the representational space comprising the self by weakening the associations between its different components. The strength of associations between different components as well as the type and degree of separation predict the strength of the cleansing effect. Viewing the effects of cleansing on mental states through the prism of intersecting object histories offers a mechanistic account of such effects and brings them into the immediate domain of interest of cognitive scientists studying event cognition and concept representation.

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Separation/connection procedures: From cleansing behavior to numerical cognition

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Abstract

Lee and Schwarz (L&S) suggest that separation is the grounded procedure underlying cleansing effects in different psychological domains. Here, we interpret L&S's account from a hierarchical view of cognition that considers the influence of physical properties and sensorimotor constraints on mental representations. This approach allows theoretical integration and generalization of L&S's account to the domain of formal quantitative reasoning.

Lee and Schwarz (L&S) argue that "much like cognitive capacities in general are grounded in sensorimotor ones, […] mental procedures in particular are grounded in physical procedures […]" (sect. 3.1, para. 5). Their grounded procedures are generalizable because brains are incorporated in bodies that interact with the environment, so embodied cognition integrates physical properties of the world, sensorimotor constraints of our body, and contextual factors. Despite broad agreement, Matheson and Barsalou (2018) recently diagnosed that an "overarching theory of embodiment and grounded cognition" is impeded by rather heterogeneous contributions from different disciplines. A hierarchical distinction between grounded, embodied, and situated cognition, initially proposed for the domain of numerical cognition (Fischer, 2012), can accomplish the desired theoretical integration.

The proposed hierarchy (see also Myachykov, Scheepers, Fischer, & Kessler, 2014; Pezzulo et al., 2013) first considers universal physical constraints on cognition, resulting from our environment (*grounding* through physical laws that shaped our nervous systems). A second level establishes *embodiment* of cognition through our sensory-motor history, including learned procedures. Finally, representing specific task instructions *situates* cognition and explains flexible performance signatures. Importantly, our conceptual distinction explains performance biases across domains, as we now illustrate.

Consider grounding first. L&S wrote about "causal links between physical cleansing and various psychological variables" and asked: "Empirically, how robust are they?" (Abstract). Because of its evolutionary origin, physical cleansing grounded on basic emotions will be most robust and hold universally for all separation/connection procedures based on approach and avoidance, for example, disgust towards rotten food (Ekman, Sorenson, & Friesen, 1969). In fact, the feeling of disgust is triggered not only by physical contaminants, but also by moral impurities and "form(s) part of a behavioural loss aversion system aimed at protecting valuable resources, including the integrity of one's body" (Schnall, 2017, p. 50).

Equally grounded is the fact that object accumulations produce higher piles because physical laws prevent objects from penetrating each other. The universal association "more is up" consequently informs metaphorical language (Lakoff & Johnson, 1980) and arithmetic intuitions (Lakoff & Núñez, 2000) and also induces judgment biases when accepting results that exceed the correct sum ("addition is more"; Shaki, Pinhas, & Fischer, 2018).

Consider embodiment next. L&S describe how cleansing separates the self from failure (sect. 3.1, para. 6) and how physical and mental connecting procedures are related (sect. 5). Again, we find similar embodiment signatures in mathematical cognition, where physical procedures of separation and connection prime subtraction and addition solutions, respectively (Werner & Raab, 2013; Werner, Raab, & Fischer, 2019). Conceptualization of addition/subtraction as connection/separation is also revealed by semantic priming between linguistic expressions defining commonly related entities and additions (Bassok, Pedigo, & Oskarsson, 2008) and by the importance of gestures in math education (Sinclair & Heyd-Metzuyanim, 2014).

By distinguishing grounding from embodiment we understand cleansing behaviors both as universally grounded mechanisms of connection and separation, and as culturally learned and experienced embodied metaphors of morality or guilt. These descriptions are hierarchically organized and complementary and explain cross-domain interactions, such as increased prosocial (Ding et al., 2016; Liao, Yam, Johnson, Liu, & Song, 2018) or self-punishing behavior (Schei, Sheikh, & Schnall, 2019) to compensate for moral transgression.

Having transferred the hierarchical distinction between grounded and embodied cognition from calculation to cleansing, we now wish to show how mental arithmetic can equally benefit from L&S's study of separation and connection procedures. In line with a hierarchical approach to cognition, they suggested that "grounded procedures of separation can be a proximate mechanism underlying cleansing effects" (Introduction, para. 4) and "once activated, whether physically or mentally, a procedure can be applied across content domains, even in unrelated situations" (sect. 3.1, para. 5). Doing just this, we realize that "at the core of grounded procedures are physical actions, which move through space" (sect. 7, para. 4), although at the core of mathematical learning are physical manipulation of quantity across space. Indeed, abstract concepts are typically understood in terms of concrete concepts: Counting numbers originated from piling up pebbles to quantify sheep (Keranen, 2016, p. 12); children acquire basic arithmetic during putting objects into and out of containers, thus constructing metaphors grounded in everyday experiences (Lakoff & Núñez, 2000).

The fact that separation/connection procedures and subtraction/addition procedures are grounded on similar physical mechanisms, predicts that they may also activate emotions similarly because bodily states and perceptions form an integral part of emotional experiences (Winkielman, Niedenthal, Wielgosz, Eelen, & Kavanagh, 2015). Indeed, "acts of separation are more likely to be triggered by negative entities, acts of connection are more likely to be triggered by positive entities" (sect. 5, para. 2). Confirming this extension across domains, several studies showed that separation procedures affect emotion perception by reducing negative moral emotions (Lee, Tang, Wan, Mai, & Liu, 2015;

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Zhong & Liljenquist, 2006), decreasing negative (guilt and shame) and increasing positive emotions (happiness; Tang et al., 2017) or even resetting them (clean slate effect), which consequently reduced the strictness of moral judgments (Kaspar, Krapp, & König, 2015). Similarly, studies demonstrating effects of emotion on arithmetic problem-solving further support this extension (Fabre & Lemaire, 2019; Schimmack & Derryberry, 2005).

If we assume that cleansing behaviors and mathematical thinking share mechanisms of separation versus connection, then cross-domain priming paradigms can test this prediction. Thus, in the framework of embodied mathematics, subtraction presupposes separation (Lakoff & Núñez, 2000), parallel to cleansing behaviors, such as hand washing. Will participants solve subtraction tasks faster after washing their hands? Or will they slow down because they already "separated" themselves and a greater separation would mean more effort? Answering these questions will clarify the mechanisms connecting everyday behaviors.

We end this comparison with a challenge pointing towards situated influences on cognition. Decision-making, as well as mathematical reasoning, features heuristics and biases (Kahneman, 2011; Shaki et al., 2018). While L&S (sect. 7, para. 3) predicted that anchoring bias should increase through acts of connection, anchoring is instead more prevalent in subtraction than in addition (Shaki et al., 2018). How can we explain this wrong prediction? Although the hierarchical understanding of grounded procedures invites a multi-layered analysis of behavior, pervasive heuristics/biases signal additional, context-dependent influences.

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Leveraging individual differences to understand grounded procedures

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Abstract

We applaud the goals and execution of the target article, but note that individual differences do not receive much attention. This is a shortcoming because individual differences can play a vital role in theory testing. In our commentary, we describe programs of research of this type and also apply similar thinking to the mechanisms proposed in the target article.

Lee and Schwarz (L&S) push the work on cleansing forward by providing a cohesive theoretical account of grounded procedures of separation (vs. connection) that organizes the diversity of findings in this area although suggesting new directions for research. Linking cleansing to a broader class of separation procedures is a meaningful development, and is likely to propel this literature into a stronger theoretical context. Yet, issues of mechanism remain uncertain. This is in part because of the diversity of findings that exist (L&S count some 500 effects focused on cleansing) and in part because a number of different processes could be responsible for the effects of an independent variable on a dependent variable, particularly in the domain of embodied cognition. In this context, individual differences have a great deal to offer in that they can target the mechanisms thought to be involved in a way that experiments cannot (Underwood, 1975). In our commentary, we highlight the value of individual difference approaches to grounded cognition although speaking to the mechanisms thought to be involved in cleansing phenomena.

Experimental methods – especially in social psychology, which favors the between-subjects design – can be finicky and unreliable, leading to replicability issues (Fetterman, 2016). Also, the results of these studies often have unknown external validity. One deceptively simple way of complementing the experimental approach, in embodiment research, is to turn the relevant behavior (or skill: Herbert & Pollatos, 2012) into an individual difference. If cleansing has psychological meaning, for example, individuals who clean themselves more often or who desire to clean themselves more often should differ in other ways that will allow us to understand the psychological functions of cleansing. Similar approaches have been taken with respect to other bodily gestures such as arm-crossing. Although some research had suggested that crossing one's arms might serve as a signal of pride, Fetterman, Bair, and Robinson (2015) thought it more likely that arm-crossing, similar to other "closed" postures, is allied with defensive forms of motivation. To test this idea, Fetterman et al. (2015) designed an arm-crossing questionnaire that simply asked individuals, in several ways, how often they cross their arms and feel like crossing their arms. As hypothesized, individuals who engaged in this gesture more frequently were socially submissive and averse to taking both social and physical risks. The correlates of cleansing frequency are relatively unknown, but relevant studies would provide important clues into why this behavior is performed as well as what psychological functions that it serves.

Individual differences can also provide key insights into the mechanisms involved in a particular experimental effect. To the extent that purity concerns motivate cleansing behavior, for example, individuals who value purity more – as a moral foundation (Graham et al., 2011) – should display the effect to a greater

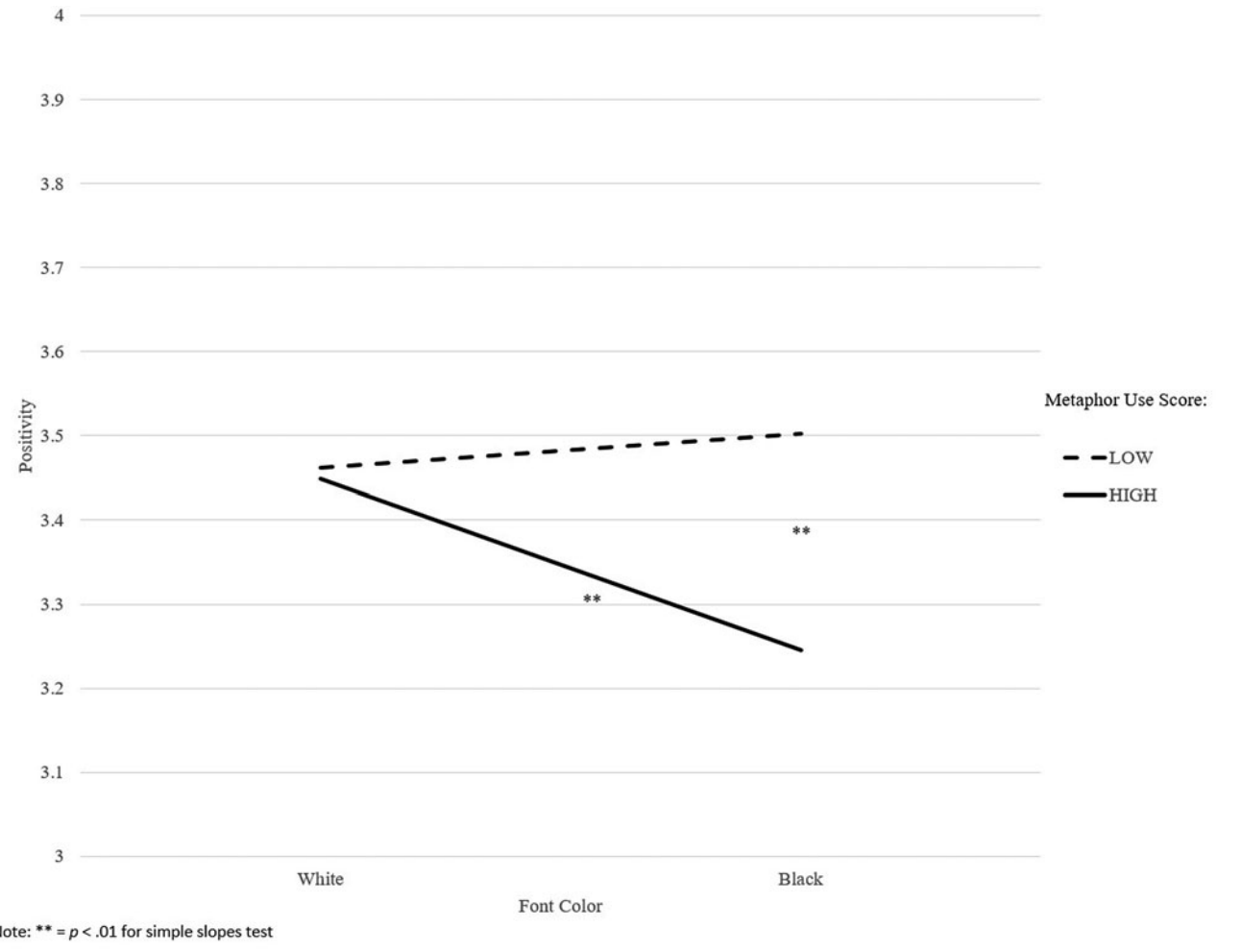

Figure 1. (Fetterman et al.) Word evaluations as a function of font color and Metaphor Usage (±1 SD), recreated from Fetterman et al. (2016).

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extent. Indeed, one might find that individuals low in purity concerns do not show the effect at all. It is difficult to overstate the explanatory value of such a pattern. First, it would establish moderator conditions for the phenomenon, which is an important next-generation question in embodiment research (Meier, Schnall, Schwarz, & Bargh, 2012), particularly given the heterogeneity in effect sizes documented by L&S. Second, it would provide critical evidence for mechanism: If purity concerns are involved, as is proposed, then individuals who have such concerns to a greater extent *should* display the phenomenon to a greater extent. If they do not, one might need to rethink the mechanism that links the manipulation to the dependent measure (Underwood, 1975).

As an example of this type, consider Study 2 of Fetterman, Bair, Werth, Landkammer, and Robinson (2016). Meier, Robinson, and Clore (2004) had shown that negative words were evaluated more quickly when in a black font color and positive words were evaluated more quickly when in a white font color. Meier et al. (2004) proposed that the relevant mechanism was metaphoric cognition because darker colors are metaphorically bad (e.g., "dark times") and lighter colors are metaphorically good (e.g., "bright person"). If such effects are driven by metaphoric cognition, then people who use metaphors more often – in their everyday speech and thought – should be more susceptible to effects of this type. Fetterman et al. (2016) examined this hypothesis by creating a Metaphor Use Measure that asked individuals whether they would use literal (e.g., "I was very sad") or metaphoric ("my heart was broken") language to characterize a series of events and feelings. There were 30 of these pairs and individuals were consistent in their tendencies toward literal versus metaphoric conceptions. Of particular importance, Fetterman et al. (2016) found that assigning relatively neutral words to a lighter (vs. darker) font color resulted in more positive evaluations, but *only* among individuals who tend to think, speak, and write metaphorically. These findings, which are displayed in Figure 1, confirm the relevance of metaphoric thinking to the phenomena identified by Meier et al. (2004).

The cleansing literature, we suggest, would benefit from similar analyses because a number of mechanisms have been proposed, but definitive individual difference studies have not been consistently carried out. If the phenomena previously identified (e.g., Schnall, Haidt, Clore, & Jordan, 2008) co-opt the disgust system, the relevant effects should be more pronounced among disgust-sensitive individuals. If they involve embodiment or metaphor, they may be more pronounced among individuals who exhibit greater embodiment (Häfner, 2013) or who use metaphors more often (Fetterman et al., 2016). As described, the psychological causes of cleansing behavior seem to involve avoidance motivation and, if so, the relevant effects should interact with avoidance motivation rather than approach motivation (Carver, 2006). On the contrary, the consequences of cleansing may involve mechanisms (like psychological separation) that are more difficult to characterize and an individual difference approach could help in clarifying these processes. In general, then, we suggest that individual differences can play a key role in theorizing and mechanism evaluation within the cleansing literature specifically and embodied literature more broadly.

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Developmental antecedents of cleansing effects: Evidence against domain-generality

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Abstract

Lee and Schwarz propose grounded procedures of separation as a domain-general mechanism underlying cleansing effects. One strong test of domain generality is to investigate the ontogenetic origins of a process. Here, we argue that the developmental evidence provides weak support for a domain-general grounded procedures account. Instead, it is likely that distinct separation procedures develop uniquely for different content domains.

Lee and Schwarz (L&S) propose grounded procedures of separation as a proximate mechanism for cleansing effects. This same mechanism is proposed to underlie other grounded procedures of separation (e.g., enclosing and avoiding contact), with a variety of psychological consequences (e.g., sympathetic magic and positive contagion). Thus, they claim that the mechanism producing cleansing effects is domain-general, and that only a grounded

procedures account can explain how cleansing effects occur in an array of contexts. In this commentary, we argue that this claim can be tested by investigating the ontogenetic origins of grounded procedures of separation. Overall, the developmental evidence casts doubt on the existence of the proposed domain-general mechanism.

The development of these "separation" (or, conversely, "connection") procedures should include some key elements. First, children must form a mental representation of the act of separation (or act of connection). The idea of cleansing, for example, suggests that there is something that must be purified or removed from one's person. In other words, children must come to understand that there are contaminants (visible and invisible) in their environments, and that such contaminants are threatening (i.e., they harbor disease or may result in other deleterious effects). Second, children must come to construe the procedures as acts of both physical separation (i.e., can remove a physically present contaminant such as dirt) and psychological separation (i.e., can remove an imagined contaminant such as bad luck). Finally, children must start behaviorally displaying the "separation" and "connection" effects. If grounded procedures of separation are the proximate mechanism behind all of these domains, then one may predict that children will display cleansing effects and other "separation effects" at similar developmental time points. Children should start cleansing themselves of dirt and germs at the same time they begin to separate themselves from social outgroup members (we suggest that this can be understood as a form of separation as one is avoiding contact with outgroup members because of negative views or expectations of the outgroup; see Table 2 in the target article). If the trajectory of development is constant across domains, then the developmental evidence supports the domain generality of grounded procedures of separation. However, if the different domains follow different trajectories, then this complicates L&S's claim that all these phenomena involve the same mechanism.

In fact, although the domain-generality of grounded procedures of separation and connection has not been explicitly studied with developmental populations, the present literature suggests that such effects may *not* have consistent developmental trajectories. In some domains, the concepts of separation and connection and subsequent avoidance behaviors appear quite early in life, but in others they emerge much later. For example, infants in their second year of life have a concept of both connection (two foods touching connects them) and separation (removing the disliked food from the plate alleviates some concern) when it comes to foods. Eighteen-month-olds will refuse to eat a preferred food that has been "contaminated" by touching a disliked food on the same plate, and many even call for the disliked food to be entirely removed from the plate (Brown & Harris, 2012). However, when it comes to germs and illness, an understanding of contamination has a much more protracted development. Preschoolers do not differentiate between eating a clean versus germ-contaminated food (DeJesus, Shutts, & Kinzler, 2015) and do not avoid contact with someone who is "sick" (Blacker & LoBue, 2016). In fact, it is not until age 5 or 6 that these capacities reliably emerge (for a review, see Rottman, DeJesus, & Greenebaum, 2019). It is important to note that some conceptual causal knowledge of germ contagion is relatively early-emerging (Blacker & LoBue, 2016; Raman & Gelman, 2008). For example, 3-year-olds can accurately provide contamination-based explanations for illness when prompted (Legare, Wellman, & Gelman, 2009). However, as explained above, it is not until kindergarten or later that children reliably display avoidance behaviors, whereas even 18-month-olds will avoid liked foods "contaminated" by disliked foods. Indeed, children who do not have knowledge of germ contagion will nevertheless engage in avoidance behaviors toward foods, animals, and core disgust elicitors (Stevenson, Oaten, Case, Repacholi, & Wagland, 2010).

Comparing the domains of food and illness suggests that perhaps children have a harder time understanding invisible contaminants such as germs, viewing them as more abstract than clearly visible foods. Indeed, this suggests that abstract forms of separation and cleansing (e.g., removing germs or an "essence") may develop later than concrete forms (e.g., removing dirt or a disliked food). Yet, there are invisible elements of separation and connection that children seem to understand even earlier than germs and illness, such as the connection between people and their objects. As early as 4 years, children value authentic objects, rate objects owned by celebrities as worth more than others, and search for traces of ownership (Frazier & Gelman, 2009; Gelman, Frazier, Noles, Manczak, & Stilwell, 2015; Gelman, Manczak, Was, & Noles, 2016; Hood & Bloom, 2008). As discussed by L&S, these so-called "sympathetic magic" effects should be undergirded by grounded procedures of connection.

Moreover, although some procedures of separation (e.g., desiring foods to be separated) seem to mature spontaneously, it seems children must be socialized to perform some procedures of separation – in particular, cleansing procedures (Oaten, Stevenson, Wagland, Case, & Repacholi, 2014; Stevenson et al., 2010). Understanding the ontogenetic precursors to grounded procedures of separation will be a crucial complement to understanding the proximate mechanisms that produce these procedures in real time.

Taken together, children are precocious separators in some domains, but the prototypical act of separation – cleansing the body of contaminants – appears to be relatively late-developing and is not immediately understood as an act of separation. The current developmental evidence presents a complex but intriguing picture of how cleansing effects may emerge in childhood, and we challenge researchers to further investigate the ontogenetic roots of cleansing effects and grounded procedures of separation and connection more broadly.

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Grounded separation: can the sensorimotor be grounded in the symbolic?

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Abstract

According to Lee and Schwarz, the sensorimotor experience of cleansing involves separating one physical entity from another and grounds mental separation of one psychological entity from another. We propose that cleansing effects may result from symbolic cognition. Instead of viewing abstract meanings as emerging from concrete physical acts of cleansing, this physical act may be appended with pre-existing, symbolic meaning.

The ubiquity of cleansing behaviors and their importance in human life cannot be overstated. Thus, the development of well-specified accounts – such as the one laid out in the comprehensive target article – is a laudable task.

Lee and Schwartz (L&S) theory is predicated on the idea that: "mental processes do not reside in a layer of amodal symbols abstracted and detached from sensorimotor capacities for perception and action." This variant of embodiment theory (Barsalou, 1999) has been widely accepted in cognitive science. However, scrutiny of the evidence, as well as classic Kantian arguments, leads us to endorse an alternative view (Gilead, Trope, & Liberman, 2020a).

The diverse representational substrates of the mind

Guided by this reasoning, we have explicated a *pluralistic*, *constructivist* account of mental representation, in which sensorimotor and amodal representations co-exist (Gilead, Trope, & Liberman, 2020b). Our model is *pluralistic* because it suggests representations form a hierarchy from the concrete to the abstract that can be parsed into concrete modality-specific or *iconic* representations; multimodal or *indexical* representations; and abstract categorical or *symbolic* representations. The model is *constructivist* because it suggests that the act of forming novel representations – that is, abstraction – designates distinct, multidimensional entities as functionally identical; as such, abstraction forces us to *choose* a dimension along which stimuli are deemed similar (Medin, Goldstone, & Gentner, 1993).

We proposed that the dimensions we choose from when forming abstractions take their place in our mind via three routes: they can be *innate*, giving rise to what we termed *iconic* abstractions; they can be discovered based on *statistical learning*, giving rise to *indexical* abstractions; or can be passed on by social interaction, giving rise to *symbolic* abstractions.

What links the acts of separation?

Our model can be used to analyze L&S's theory. They argue that "sensorimotor experience of cleansing involves separating one physical entity from another. This experiential basis can ground mental separation of one psychological entity from another." Thus, in their view, a mental *linkage* is created between the concrete act of handwashing, and more abstract acts of separating ideas.

The suggestion that such a linkage exists is an interesting and plausible hypothesis. However, there is room for further analysis of the possible ontogeny of this purported linkage. Different conclusions of this discussion suggest different mechanistic explanations.

Indexical underpinning

The linkage may be an *indexical* relation, namely, the result of repeated associations between experiences of physical and non-physical separation.

However, as suggested by the constructivist perspective, events can be interpreted in numerous ways, by focusing on different dimensions of the experience. Modern associationist models of learning have begun to acknowledge that in order to learn that event A (e.g., red light) and B (e.g., shock) co-occur, these events need to be consistently construed as such (i.e., as "red light" rather than "light" or "heat"), a process termed "situation recognition" (e.g., Redish, Jensen, Johnson, & Kurth-Nelson, 2007).

Is it indeed the case that acts of handwashing correlate with an experience consistently construed as "mental separation"? Does this interpretation indeed exist "out there" in the world, patiently waiting to be discovered by a statistician-child? We think that it is important to keep in mind that "a separation act" is a potentially idiosyncratic choice of how to construe cleansing (which can be viewed in innumerable other ways; e.g., as the annihilation of dirt, dilution, transformation, and so on).

Iconic underpinning

The linkage may be a necessity borne out of the fundamental, potentially *innate* dimensional structure of the mind (i.e., that this is a manifestation of an *iconic* relation). Specifically, it is possible that the world of a newborn child is comprised of such

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primitives as proximity/separateness and purity/toxicity – and that both mental and physical objects are embedded within such a multidimensional mental space.

This exact possibility has been raised in the psychoanalytic writings of Klein (1952). Klein imagines the mind of a newborn child as a place where toxic and nourishing elements are separated via procedures such as "splitting." The consequences of splitting (e.g., lack of integration of aspects of the self, cognitive rigidity) resemble those posited by the "separation" processes hypothesized by L&S.

Symbolic underpinning

The linkage may emerge from the construals prevalent in one's culture. Namely, contrary to L&S's suggestion, this mapping may be an example of a *symbolic* relation representation.

Specifically, cleansing can be seen as an instantiation of the linguistically-based category *separate* (of dirt from one's body); the act of compartmentalizing aspects of the self can be seen as an instantiation of the linguistically-based category *separate* (one idea from another); and the possibility of viewing the two acts as similar in that respect, may be introduced into people's minds via the process of symbolic interaction with other people (e.g., by being exposed to abstract conceptual metaphors denoting this relation). According to our model, such a mapping will be subserved by frontotemporal regions implicated in symbolic thought and will not be observed among individuals who were not exposed to this conceptual metaphor.

Embodiment or symbolization?

If we adopt the view that cleansing effects are the result of symbolic cognition, their "embodiment" may be viewed differently. Instead of viewing abstract meanings as emerging from concrete physical acts of cleansing, this physical act may be appended with pre-existing, symbolic meaning (Freud, 1955; Reuven, Liberman, & Dar, 2014).

Whenever abstract ideas are transmuted into vivid symbols, they are imbued with a sense of additional importance. For example, the Jewish ritual of taking a live chicken and rotating it around one's head in order to be absolved of one's sins, seems to have some profound effect on the believer, that outstrips merely reciting a silent prayer.

Such symbolization signals commitment to an idea (e.g., Henrich, 2016); it makes it an observable reality that can be socially shared, and thus, gain the epistemic gravity of a "shared reality" (e.g., Echterhoff, Higgins, & Levine, 2009); it also transforms an ephemeral idea that can be quickly washed away by ensuing thoughts – into a vivid placeholder that would remain "out there" after the thoughts (and even the mind that formed them) disappear.

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Grounded procedures of separation in clinical psychology: what's to be expected?

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Abstract

The hypothesis of grounded procedures of separation predicts accentuated effects in individuals with psychiatric disorders, for example, obsessive-compulsive disorders with washing compulsion. This could provide a vantage point for understanding cognitive processes related to specific disorders. However, fully exploring it requires updated experimental designs, including extensive control conditions, exclusion of alternative explanations, internal replications, and parametric variation to strengthen internal validity.

Lee and Schwarz (L&S) review an extensive body of research on cleansing behavior in healthy adults. Here, we discuss implications for the field of clinical psychology. As psychiatric disorders can be considered to be cognitive states at the end of a continuum (Keyes, 2002), grounded procedures should reproduce in individuals with psychiatric disorders. Disorders most associated with moral conflicts – important triggers of cleansing behavior according to L&S – are obsessive-compulsive disorders (OCD, Chiang,

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Purdon, & Radomsky, 2016). In the washing subtype of OCD, individuals respond to unwanted thoughts and ideas (obsessions) with extensive cleaning rituals (compulsions). Even though extensive cleaning leads to short-term relief in individuals suffering from OCD, it is also a major factor that contributes to the disorder's maintenance. The initial feeling of relief as well as the patient's assumption that extensive cleaning prevented a feared outcome can lead to an extensive and repeated execution of compulsions. Accordingly, exposure to obsessions combined with a prevention of compulsion is considered first-line treatment for OCD (Koran, Hanna, Hollander, Nestadt, & Simpson, 2007).

L&S's grounded-cognition account predicts that cleansing effects should be accentuated in individuals with psychiatric disorders. In a moral context, compared to a healthy control group, grounded separation effects should be stronger in disorders associated with hypermorality (e.g., OCD) and weaker in those associated with hypomorality (e.g., antisocial personality disorder; Braun, Léveillé, & Guimond, 2008). In a non-moral context, the influence of cleansing behavior on social threat – as proposed by L&S – might be investigated by comparing individuals with different levels of social anxiety (e.g., social phobia vs. low social anxiety). Similarly, we should find evidence for grounded separation in disorders associated with ruminations, such as depression. Potentially, cleansing may separate the self from these negative experiences or thoughts. If this were the case, a grounded cognition view could provide a new vantage point for understanding cognitive processes related to specific disorders, and might even suggest improvements in therapeutic interventions. Indeed, Reuven, Liberman, and Dar (2013; see also D'Olimpio & Mancini, 2014) showed that effects of grounded procedures were stronger in OCD patients compared to controls (replication of Zhong & Liljenquist, 2006; but see Siev, Zuckerman, & Siev, 2018). In light of this initial evidence, it is surprising that experiments testing grounded procedures in clinical disorders are still scarce.

There are comprehensive requirements to be met before moving into the clinical field (involving preregistration, eligibility criteria, power analysis, sample stratification, etc.; Schulz, Altman, Moher, & the CONSORT Group, 2010). Additionally, clinical researchers are not merely interested in statistical, but clinical significance, that is, the practical importance of a treatment effect. Are the grounded-cognition effects of separation stable enough to meet such criteria? L&S discuss the replicability of central findings in the field, and their meta-analysis comes to the conclusion that there is a valid but small effect underlying the many studies. Given the notoriously low power of much of psychological research (especially if it rests on group comparisons), it is little wonder that some of the effects reproduce in some studies but fail to replicate in others – indeed, a chequered replication performance is a hallmark of a small genuine effect tested with many underpowered studies.

However, replication is not only relevant *across* studies, but also *within* studies. This is a matter of experimental design. From our inspection of the literature reviewed by L&S, the dominant experimental design in the field seems to be very small. The typical experiment is a 2×2 design where a cleansing manipulation (e.g., handwashing or no handwashing) is crossed with a manipulation that elicits the effect of interest (e.g., cognitive dissonance before and after a choice; e.g., Lee & Schwarz, 2010a). Sometimes the design only consists of an experimental and a control group (e.g., Schnall, Benton, & Harvey, 2008). Even though designs generating such *solitary outcomes* are common in many areas of psychology, they are only able to demonstrate the effect of interest exactly once, giving them only minimal internal validity. In that case, statistical significance is far from guaranteeing replicability – remember that out of all solitary outcomes that are significant at a p value of exactly 0.05, only about half would be expected to replicate significantly and in the same direction.

Even more importantly, small designs often fail to include sufficient control conditions. For example, Lee and Schwarz (2010a) observed reduced cognitive dissonance for a choice of a music CD after handwashing with soap, compared to mere inspection of the soap (see de los Reyes, Aldao, Kundey, Lee, & Molina, 2012, for a replication). But because this is a solitary effect, we do not know whether it is specific to cleansing. Maybe the critical difference is simply between a completed action and a passive waiting period? What if potting a plant, which actually soils the hands, had reduced dissonance by the same amount as washing them? There is a second experiment in the paper to validate the effect, but it just substitutes jam for music, never examines the actual cleansing manipulation, and is therefore open to the same questions. This is suggestive of an overly confirmative research strategy (Firestone & Scholl, 2016) and future studies should put emphasis on eliminating alternative explanations.

We suggest introducing parametric manipulations within single experiments to see whether the theoretically critical manipulation actually drives the *magnitude* of the effect – in other words, parametric experiments exploring a dose–response relationship. For instance, five ordered levels of handwashing (no washing, dry cloth, clear water, plus soap, plus disinfectant) would predict exactly one ordering of conditions with respect to the dependent variable, out of a possible 120 orderings. This is a powerful permutation test, which entails up to four internal replications of the effect, tells us the range of possible effect sizes, and immediately rejects most alternative explanations. Comparing parametric variations between clinical groups further increases combinatorial power – not just linearly, but exponentially. To conclude, we believe that using these design options and also exploring clinical populations will spawn studies that have the potential to solidify the account of grounded procedures and improve understanding of cognitive processes in clinical disorders.

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The role of mortality concerns in separation and connection effects: comment on Lee and Schwarz

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Abstract

Using terror management theory and research findings, we expand the framework provided by Lee and Schwarz to highlight the potential link between separation and connection effects to existential, death-related concerns. Specifically, we address how death awareness may motivate separation and connection behaviors and how engaging in these behaviors may serve a protective terror management function.

Presenting a *grounded procedures* perspective in their target article, Lee and Schwarz proposed that engaging in *physical* acts of separation (e.g., cleansing) or connection (e.g., touching) activates a sense of *mental* separation or connection by either attenuating the influence of prior experience or mentally connecting one entity to another, respectively. This perspective offers a useful framework for better understanding such processes. We extend this framework by highlighting how people's efforts to manage their concerns about mortality contribute to mental and physical forms of separation and connection.

Terror management theory (TMT; Greenberg, Pyszczynski, & Solomon, 1986; Greenberg, Vail, & Pyszczynski, 2014) proposes that humans are uniquely aware of mortality and that much of human behavior is geared toward managing the potential for anxiety engendered by this awareness. People manage death-related concerns by maintaining faith in both a culturally-derived worldview that imbues life with meaning and purpose and their sense of being valued contributors to that meaningful world (for review, see Routledge & Vess, 2019). Being so valued provides a sense that one's identity will last beyond physical death through an immortal soul or one's links and contributions to the ongoing culture (e.g., offspring and scientific accomplishments). Supporting research has found that (1) mortality salience (MS) leads people to defend their worldviews and strive for self-esteem (e.g., Arndt, Greenberg, Pyszczynski, & Solomon, 1997; Taubman Ben-Ari, Florian, & Mikulincer, 1999; Zestcott, Lifshin, Helm, & Greenberg, 2016); (2) bolstering self-esteem or their worldview can prevent typical MS-induced defensiveness (Harmon-Jones et al., 1997; Schmeichel & Martens, 2005); and (3) self-esteem and worldview threats increase death-thought accessibility (DTA; Hayes, Schimel, Faucher, & Williams, 2008; Schimel, Hayes, Williams, & Jahrig, 2007). Collectively, this work supports the basic tenets of TMT but also points to interesting links between death awareness and both separation and connection behaviors.

Specifically, in line with this research, there are conditions in which (1) MS may motivate physical separation and connection behaviors; (2) engaging in these behaviors may reduce terror management defenses; and (3) certain antecedent events of these behaviors may be tied to increased DTA. One way that people defend against death awareness is by denying the human association with animality; as in most modern cultures, nonhuman animals are not granted the literal or symbolic bases of death transcendence that cultures grant us humans. Research has shown that MS and exposure to stimuli that link humans to animals (e.g., feces, blood, and breast-feeding) can increase disgust, DTA, and physical distancing (for review, see Goldenberg, Morris, & Boyd, 2019). Moreover, MS has been shown to increase support for the killing of animals (Lifshin, Greenberg, Zestcott, & Sullivan, 2017). Other physical separation tactics – such as confining animals or physically distancing oneself from reminders of animality – might also serve this terror management function by bolstering a sense of mental distinction between humans and animals.

Such processes may also be implicated in other domains. For example, research on separation effects has found that social exclusion and exposure to out-group related stimuli can instigate cleansing behavior (e.g., Poon, 2019; Reicher, Templeton, Neville, Ferrari, & Drury, 2016); moreover, engaging in cleansing behaviors can attenuate the mental connection between oneself and prior events (e.g., reducing pessimism after academic failure; Kaspar, 2012). Relatedly, threats to close relationships, exposure to out-groups, and threats to self-esteem have all been shown to increase DTA, and ameliorating these events – for instance, through affirming one's value or worldview – can reduce DTA (for review, see Hayes, Schimel, Arndt, & Faucher, 2010). Thus, one possibility is that physical acts of connection or separation might also provide a buffering function by enabling people to either feel connected to meaningful and death-transcendent entities or feel mentally

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disassociated from the threats to one's bases of meaning and personal significance. Indeed, a substantial body of prior literature has shown that MS leads to mental forms of connection – by increasing praise and reward and seeking closeness with those who validate one's worldview and self-worth – as well as mental forms of separation – by increasing derogation of, and physical aggression toward, those with different worldviews (e.g., Cox & Arndt, 2012; Greenberg et al., 1990; McGregor et al., 1998). Thus, separating and connecting physical acts conferring corresponding mental states clearly sometimes serve a terror management function.

In one study particularly illustrative of this, MS led to more reluctance to engage in (i.e., separating from) acts involving using cultural icons in inappropriate ways (e.g., pouring ink through an American flag; Greenberg, Porteus, Simon, Pyszczynski, & Solomon, 1995), as these symbols represent participants' worldview. Similarly, people may feel buffered against death awareness when connecting appropriately with objects representing the culture, and MS may motivate people to seek out such experiences. In doing so, people may feel more mentally connected to these transcendent entities through personal physical connection (e.g., wearing a pin of one's national flag, touching the hand of a cherished religious leader). On the other hand, regarding separation effects, cleansing oneself of existential threats (e.g., destroying the works and monuments of an opposing worldview, throwing away a reminder of a failed attempt toward self-esteem) may re-affirm one's sense of worth and reduce DTA.

Finally, the usefulness of physical acts of separation and connection to manage death-related anxieties, as well as the likelihood of such engagement, might vary across individuals. For example, research has shown that MS increases time spent washing hands for those who rate high (but not those who rate low) on a measure of compulsive hand washing (Menzies & Dar-Nimrod, 2017; Strachan et al., 2007). Moreover, various forms of physical touch and approach to members of one's culture appear to be effective death-anxiety buffers, especially for those with low self-esteem (e.g., Koole, Tjew, Sin, & Schneider, 2014). These findings suggest that certain physical acts of separation and connection may be more readily used by some over others to manage death awareness.

Although a comprehensive analysis on the role of mortality concerns in separation and connection effects is beyond the current scope, the research we have reviewed suggests that an integration of the grounded procedures perspective and TMT would be a fruitful basis for future research and a fuller understanding of both acts of separation and connection and how people manage death-related concerns.

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Going beyond elementary mechanisms: the strategic interplay between grounded procedures

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Abstract

The model presented by Lee and Schwarz provides a novel explanation for the elementary mechanisms of psychological cleansing. I argue that the model could be extended to account for complex instances of psychological cleansing where the grounded procedures are not isolated and the opposing motives of separation and connection are entangled in a strategic interplay.

Grounding cleansing behavior in the sensorimotor processes of separation and connection provides a parsimonious explanation for a wide array of psychological phenomena. Lee and Schwarz (L&S) display in the target article that the experimental modeling of cleansing behavior typically means either creating an incidental aversive stimulus (e.g., moral and emotional) with an opportunity of subsequent cleansing or prompting a cleansing activity and measuring the consequences. Additionally, L&S show how, on the flipside, sensorimotor connection can ground mental connection. With laying important groundwork, L&S stick to a rather fragmented perspective of isolated mechanisms. Real-life situations and the psychological phenomena that the model aims to explain aren't necessarily characterized by a clean division of motivations and effects. The model presented by L&S fails to account for situations where the grounded procedures are not isolated and the opposing motives of separation and connection are entangled. Two types of these situations are of greater theoretical relevance and practical consequence. First, people desire things that are not "clean." Second, when cleansing is felt necessary, it often requires connecting with the contaminating property – you have to get dirty to clean up the mess.

The dilemma of dirty money is an example for desiring things that are not clean. Psychological research found that money isn't only appraised based on its material value, its origin matters too (Bloom, 2010; Tasimi & Gelman, 2017). People devalue money with immoral origin (Stellar & Willer, 2014) and spend it reluctantly (Kardos & Castano, 2012) – grounded separation can explain both outcomes. A self-control-based approach has recently been offered to understand the dirty money dilemma (Tasimi & Gross, 2020). In this approach, the valuation conflict is presented as competing processes, where shifting attention (between material and moral) and the ensuing differences in the appraisal of the dirty money (material: good; moral: bad) would determine the valuations and the subsequent behavior. This view of competing processes is compatible with L&S's view. The separation and connection motives would emerge from the different appraisals and then manifest in responses appropriate to the grounded procedures of separation (get away from it) and connection (get it).

People's naïve understanding of magical contagion (Nemeroff & Rozin, 1994) and the fact that they actively adapt to disgust eliciting situations (Rozin, 2008) suggests a more dynamic process and alternative outcomes with no necessary winner between the competing motivations but with a combined, strategic interplay between them. Money laundering is practiced to remove negative traces of the past, and not only to escape legal consequences, as money's immoral origin influences people even when no one else is involved (Tasimi & Gelman, 2017). After receiving money under negative circumstances, people tend to use the available laundering opportunity, which, in turn, alleviates the negative emotions felt over the money's origin (Levav & McGraw, 2009). The relevant question is whether people are more likely to accept tainted money when they believe that they can launder it *later* – parallel to the finding that preventing money laundering decreases the incentives of crime (Levi, 2002). Knowing, for example, that acts of separation are available, people should be less reluctant to connect with tainted money. Instead of a one-dimensional separation versus connection choice, the process likely involves the strategic execution of a sequence of separation(s) and connection(s).

In a more benign example and moving from moral to literal dirt, picking up loose change poses a similar dilemma between connection and separation. Here too, a combination of the two should be the answer. In itself, a free quarter is desirable. When it lays on the subway platform, it will be perceived to be associated with an undesirable property. Carrying a hand sanitizer, that is, knowing and planning that subsequent separation can follow, the connection motive to pick it up should more likely manifest. Exploring how these elementary grounded procedures link sequentially in a process would shed light not only on the mechanism and function, but also on the lay knowledge that people have about the psychology of cleansing.

As for the second type of situations, in the practices that the authors highlight to show how cleansing behavior permeates everyday life, the separation often requires an initial connection. Again, the question is not merely the extent of separation or separation versus connection, but their combined use in a logical arrangement. Think about the banal case of noticing an icky think on your shoes. The separation motive exists, but separation requires connection. A tissue is a material solution designed to satisfy the separation motive, while also minimizing connection. Civilization has invested excessive creative efforts to solve such problems. Babies have to be kept clean and modern diapers offer an ever-cleaner experience of disposing waste. Automated no-touch soap dispensers and faucets ensure separation without connection.

Similar processes can play out in moral issues. Unlike in experimental settings where the cleansing behavior is typically unrelated to the property being cleansed away (e.g., using hand sanitizer to activate separation in the domain of luck), real life separation induced actions are often related to the (moral) property that they are supposed to impact. In religious practices, for instance, getting rid of a sin often requires recounting it first, that is, facing it, connecting with it, and only then can one wash it away in a ritual bath or send it away in the desert symbolically tied to a scapegoat. The prearranged separation makes it easier to reconnect with the undesired property. The interplay between the different grounded procedures reveals the tension that the more one cares about cleansing something away, the more aversion one might experience for having to do the cleansing.

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The proposed model of cleansing offers explanation for a wider array of phenomena than previous accounts. The model could capitalize on the new understanding of the separate mechanisms and capture the complexity of cleansing-related psychological processes. It is understandable that when introducing a new model, the elementary mechanisms receive the most attention. Extending this attention to the combination as well as the strategic, sequential application of the elementary mechanisms should advance the model.

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Specifying separation: avoidance, abstraction, openness to new experiences

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Abstract

Lee and Schwarz suggest *grounded procedures of separation* as a mechanism for embodied cleansing. We compare this process to other mechanisms in grounded cognition and suggest a broader conceptualization that allows integration into general cognitive models of social behavior. Specifically, separation will be understood as a mindset of completed avoidance resulting in high abstraction and openness to new experiences.

Tackling the underlying mechanisms of embodiment, we (Körner & Strack, 2018; Körner, Topolinski, & Strack, 2015) suggested four distinct mechanisms through which grounded experiences may influence psychological processes: modal priming (spreading of semantic activation), sensorimotor simulation (automatic simulation of sensations, actions, or emotions when perceiving or thinking about related stimuli), direct state induction (altered motivational-affective state or mindset from grounding, unmediated by further cognitive processes), and conscious inferences (usage of sensorimotor states to infer psychological states). Unfortunately, grounded procedures of separation do not seem to fit neatly into one of these process-pure categories. Instead, features of both direct state induction and conscious inferences seem to co-operate.

The first two mechanisms, modal priming and sensorimotor simulations cannot explain the entire range of phenomena that are reviewed in the target article and therefore fail to provide parsimonious explanations for grounded procedures of separation. Although early research showed that physical cleaning influences psychological processes in metaphorically associated domains, multiple later studies (reviewed in the target article) found physical cleaning to yield separation effects even in unrelated content domains, such as purchasing decisions or task performance. The lack of semantic associations between these domains and metaphors of cleansing or (moral) disgust excludes spreading of semantic associations as a mechanism. Similarly, even though cleaning imagery has been observed to result in cleansing (see Zhong, Strejcek, & Sivanathan, 2010), the finding that cleaning oneself has different consequences than cleaning an object (Körner & Strack, 2019) speaks against the automatic sensorimotor simulations as a mechanism.

Conscious inferences, on the contrary, seem to be necessary for grounded procedures of separation. As reviewed in the target article, the mere motor action involved in cleaning is not sufficient to trigger separation. Instead, the action must be understood as cleaning (Körner & Strack, 2019). Although the meaning of the bodily action must be cognitively represented, this is not required for the outcome of the action. In other words, although participants need to be aware that they are cleaning themselves, the idea of separation as a generalized concept does not need to be activated.

The last process, direct state induction, was originally supposed to be unmediated by inferences or other cognitive processes (see Körner et al., 2015). Although cognitive processes do play a role in grounded procedures of separation (see above), separation nevertheless shares features with direct state induction in that the consequences are domain-general. In fact, separation effects have been shown to be so general as to indicate an altered motivational/affective state or mindset, altering information processing. In sum, the mechanism driving grounded procedures of separation seems to be a state induction requiring inferential processes.

We suggest, and this is our second point, that separation is the functional end state of a behavioral activity that belongs to the approach/avoidance dichotomy and directly induces a psychological condition (see Körner et al., 2015). As a consequence, separation is predicted to reduce the feelings that were previously elicited and to neutralize the evaluation of previously encountered stimuli. Approach/avoidance behavior acts as a basic tie between behavior and evaluation. Specifically, it has been shown that approach versus avoidance tendencies stand in a bidirectional relation with positive versus negative evaluations; that is,

avoidance behavior may be facilitated by negative affect and elicit negative evaluations during its execution (Cacioppo, Priester, & Berntson, 1993; Krieglmeyer, Deutsch, De Houwer, & De Raedt, 2010; cf. Krishna & Eder, 2018; Strack & Deutsch, 2004). The current analysis suggests that (a) negative feelings trigger a motivation to engage in cleansing, that (b) the negative affect will be maintained or even increase during the procedure, and that (c) its completion (separation) will neutralize or eliminate these feelings and trigger a new mindset that differs from the grounded procedures that result in separation.

This new mindset may be further facilitated by separation's leading to an increased psychological distance between the self and the target, which, in turn, leads to more abstract information processing (Trope & Liberman, 2010). This mechanism, separation leading to more abstract construal, could also explain the emotion-neutralizing effect of separation actions. Several studies on cleansing observed that previous affect-altering experiences (e.g., feeling guilty because of a moral transgression or confident because of a successful performance) were neutralized by separation procedures. This accords with the reduced affective quality of abstract compared to concrete construal, as it has been demonstrated (Strack, Schwarz, & Gschneidinger, 1985) that affect is less likely to be intensified by abstract than by concrete representations. Moreover, conceptualizing separation as increasing psychological distance allows for additional predictions. Compared to neutral actions, separation should lead to a more abstract representation of stimuli or events encountered before this action. As characteristics of abstract representations, central and enduring (compared to peripheral and transient) features of events and objects are postulated to be more likely to determine judgments after separation procedures.

Finally, we argue that separation will lead to a *reset* of previous mental operations, causing old ties to be severed and new experiences to be facilitated. Thus, we suggest that the reset aspect of separation should have the additional effect of increasing openness to new experiences. Although openness to experience has been frequently characterized as a disposition, it also has motivational aspects that may vary depending on situational characteristics (Sheldon, Ryan, Rawsthorne, & Ilardi, 1997) and can alter with training (Jackson, Hill, Payne, Roberts, & Stine-Morrow, 2012). When seen as a psychological reset, grounded procedures of separation should lead to greater readiness to accept unusual (as opposed to conventional) ideas, and to enlarging experiences, a greater breadth in outlook, more divergent thinking, tolerance for ambiguity and inconsistencies, reduced appeal for routine, and increased flexibility in general (McCrae & Costa, 1997). In sum, taking the idea of grounded procedures of separation further enables new predictions about the psychological consequences of cleaning and other grounded procedures of separation.

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Culture, ecology, and grounded procedures

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Abstract

We propose that grounded procedures may help explain psychological variations across cultures. Here we offer a set of novel predictions based on the interplay between the social and physical ecology, chronic sensorimotor experience, and cultural norms.

Lee and Schwarz (L&S) propose that cleansing effects can be explained by grounding of mental separation in the sensorimotor processes associated with physical acts of separation, and that this mechanism can be generalized to other forms of separation across various domains and other grounded procedures, such as connection. We propose that grounded procedures may also provide

insights into patterns of cultural psychological variation and vice-versa. Below we discuss four ways in which culture and embodiment may be linked, and provide novel predictions based on these linkages.

First, considering how features of the environment constrain collective sensorimotor experiences may shed light on how cultural variations occur. A growing body of work suggests that patterns of cultural variation may be shaped by adaptive responses to ecological conditions (Sng, Neuberg, Varnum, & Kenrick, 2018; Thornhill & Fincher, 2014; Van de Vliert, 2013; Varnum & Grossmann, 2017). This ecologically based perspective on cultural variation has been relatively agnostic about mechanisms by which these effects occur, positing that these environmental cues may lead to cultural differences both through immediate evoked responses, and through cultural transmission (i.e., values, norms, etc.) and structures (institutions). Embodied cognition might also be one mechanism by which these environmental inputs are translated into cultural outputs. The value of the embodied perspective may be especially apparent in cases where behavioral ecological theory does not as clearly specify the mechanism for environment-culture linkages, such as the relationship between resource scarcity and collectivism or interdependence. Consider, for example, that resource scarcity often necessitates greater sharing of space with others (e.g., smaller homes, shared sleeping spaces, and cohabitation with a larger number of people) and greater coordination of physical activity (e.g., modes of labor involving more coordination or synchrony). Grounding of psychological connection in these repeated sensorimotor experiences of connection may explain, *at least in part*, why a more connected, less distinct sense of self is more common in places and times where resources are more scarce (Grossmann & Varnum, 2011, 2015; Inglehart & Baker, 2000; Kraus, Piff, Mendoza-Denton, Rheinschmidt, & Keltner, 2012; Santos, Varnum, & Grossmann, 2017). If these embodied experiences of connection are key, then links between scarcity and interdependence should be weaker in places where the association between wealth and dwelling size or family size is weaker, or where there is less differentiation in the sensorimotor work experiences of those low versus high in status.

Second, considering the possible functions or adaptive consequences of cultural influence on sensorimotor experiences may help explain how culturally normative actions of separation and connection emerge in the first place and why they may persist. From the threats and opportunities people perceive in their ecology eliciting collective desire to separate or avoid separation, we can postulate links to specific versions of grounded procedures shared by groups of individuals. In environments where the threat of infectious disease is high, norms that limit physical contact with others should prevail, whereas, in places where the threat of infectious disease is low, physical contact should be more normative. Thus, bowing, for example, should be a more common form of greeting in cultures where infectious disease threat is chronically high, whereas hugging and kissing should be more common as greetings in cultures where this threat is chronically low. Consistent with this idea, a recent study has shown that historic disease prevalence is negatively correlated with physicality in greetings among small scale societies (Murray, Fessler, Kerry, White, & Marin, 2017). Thus, rituals designed to accomplish the same goal (creating a sense of affiliation) may take very different physical forms as a function of the ecology. Similar links might be observed among larger scale societies typically studied in cross-cultural research, and changes over time in levels of pathogen threat might be linked to shifts in greeting norms and behaviors.

Third, how we comport our bodies around others likely affects how we feel and think about them in relation to ourselves. There are numerous examples of cultural norms facilitating physical connection to others (e.g., joining hands in prayer and handshaking), as well as physical separation (e.g., maintaining personal space and coming-of-age rituals involving relocation from home). Norms widely shared and enforced by a society should shape collective sensorimotor experiences, such that, from the grounded perspective, pervasive psychological consequences should be observed, including variations in how one views the self (e.g., independent vs. interdependent) and the values one endorses (e.g., individualism-collectivism). For example, the impact of religiousness on these values and views of self might be moderated by the extent to which the practices of a religious group involve physical contact and connection with others. Similarly, the link between higher education and independence might be stronger in places where going to university typically involves leaving home.

Fourth, cultural psychological variables may moderate the effects of grounded procedures on psychological states. For example, L&S suggest that cleansing effects can diverge depending on whether the focal event and measured outcome of cleansing are relevant to an important aspect of the self. Someone with an interdependent self-construal may perceive the group to have inherently taken part in an individual's poor performance or moral transgression. In this case, individual cleansing could have either a diminished effect, as it would not be sufficient to separate the entire group from the event, or a vicarious effect, as the boundary is blurred between the "agent" performing the cleansing and the "patient" being cleansed.

In sum, we believe there is much to be gained by exploring the links between grounded procedures, ecology, and cultural variation. Broadly, grounded procedures may help bridge theoretical accounts of cultural variation that emphasize evoked responses to ecological conditions (e.g., Sng et al., 2018) and those that emphasize embodied cognition (e.g., Leung, Qiu, Ong, & Tam, 2011; Soliman, Gibson, & Glenberg, 2013). Doing so may not only enhance our theoretical understanding of embodiment and cultural variation, but also be highly generative from an empirical standpoint.

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Bio-culturally grounded: why separation and connection may not be the same around the world

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Abstract

Central to the account of grounded procedures is the premise that mental experiences are grounded in physical actions. We complement this account by incorporating frameworks in cultural psychology and developmental neuroscience, with new predictions. Through the examples of vicarious experiences and demerit transfer, we discuss why, and how, separation and connection may operate somewhat differently across cultures.

Perspectives on grounded cognition assume the existence of mutual links between mental experiences and physical actions. The mental depends on the physical, and vice versa. Lee and Schwarz (L&S) propose an account for grounded procedures, which assumes that mental experiences of separation (e.g., desire to keep bad luck away) are grounded in physical actions of separation (e.g., washing one's hands). The account offers a parsimonious explanation for existing findings on cleansing effects. The opposite of separation was discussed, whereby mental connection is grounded in physical contact. The present commentary aims to broaden the scope of the proposed account by incorporating frameworks in cultural psychology and developmental neuroscience.

What underlies most empirical demonstrations of cleansing effects to date? Effects were triggered by an event personal to the self. For example, participants in Zhong and Liljenquist (2006) had a strong desire to cleanse after recalling their own immoral behavior. Similarly, prior to the cleansing manipulation, participants in Lee and Schwarz (2010a) were asked to make an unjustified decision for themselves. In another study (Xu, Zwick, & Schwarz, 2012), feelings of good and luck were manipulated through a game of chance, played by participants and not by others. Immorality, dissonance, luck, whatever the mental state in question (e.g., endowment, ownership, and stress), it was a result of a prior event experienced first-hand by the self, not by someone else.

However the source of mental states can be relational. People feel guilty, conflicted, unlucky for themselves, and also for others. This tendency, commonly known as vicarious experience (Lickel, Schmader, Curtis, Scarnier, & Ames, 2005; Stipek, 1998), is widespread in Eastern cultures (e.g., China, Japan, Korea, and India) in which interdependence (Markus & Kitayama, 1991) and collectivism (Bond, 1986; Triandis, 1995) permeate all ways of life. In these cultures where the group precedes the individual, the impact of a life event, good or bad, are shared among close others, even if they play no role in the event. Past research supports this claim. Chinese, for example, are inclined to feel vicarious shame and guilt for an immoral act committed by someone close to them (e.g., best friend cheating for scholarships) as if the act were theirs (Stipek, 1998). In contrast, vicarious experiences are less pervasive in Western cultures (e.g., American, Australian, and Canadian), in line with their independent and individualistic nature (Bond & Cheung, 1983; Markus & Kitayama, 1991; Triandis, McCusker, & Hui, 1990). Cultural differences in vicarious experiences can be attributed to the patterns of early social interaction between parent and child, which gradually shape the cognitive and socio-emotional lives of the developing child brain, from how they construct the self, construe social relationships, all the way to how they interpret life experiences later in life (Esposito, Setoh, Shinohara, & Bornstein, 2017a; Esposito et al., 2017b). Interacting with other social groups (e.g., family, proximal network, and society) further reinforce the transmission of attitudes, beliefs, assumptions, and values, all of which are the "cultural grammar" underneath processes in the self, social relationships, and the understanding of the world as the child matures (Esposito, Setoh, & Bornstein, 2015; see also Fig. 1).

Applying cultural and developmental frameworks to the context of grounded procedures generates new predictions. For example, given the relational nature of Easterners, effects of separation may arise from a prior event experienced not by the person, but his or her close ones. Son has committed a crime, dad feels the impact, probing the desire for mental separation through physical actions. This prediction, giving grounded procedures a cultural look, is empirically testable. Conceptually, we expect culture to operate in the same way in connection as it does in separation, assuming they both share the same structural properties (sect. 5, para. 2).

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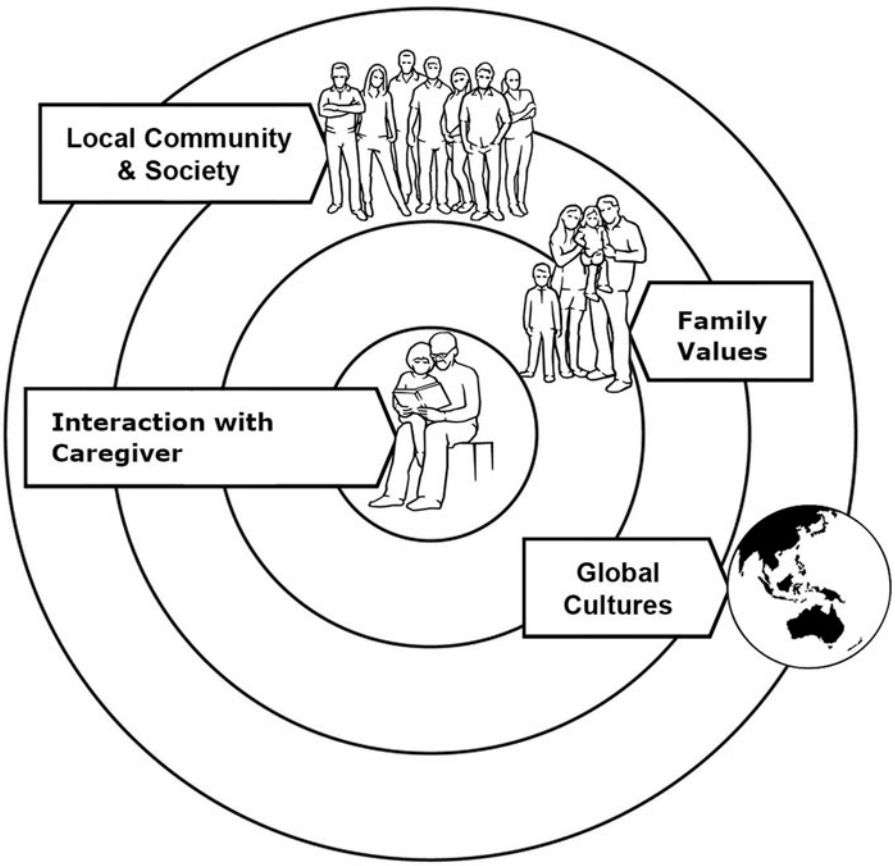

Figure 1. (Lee & Esposito) Groups of social influence shaping early life interaction. Different cultural forces can act on every concentric ring of influence that shape early life interaction and, by extension, the construction of the self. This claim is supported by cross-cultural developmental studies examining the effects of socio-cultural forces on the infant brain.

Bringing grounded procedures back to the wild opens up new research directions. Consider the example of demerit transfer (Billington, 2002; Reichenbach, 1990), a religious ritual which assumes that demerit, or negative moral energy accumulated from past misdeeds, can be passed on from one person to another. Putting it into context, a filial son could choose to bear demerit (and whatever karmic punishment that follows) for his father, who has been morally corrupt all his life. Demerit transfer is practiced worldwide, though far more common in Buddhist cultures. Conceptualizing demerit transfer in terms of separation and connection generates deeper questions. For example, is demerit transfer a simple two-stage process of removing demerit from an agent (separate from dad) and applying it to a new recipient (connect with son)? It is possible. Another possibility is that although demerit transfer is a compounded procedure of separation and connection, the underlying processes are moderated by culture-specific variables. In other words, demerit transfer may not exert impacts on everybody; it works only on people who, let say, believe that demerit is fluid, malleable, and not bound to the self like a fixed attribute. Past research on cultural lay beliefs points to this possibility (e.g., Marriott, 1989; Savani, Kumar, Naidu, & Dweck, 2011).

In sum, we hope to highlight the possible roles of cultural and developmental processes in grounded procedures. Through the examples of vicarious experiences and demerit transfer, we discuss why, and how, separation and connection may operate somewhat differently in Eastern cultures compared to Western cultures. We made several predictions. Empirical evaluations of these predictions will advance our understanding of grounded procedures.

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From washing hands to washing consciences and polishing reputations

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Abstract

While Lee and Schwarz propose grounded procedures of separation as an explanation for physical cleansing in various domains (e.g., washing one's hands), we suggest that separation can also account for behavioral cleansing aimed at washing consciences and polishing reputations. We discuss this extension in terms of degrees of behavioral cleansing, motivations, and intentions behind cleansing, and social settings.

Lee and Schwarz (L&S) posit that separation, as a grounded procedure, is a main driver of cleansing. In doing so, they relate physical cleansing to the moral domain; for instance, they review empirical evidence suggesting that moral violations tend to elicit cleansing behavior (e.g., Zhong & Liljenquist, 2006). While L&S focus on the antecedents and consequences of physical cleansing (most of it symbolic), we propose to extend the scope of their theoretical contribution to include behavioral cleansing, specifically, the washing of consciences in the moral domain and the polishing of reputations in social settings.

Degrees of behavioral cleansing. Whereas symbolic cleansing (of the kind advocated by L&S) is only metaphorically related to a past misdeed, behavioral cleansing refers to behaviors that compensate in one domain for a misdeed performed in another (West & Zhong, 2015). It has been operationalized, for instance, through the amount individuals donate to a charity (e.g., Sachdeva, Iliev, & Medin, 2009 or Légeret, 2020). Donations have the advantage of being continuous, thereby providing more information than dichotomized variables and allowing for sharper tests with more power to disentangle competing hypotheses. Note that variables capturing symbolic and physical cleansing can also be continuous, ranging, for instance, from simply rinsing fingers to washing hands thoroughly.

Motivation and intentions. Just as cleansing can be performed to different degrees, the motivations and intentions behind it can vary too. It is only a small step from removing physical or moral dirt to acts of polishing and shining. Polishing and shining can be observed in both the physical domain (cosmetics and make-up) and in the social domain (managing one's reputation). Such activities are ubiquitous, both for individuals and organizations. For example, many organizations engage in "greenwashing" – the act of superficially signaling interest in social and environmental issues (Delmas & Burbano, 2011; Laufer, 2003; Lyon & Montgomery, 2015). While some individuals or organizations might engage in this activity to compensate for past misdeeds, others may do so for opportunistic reasons even when there is no need to reduce internal dissonances: they simply seek to bring their public image closer to the expectations of their audience.

Separations and reparations in social settings. It is hard to define morality universally, partly because it is grounded both in the self (i.e., an individual's values and identity; Aquino & Reed, 2002; Reynolds & Ceranic, 2007) and societal norms (Suchman, 1995; Tost, 2011). For some situations, these two pillars may suggest different behaviors, thereby fueling moral conflict. Consequently, an observable behavior may be misaligned with an identity, with societal norms, or both. A misalignment constitutes an unstable state, which may be overcome through distancing, or another kind of separation, from past misdeeds, from one's identity, and/or from one's social group. While L&S focus on entities, events, and experiences in their theorization of separation, we propose applying the notion of separation to social settings, thereby distinguishing between: (1) the individual and his or her social environment, be it society at large or more localized formations; (2) observable behavior and underlying identity; and (3) whether the observable behavior is aligned with societal norms or not. Figure 1 displays conflicts that can be characterized as combinations of these three distinctions. Such conflicts can be explained by mismatches and/or separations, and can eventually also be resolved by separations or reparations.

These resolutions may be categorized as follows (see the eight cells of Fig. 1). *Identity reparation*: A mismatch between behavior and identity within a given individual (cognitive dissonance; Festinger, 1957), specifically if the behavior is aligned with societal norms, may be resolved by changing the individual's identity so as to make it consistent with the individual's behavior and with society (cell 1). Similarly, if the individual's behavior is misaligned with both the identity of a given group and societal norms, then the individual may engage in cleansing or polishing, for instance by signaling values that correspond to that group's identity (cell 4). Likewise, if there is a mismatch between a group's behavior and an individual's identity, and the group's behavior is aligned with societal norms, then the individual's identity may have to be adapted (cell 5). Finally, if a group's behavior conflicts with its own identity and if this behavior is aligned with societal norms, a new group identity may emerge (cell 7). *Identity separation*: In contrast, if a particular behavior is not aligned with societal norms, the individual may condemn his or her own past behavior and distance his or her self from it, that is, engage in cleansing, in order to protect his or her identity (cell 2). *Social reparation*: If the behavior of a group is misaligned both with its own identity and with societal norms, then that group is likely to engage in cleansing or polishing (cell 8). Such reparations at

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		Is the past behavior aligned with societal norms?	Identity	
			Individual	Group
Behavior	Individual	Yes	1. Change of identity	3. Exclusion
		No	2. Cleansing	4. Cleansing or Polishing
	Group	Yes	5. Change of identity	7. Change of identity
		No	6. Whistleblowing	8. Cleansing or Greenwashing

Figure 1. (Légeret & Hoffrage) Potential solutions to conflicts occurring within an individual, within a group, or between an individual and a group, depending on whether the behavior is aligned with societal norms

group level can also combine deep and superficial washing; that is, a combination of moral cleansing to solve the internal conflict and greenwashing to reestablish a positive moral identity in the eyes of society. *Social separation*: If an individual's behavior conflicts with his or her group's identity, group members will be alerted. If the individual fails to appease these members or even bluntly refuses to adapt to the group – which may be facilitated if the behavior is in line with society – he or she may be excluded from the group (cell 3). If the group's behavior is not aligned with societal norms, then cleansing on the side of the individual may not be sufficient. Rather, the individual's discomfort arising from such a mismatch may grow internally until it eventually erupts, resulting, for instance, in whistleblowing (Near & Miceli, 1985, 1995). Even though the whistleblower typically aims at changing (i.e., repairing) certain of the group's practices, it typically leads to the separation of the group and the whistleblower (cell 6).

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Cultural mindsets shape what grounded procedures mean: Cleansing can separate or connect and separating can feel good or not so good

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Abstract

Are grounded procedures such as cleansing value-neutral main effects? Culture-as-situated-cognition theory suggests otherwise. Societies differ in how frequently they trigger membership and individualizing cultural mindsets and their linked mental-procedures – connecting and separating, respectively. Commonly triggered mindsets (and their linked mental-procedures) feel fluent. Fluency feels good. Cleansing can separate from but also connect to others in the form of membership-based rituals.

Cleansing as a religious ritual connects individuals to a community of faith and to a tradition that extends both backward and forward in time. In Christianity, baptizing is the way to enter the Christian faith, to include Christ within oneself, and to join the community of Christians. Bathing and cleansing rituals linked to the cycle of life are essential to being Jewish, Muslim, and Hindu. In each religion, cleansing rituals provide individuals with a culturally fluent way of instantiating their group membership and connecting to the sacred. Cultures vary in the extent to which group membership, rather than individuating, is repeatedly triggered. This variability implies that people should be more, or less, likely to chronically think of cleansing as a form of connection, depending on the culture or subculture surrounding them. The alternative to experiencing cleansing as connecting is to consider it as a separating procedure. When experienced as a separating procedure, cleansing takes away rather than connecting the person with the divine and a community of others.

By postulating separation as the mechanism by which cleansing yields psychological outcomes, Lee and Schwarz (L&S) produce order and clarity in an otherwise messy array of findings regarding what cleansing is and what it does. As my opening example suggests, however, this admirable clarity misses the effect of culture on meaning-making. L&S make several assumptions about the link between cleansing and separation as a mental procedure, that cleansing always entails separating, that separating is a separate mechanism from connecting, and that separating is more likely in negative than in positively valenced situations so that separating itself is not valenced, only the consequence of separating is valenced. Each of these core assumptions warrants re-examination using a cultural lens. In this commentary, I use culture-as-situated-cognition theory to do so (Lin, Arieli, & Oyserman, 2019; Mourey, Lam, & Oyserman, 2015; Oyserman, 2018; Oyserman & Yan, 2019). Culture-as-situated cognition theory predicts first that what actions mean is culturally grounded and hence variable and second that mental procedures that are normative (the typical way to think) in a societal culture should feel right, yielding subtle positive valence.

Culture-as-situated-cognition theory starts with the premise that culture is part of human evolution (Oyserman, 2018; Oyserman & Yan, 2019). Humans need other humans to survive and thrive (Baumeister & Leary, 1995; Mesoudi, 2019; von Hippel, von Hippel, & Suddendorf, in press). This interdependence has shaped human culture in two ways. It required that people be sensitive to the demands of group membership (collectivism). This sensitivity afforded the development of a complex, tool-intensive, and cumulative culture (Osiurak & Reynaud, 2020). Societal cultures formalize when to fit in, how to signal deservingness and worthiness of others' trust (honor), and when it is possible to do one's own thing (individualism) (Oyserman, 2018). People can innovate, and this innovation can be passed on to others. People do not redevelop or rediscover their societal culture with each generation (Boyd & Richerson, 2005). Instead, people acquire culture from others and do so mostly on faith (Mesoudi, 2019). They accept what members of their ingroups tell them and proceed from there (Boyd & Richerson, 2005; Osiurak & Reynaud, 2019). This tendency to assimilate ingroup knowledge into worldviews allows cumulative culture and increasing cultural complexity (Osiurak & Reynaud, 2019). It also means that culturally acquired ideas may or may not be optimal and can even be maladaptive (Mesoudi, 2019). People do things because it is the way we do it, not because it is the best or optimal way. Culture is transmitted both vertically (across generations) and horizontally (among peers, Mesoudi, 2019).

A collectivistic mindset is a mental representation that includes goals (fitting in and belonging), content (valuing the act of fitting in), actions (attending to others), and mental procedures (connecting and relating) (Oyserman & Lee, 2008). As just described, collectivistic mindsets should be universally available in memory. Situations highlighting group membership (e.g., team sports, patriotic events, and political rivalry) should trigger collectivistic mindsets. Collectivistic mindsets should be more chronically accessible among people living in societies that were historically harsher and more hazardous (e.g., experiencing high pathogen risk, Fincher, Thornhill, Murray, & Schaller, 2008) and stable (e.g., people experienced more cross-generation transmission of culture, Mesoudi, 2019). Collectivistic mindsets should be triggered in situations that people experience as more dangerous. The same evolutionary model clarifies that people also innovate, do something unique, and different, which is how cumulative culture expands. The implication is that individualistic mindsets are also available in memory and will be more chronically accessible in resource-rich societies, in situations that are not experienced as hazardous, and among individuals exposed to fewer cross-generational (vertical) and more to within-generational (horizontal) cultural transmission opportunities.

With regard to cleansing, culture-as-situated cognition theory yields three predictions. First, cleansing should not always be associated with a separating mental procedure. Instead, whether cleansing is experienced as connecting or separating should depend on whether a collectivistic or an individualistic cultural mindset is accessible in the moment of judgment. Second, separation as a mental procedure should not be value-neutral. Instead, whether separating feels subtly fluent or disfluent should depend on whether a collectivistic or an individualistic mindset is more chronically accessible. Third, cleansing should be experienced as positive when it binds people together with one another or with the divine as well as when it signals propriety (doing things the right and honorable way) and when it signals group boundaries, separating people from those who fail to perform the cleansing ritual. Fourth, as exemplified in ritual cleansing, whether separating and connecting are experienced as distinct or related mental procedures should be context-dependent. In cultures and contexts in which collectivism is cued, cleansing is likely to be experienced as both separating the self from others, from impurity, the past, and also connecting the self to others, to purity, and the future. A culture-as-situated cognition lens clarifies how separating and connecting mechanisms can be culturally universal, differ in the likelihood that they will be chronically on the mind, and yield sometimes opposing consequences depending on the context in which they are cued.

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It's a matter of (executive) load: Separation as a load-dependent resetting procedure

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Abstract

Lee and Schwarz made considerable theoretical advances in the psychology of cleansing by proposing that cleaning actions might serve as separation procedures between two psychological entities. Here, we propose that the effectiveness of the separation process may be modulated by the available amount of executive resources, and that separation may operate as a load-dependent resetting procedure.

The objective of the target article is to present a new theoretical perspective on the psychology of cleansing, which posits the physical action of cleaning as a procedure of separation between two entities, e1 (e.g., failure/success) and e2 (e.g., one's self). This procedure results in attenuation/elimination processes of the effects of the former (e1) on the latter (e2).

In our view, the theoretical account proposed by Lee and Schwarz (L&S) needs to be enriched by considering the limited capacity of the human executive control system (Schmeichel, 2007). Threats to the self (e.g., negative emotions and intrusive thoughts) load executive control processes (Cohen, Mor, & Henik, 2015; Curci, Lanciano, Soleti, & Rimé, 2013). Crucially, Kalanthroff et al. (2017) recently demonstrated that physical cleansing reduces the detrimental effect of threatened morality on two executive processes: conflict monitoring and response inhibition. Therefore, physical cleansing appears to unload executive control processes, which are involved in top-down, goal-related behavior (Lavie, 2010). Indeed, cleansing may exert its effects through the embodied processes involved in physical actions, which improve cognitive performance and problem-solving and reduce cognitive load (Chum, Bekkering, Dodd, & Pratt, 2007; Schaefer, Lövdén, Wieckhorst, & Lindenberger, 2010; Skulmowski & Rey, 2017; Wagner Cook, Yip, & Goldin-Meadow, 2012; Wilson, 2002).

We propose that L&S's predictions about the effectiveness of cleansing-mediated separation are dependent on individual differences in the available amount of executive resources. In support of this, de Los Reyes et al. (2012) found that post-decisional dissonance (i.e., aversive feeling triggered by a choice between two similarly valued alternatives) is not eliminated by means of handwashing in compromised decision makers (healthy individuals with high levels of anxiety, intolerance toward uncertainty, and rumination) versus non-compromised individuals. On the contrary, Reuven, Liberman, and Dar (2014) showed that the association between physical cleansing and the reduction of moral discomfort is particularly strong in individuals diagnosed with obsessive-compulsive disorder (OCD) as compared with healthy controls.

These results may appear inconsistent with one another, as both samples are characterized by excessive negatively-valenced cognitions (rumination in anxious individuals and obsessive thoughts in OCD). We propose a load-dependent role of cleansing as a procedure whose efficacy is related to an individual's current amount of available executive resources. Consequently, the differential load charged to the executive control system in the two aforementioned populations (high in compromised decision makers and low in OCD, see below) represents a plausible candidate to explain the inconsistent effects of cleansing actions (de Los Reyes et al., 2012; Reuven et al., 2014).

Excessive negatively-valenced cognition can take the form of rumination, consisting of intrusive thoughts related to past or possible future events (Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008). A recent meta-analysis reported a negative association between rumination and the functioning of core executive functions such as inhibition and set-shifting (Yang, Cao, Shields, Teng, & Liu, 2017). Rumination is also associated with deficits in executive processing (Watkins & Brown, 2002), cognitive control (Joormann, Levens, & Gotlib, 2011), attentional control (Daches, Mor, Winquist, & Gilboa-Schechtman, 2010), working memory (Joormann & Gotlib, 2008), inhibition (Joormann, 2006), and goal disengagement (van Randenborgh, Hüffmeier, LeMoult, & Joormann, 2010) (see Whitmer & Gotlib, 2013). The sample used by de Los Reyes et al. (2012) was characterized by high levels of anxiety, which is known to impair executive function (Shields, Moons, Tewell, & Yonelineas, 2016), storage and processing capacity of working memory (Darke, 1988; Moran, 2016), and attentional control (Eysenck, Derakshan, Santos, & Calvo, 2007; Forster, Elizalde, Castle, & Bishop, 2015). This evidence, suggesting that rumination and anxiety contribute to loading executive functions, could explain the absence of cleansing-related effects in this sample (de Los Reyes et al., 2012).

Excessive negatively-valenced cognition can also take the form of obsessions that, together with repetitive behaviors or mental acts (compulsions), characterize OCD (American

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Psychiatric Association, 2013). According to the "habit hypothesis" (Graybiel & Rauch, 2000), in OCD striatal circuit dysfunction favors the expression of a routinized, habitual sequence of actions (Gillan et al., 2011, 2015), resulting in a reduced need for executive resources for their generation/inhibition (overpracticed behaviors are known to reduce cognitive load; Haith and Krakauer, 2018). Moreover, compulsions may partially relieve the detrimental effects of obsessions on executive processes (Starcevic et al., 2011) by reducing anxiety, which impairs executive function (Moran, 2016; Shields et al., 2016). In agreement, recent studies on individuals with OCD found an absence of deficit in sustained attention (Milliery, Bouvard, Aupetit, & Cottraux, 2000), enhanced action-monitoring processes (Gehring, Himle, & Nisenson, 2000; Hajcak & Simons, 2002), executive hyper-control (Bucci et al., 2004), lack of impairment in decision making (Johansen & Dittrich, 2013), and a superior performance in information gathering (Hauser et al., 2017) and in automatic versus controlled response inhibition (Wolff, Chmielewski, Buse, Roessner, & Beste, 2019). These findings, suggesting that in patients with OCD compulsions seem to unload executive functions, could explain why cleansing-related separation effects appear preserved in this population.

The aforementioned evidence may illustrate why individuals high in anxiety and rumination (with supposedly overloaded executive functions) do not fully benefit from the cleansing-related separation effects. In this population, although physical cleansing allows executive resources to unload, separation might be less efficient, as these resources are already partially recruited for coping with intrusive thoughts/emotions. Conversely, the inverse mechanism is proposed for OCD: obsessions overload the executive system (Abramovitch, Dar, Hermesh, & Schweiger, 2012) but compulsions, particularly the cleaning-related ones (Starcevic et al., 2011), may partially relieve the detrimental effects of obsessions on executive functions. Also, because compulsions are thought to be supported by a habit system (Burguière, Monteiro, Mallet, Feng, & Graybiel, 2015; Gillan & Robbins, 2014), fewer executive resources are needed for their implementation, and the available resources can be dedicated to separation procedures. In line with these findings, attentional control deficits in anxiety disorders are associated with perseverative worry, whereas in OCD this association is not significant (Armstrong, Zald, & Olatunji, 2011).

To conclude, we propose that the cleansing-mediated separation effect introduced by L&S is load-dependent: cleaning actions reset the influence of a prior event (e1) on a subsequent one (e2), only when sufficient executive resources can be dedicated to the separation procedure. In this frame, the efficacy of the separation procedure may depend on individual executive load.

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The lack of robust evidence for cleansing effects

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Abstract

The pattern of data underlying the successful replications of cleansing effects is improbable and most consistent with selective reporting. Moreover, the meta-analytic approach presented by Lee and Schwarz is likely to find an effect even if none existed. Absent more robust evidence, there is no need to develop a theoretical account of grounded procedures.

Lee and Schwarz (L&S) provided a theoretical account of *grounded procedures*, based on purportedly robust cleansing effects. Although acknowledging numerous failed replications of cleansing effects, L&S argued that several successful replications make it difficult to dismiss cleansing effects offhand. Here, we investigate whether the results of successful replications of the cleansing effects may in fact be consistent with the failed replications. We conclude that – based on the evidence they present – there is no support for the replicability of cleansing effects in the first place and thus no need to develop a theoretical account of grounded procedures.

Throughout the target article, L&S presented a selection of 23 effects in total, 14 non-significant, and 8 statistically significant (the results of one of the studies were not available). To critically appraise the evidence presented by L&S, we identified and coded the exact *p*-values reported for all the presented focal effects from the replication studies (data and R code are available at http://osf.io/c7ehk/). If the replication studies presented by L&S tapped into a genuine effect, the distribution of significant *p*-values would be expected to be right-skewed (i.e., indicative of evidential value). Under a true effect, low *p*-values (e.g., 0.01) are more likely than high, "just-significant" *p*-values (e.g., 0.04). That holds regardless of the level of statistical power. Using *p*-curve analysis, the degree of right skew can be used to test whether selective reporting can be ruled out as the sole explanation of the observed findings (Simonsohn, Nelson, & Simmons, 2014b). As shown in Figure 1, the distribution of significant *p*-values has a strong left skew. Such a distributional shape is expected *only* under widespread selective reporting in primary studies or strong publication bias. The *p*-curve analysis indicated that the set of significant replication effects lacks evidential value, $z = 2.79$, $p = 0.997$. The direct replications of those seven successful replications are thus not expected to find an effect.

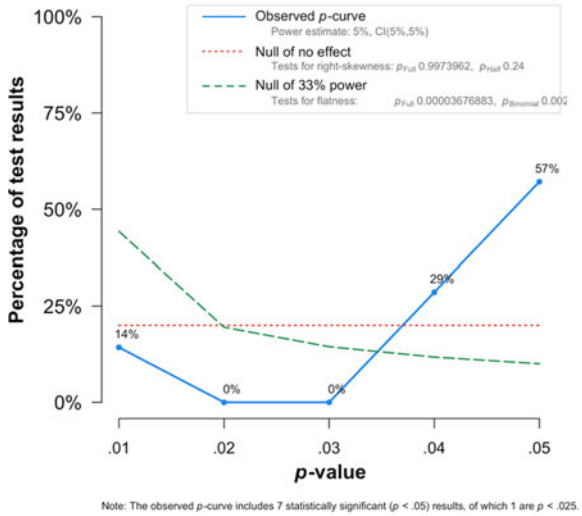

Figure 1. (Ropovik et al.) Distribution of *p*-values from the successful replications of cleansing effects.

We also assessed the chance of conducting 22 independent replication studies and finding seven significant effects yielding the observed or more deviant pattern of *p*-values (median *p*-value closer to 0.05 or greater left skew). To do so, we carried out a Monte Carlo simulation, systematically varying the effect size from $d = 0.1$ to 0.6 in steps of 0.1, fully crossed with the set of sample sizes employed in the given replication designs (from 28 to 727). We simulated 10,000 sets of 22 replication studies for each combination of effect size and *N*. Then, we calculated the cumulative probability of observing seven or more significant effects for which the median *p*-value was the same or higher than the median of the observed *p*-value distribution ($Mdn_p = 0.04$). In the simulation, the probability of observing such a pattern of high, significant *p*-values was only 0.00015. Based on 10^7 simulations, this pattern was unlikely *even* under the null hypothesis, with a probability of 0.0000017 (about 2 in a million). The probabilities of observing a set of significant *p*-values with the same or higher degree of left skew were even an order of magnitude smaller (see our OSF page). There were also other issues in four out of seven of the successfully replicated effects, like the undisclosed use of a one-tailed test and multiple testing without proper control of the error rate, rendering the chance that cleansing effects are replicable as even less likely.

Are cleansing effects real? We don't know. L&S tried to unravel the purportedly contradicting results of replication studies using a meta-analysis, which did include a majority of successful replications (9 out of 17). They described finding an overall effect more generally and an effect for successful replications in particular, even after accounting for publication bias. Their analytic approach is, however, expected to yield an underlying cleansing effect even if none exists. Both of their bias-tackling workhorses, fail-safe *N* and trim-and-fill are known to rest on untenable assumptions and are long considered outdated (see Becker, 2005b; Ferguson & Heene, 2012; Stanley & Doucouliagos, 2014). Their third method, the examination of the normal-quantile plot, is neither a formal bias detection nor bias correction technique. Simulations show that under publication bias, the false-positive rate of the methods used by L&S approaches 100% with the increasing number of included effects (Carter, Schönbrodt, Gervais, & Hilgard, 2019). Selective reporting for which we have found indications then further amplifies the effect of publication bias (Friese & Frankenbach, 2019). The analytic workflow employed by L&S thus makes the cleansing effects hardly falsifiable. To examine one of the possible causes for the lack of evidence, we gathered information concerning the validity of measurement (i.e., whether previous validation was obtained or not, whether factor structure was examined either in the study itself or in an independent validation study, and whether any evidence of construct validity existed) for the 23 effects included by L&S. For the focal variables, we were not able to find *any* evidence of validity, with only a single article reporting Cronbach's alphas.

To justify a need for an explanation, the literature on cleansing effects needs to be subjected to a more severe test first. A quantitative synthesis should examine patterns consistent with selective reporting and the integrity of the statistics reported in primary studies by looking for inconsistencies. Publication bias tests should not be relied upon – they address a hypothesis that is known to be false (Morey, 2013). State-of-the-art correction methods such as the regression-based (Stanley & Doucouliagos, 2014) and especially the multiple-parameter selection models (McShane, Böckenholt, & Hansen, 2016) should be employed by default. The specific implementation of bias-correction depends on the analytical context, but for an example of such a workflow, see IJzerman et al. (2020) and Sparacio et al. (2021).

Short of solid evidence, we recommend that the research program on cleansing effects proceeds by establishing explananda prior to explanations. The first stage in establishing explananda, we feel, is developing reliable tools to measure and manipulate.

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The role of meta-analysis and preregistration in assessing the evidence for cleansing effects

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Abstract

Lee and Schwarz interpret meta-analytic research and replication studies as providing evidence for the robustness of cleansing effects. We argue that the currently available evidence is unconvincing because (a) publication bias and the opportunistic use of researcher degrees of freedom appear to have inflated meta-analytic effect size estimates, and (b) preregistered replications failed to find any evidence of cleansing effects.

Lee and Schwarz (L&S) present a "theory of grounded procedures" that aims to account for empirical findings relating to cleansing and other physical actions (henceforth "cleansing effects"). In sect. 1.2, they report two forms of evidence that they argue indicate that cleansing effects are robust: (a) meta-analytic research and (b) replication studies. Although we applaud their consideration of robustness issues, we argue that they have not provided convincing evidence for the existence of cleansing effects.

L&S summarize the results of meta-analysis (currently unpublished and data unavailable) of experimental studies of cleansing effects (Lee, Chen, Ma, & Hoang, 2020a) that estimates the overall effect size to be "in the small-to-medium range and highly significant" (sect. 1.2., para. 2). Moreover, they claim that converging evidence from fail-safe *n*, trim-and-fill, and normal quantile plots shows that "publication bias alone was unlikely to account for the existence of cleansing effects" (sect. 1.2, para. 2). However, we agree with Ropovik et al. (this treatment) that this conclusion is unwarranted because these bias detection methods rely on untestable assumptions and have been superseded by more sophisticated methods. In addition, we note that these methods are particularly inappropriate for assessing this literature because, as L&S note, effect sizes are "highly heterogeneous" (sect. 1.2, para. 2). Fail-safe *n* does not take heterogeneity in effect sizes into account at all (Iyengar & Greenhouse, 1988), whereas trim-and-fill provides misleading results when heterogeneity is present (Peters, Sutton, Jones, Abrams, & Rushton, 2007; Terrin, Schmid, Lau, & Olkin, 2003). Removing large positive effects identified in a normal quantile plot is also inappropriate because these large effects may be genuine if the studies are heterogeneous. Consequently, we encourage Lee and colleagues to re-examine the evidence for publication bias in their upcoming meta-analysis using state-of-the-art methods such as Bayesian fill-in meta-analysis (Du, Liu, & Wang, 2017), PET-PEESE (Stanley & Doucouliagos, 2014), and *p*-uniform* (van Aert & van Assen, 2020).

Another serious concern is that the *p*-curve analysis conducted by Ropovik et al. (this treatment) indicates that the statistically significant replication effects reported in the target article contain no evidential value and that the large proportion of *p*-values just below 0.05 may have been caused by the opportunistic use of researcher degrees of freedom (Simonsohn, Nelson, & Simmons, 2014a).

We argue that the evaluation of evidence for cleansing effects should be largely focused on preregistered studies. Preregistration is an effective approach for restricting researcher degrees of freedom and, thus, has an important role to play in resolving the replication crisis in psychology (Lakens, 2019; Nosek, Ebersole, DeHaven, & Mellor, 2018). Among other things, a high-quality preregistration includes a specification of a target sample size that prevents optional stopping, a description of primary and secondary outcomes that prevents outcome switching, and an analysis plan that constrains the use of other researcher degrees of freedom (Bakker et al., 2020; Wicherts et al., 2016). By contrast, meta-analytic methods that aim to correct for biases necessarily rely on untestable assumptions about the processes that generate biases and the magnitudes of these biases, which means we cannot be confident that biases have been corrected (Carter, Schonbrodt, Gervais, & Hilgard, 2019). In other words, meta-analysis is no substitute for preregistered replications (van Elk et al., 2015).

We identified 22 replication studies (that reported results) in the target article and found that only four of them (from two publications) were preregistered (Camerer et al., 2018; Johnson, Cheung, & Donnellan, 2014b; see https://osf.io/7ehr8). Notably, each of these preregistered studies had much larger samples ($N = 219$, $N = 132$, $N = 123$, and $N = 286$) than the studies they attempted to replicate (all $N = 40$) (Lee & Schwarz, 2010a; Schnall, Benton, & Harvey, 2008) and none of them found any evidence for the cleansing effects reported in the original studies. In fact, in all four studies the point-estimate for the effect size was very close to zero ($d = -0.01$, $d = 0.01$, $r = -0.07$, and $r = -0.05$). In addition, we have identified a large multisite replication project ($N = 7{,}001$) not cited by L&S that included a test of a cleansing effect (Klein et al., 2018). This study attempted to replicate Study 2 of Zhong and Liljenquist (2006) ($N = 27$) across 50 sites and found no evidence for the predicted effect ($d = 0.00$). This fits a general pattern in the psychology literature: preregistered replication studies fail to replicate at a much higher rate than one would expect given the large effect sizes reported in original studies (Camerer et al., 2018; Open Science Collaboration, 2015), including for effects that had been supported by meta-analyses of studies that were not preregistered (Kvarven, Stromland, & Johannesson, 2020).

Because researcher degrees of freedom are curtailed in preregistered studies (if not entirely absent, see Bakker et al., 2020; Claesen, Gomes, Tuerlinckx, & Vanpaemel, 2020) we suggest that Lee and colleagues could enhance the informativeness

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of their upcoming meta-analysis of cleansing effects by supplementing it with a targeted meta-analysis that includes only those studies that were preregistered. Finding meta-analytic evidence for cleansing effects in preregistered studies would considerably strengthen the case for cleansing effects being robust phenomena, whereas a failure to find evidence would be cause for concern. A meta-analysis of the money priming effect provides an interesting example of the extent to which results can diverge (Lodder, Ong, Grasman, & Wicherts, 2019). The full meta-analysis of 246 money priming studies estimated an overall effect size of small to medium magnitude ($g = 0.31$; see Fig. 1 (top-left plot), p. 701). By contrast, the targeted meta-analysis of the 47 preregistered studies found an average effect size that was non-significant ($g = 0.01$; see Fig. 1 (middle-right plot), p. 701).

In summary, we have argued that a scientific assessment of the evidence for cleansing effects requires the application of state-of-the-art publication bias methods and a meta-analysis of preregistered studies. As things stand, the empirical foundation for the theory of grounded procedures is tenuous.

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Grounding together: Shared reality and cleansing practices

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Abstract

We propose that cleansing behaviors and other acts of separation or connection have more powerful effects when they are grounded in *shared practices* – in a shared reality. We conceptualize sensorimotor and shared reality effects as synergistic. Most potent should be physical behaviors performed collectively as a shared practice (e.g., communal bathing), grounded both in sensorimotor experience and in shared reality.

In their paper, Lee and Schwarz identify grounded procedures of separation as a critical mechanism underlying the effects of cleansing behaviors. By physically distancing themselves from unwanted dirt and germs, people psychologically distance themselves from recent events. Cleansing manipulations and other forms of separation (or connection) that more directly engage sensorimotor capacities produce stronger effects.

In this paper, we leverage shared reality theory to provide a complementary perspective on cleansing behaviors and other

forms of separation and connection. We propose that the extent to which particular behaviors are grounded in sensorimotor experience cannot fully account for the variance in their effects. For example, a given physical cleansing behavior – splashing water on a child's head – can have very different effects depending on the socially shared construal of the situation: the exact same cleansing behavior conducted by a priest during a baptism will be experienced as far more purifying than that conducted by a parent in the tub. The sensorimotor experience alone cannot explain the difference in the power of these identical cleansing behaviors. We propose that acts of cleansing and other acts of separation and connection have more powerful effects when they are grounded in *shared practices* – in a shared reality.

Humans engage in a variety of shared practices from a very young age. They learn to talk, eat, dress, and behave like others – they are taught "how we do things" (see Higgins, 2016 for a review). Many of these shared practices revolve specifically around cleansing. Children are taught particular bathing and toilet routines, depending on the culture they grow up in (Higgins, 2016; Rogoff, 2003). Collective cleansing rituals abound, from preparation for the Chinese Lunar New Year to Thailand's Songkran festival, in which people cleanse themselves and their homes. Bathing is often performed communally in various countries (e.g., Japan, Morocco, and Sweden) and has been for much of history (e.g., Roman bathhouses). Even private rituals performed alone – tooth-brushing, washing clothes, shaving, and so on – are shared societal practices learned through interactions with others.

We argue that the power of these cleansing practices stems from more than just their physical movements and sensations. It also stems from shared reality – the perceived commonality with others of feelings, beliefs and concerns (inner states) about something (Echterhoff, Higgins, & Levine, 2009; Hardin & Higgins, 1996). Research has shown that the experience of shared reality predicts certainty (Rossignac-Milon, Bolger, Zee, Boothby, & Higgins, 2020); for example, conversation partners discussing ambiguous images who create a greater sense of shared reality feel more certain of what is *truly* going on in the images. We propose that cleansing behaviors rooted in shared practices feel *truly* clean, because people believe they clean in the *right* way (Higgins, Nakkawita, Rossignac-Milon, Pinelli, & Jun, 2020). For example, people colloquially express the belief that their shared cultural practices surrounding toilet routines are cleaner than those of other countries (e.g., people raised to use toilet paper believe that toilet paper is superior to bidets, and vice versa).

The importance of social construction in the experience of cleansing is exemplified in the fact that many acts of cleansing do not involve physical acts of separation. For example, burning incense, which does not involve physical separation, is often considered to purify and cleanse the air. Thus, sensorimotor actions alone cannot fully explain the psychological effects of cleansing behaviors. The power of these behaviors also stems from the fact that people have a shared reality about them. In other words, it is the shared reality that makes baptism purifying and not the physical act of splashing water.

We propose that acts of cleansing that are grounded in a shared reality should produce stronger effects, such that cleansing behaviors should be more powerful if people see these behaviors as shared practices. For example, the most powerful types of cleansing behaviors should involve collective rituals simultaneously performed with others (e.g., collective bathing). Partaking in this cleansing ritual with others who share the same inner states about the cleansing should amplify its effects. Less powerful should be societally shared cleansing practices performed alone (e.g., bathing alone), and least powerful should be idiosyncratic cleansing behaviors performed alone that are not experienced as a shared practice.

We conceptualize sensorimotor grounding and shared reality not as additive, but as synergistic effects – each should amplify the effects of each other. For example, sensory experiences are amplified when experienced with others (Boothby, Clark, & Bargh, 2014; Boothby, Smith, Clark, & Bargh, 2016). Thus, engaging in a cleansing behavior with other people should make the sensorimotor experience even more engaging, further grounding the act of separation in the physical world. Similarly, engaging in a sensorimotor (vs. imaginary) practice should amplify the effects of shared reality: for example, research suggests that physical coordination (e.g., moving in synchrony) promotes social connection and shared cognition (Marsh, Richardson, & Schmidt, 2009; Semin & Smith, 2013). Thus, physically engaging in the shared practice together should amplify the effects of shared reality. In this way, shared reality should intensify the effects of sensorimotor behaviors, and vice versa. The synergy between these is exemplified by the fact that developmentally, children acquire shared practices during the same stage that they experience major sensorimotor development – in fact, one of the first acts of shared reality is protodeclarative pointing, which is a motor movement (Higgins, 2016).

In sum, we propose that cleansing behaviors and other acts of separation are procedures grounded not only in sensorimotor experience, but also in shared reality. We conceptualize these effects as synergistic, such that each amplifies the effects of the other. Given this synergism, physical acts of separation (and connection) performed *together* as a shared practice – acts grounded in both sensorimotor experience and shared reality – should be most potent.

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Body ownership as a proxy for individual and social separation and connection

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Abstract

Lee and Schwartz procedures of separation offer a much needed interpretation of the literature on moral cleansing. However, body ownership as a grounded mechanism of separation and connection has been neglected. We argue that embodiment may be employed to connect the self to desirable aspects of cognitive and emotional interactions and disembodiment to disconnect from undesirable elements.

In their target article, Lee and Schwartz (L&S) propose a novel interpretation of cleansing behaviors, arguing that the act of self-cleansing can be used as a physical representation of the psychological separation of the self from something perceived as negative. The authors provide a comprehensive and parsimonious take on the matter that can help interpret the implications of cleansing behaviors beyond the areas of morality and disgust. However, we note that the authors examine "procedures of separation" and "connection," but somewhat neglect potentially important grounded mechanisms for separating or connecting. Here we focus on one of the pillars of corporeal awareness, namely, body ownership: one's perception of the body, or parts of it, as belonging to the self (Giummarra, Gibson, Georgiou-Karistianis, & Bradshaw, 2008). We will consider the possible use of body ownership as a means of distancing oneself from undesirable aspects of a given situation or associating with desirable ones.

An individual's sense of body ownership may be wrongly thought a stable trait. However, it is actually a highly moldable representation. At any given moment, one's identification with the body is determined by the continuous integration of signals from multiple sensory modalities (Blanke, 2012) with a top-down representation of the body (Monti, Porciello, Tieri, & Aglioti, 2020). These processes are not only fundamental to building and maintaining corporeal awareness, but are also responsible for the malleability of bodily self and how objects (Berlucchi & Aglioti, 1997), faces (Porciello, Bufalari, Minio-Paluello, di Pace, & Aglioti, 2018), limbs (Botvinick & Cohen, 1998), and virtual agents (Slater, Perez-Marcos, Ehrsson, & Sanchez-Vives, 2009) are incorporated into it. Crucially, transient changes in our representation of the body can alter how we perceive (Banakou, Groten, & Slater, 2013) and emotionally react (Guterstam, Abdulkarim, & Ehrsson, 2015) to the world. Changes of body representations can even shape our attitudes toward (Gonzalez-Liencres et al., 2020; Maister, Slater, Sanchez-Vives, & Tsakiris, 2015; Peck, Seinfeld, Aglioti, & Slater, 2013) and interactions with, those around us (Yee, Bailenson, & Ducheneaut, 2009). Given the intrinsically plastic nature of body ownership and its effect on subjective experiences, we argue that variations in the strength of body ownership may induce feelings of connectedness and disconnectedness. More specifically, we suggest that a lower sense of body ownership may produce a sense of disconnection and therefore serve as a means of distancing the self from negative events and reducing their impact on the individual. Conversely, enhanced embodiment, as in the case of incorporation of external entities, may favor association with desirable characteristics.

The valence- and domain-related rules developed by L&S to examine self-cleansing as a psychological strategy can be applied to variations in the sense of body ownership. Events occurring before and after alterations in the strength of body ownership, that is, their antecedents and consequences, seem to follow the same pattern as that observed for self-cleansing behaviors. The consequences of low embodiment seem to be valence-general, as there are dampened physiological responses to both negative and positive stimuli (Fusaro, Tieri, & Aglioti, 2016). Additionally, the same domain-general principle observed for the consequences of cleansing, which can pertain to different psychological domains (e.g., morality, post-decisional dissonance, and previous good/bad luck), seems to apply also to body ownership. Indeed, the consequences of low embodiment have been observed in a variety of situations and include lower self-reports of negative emotions (Bourdin, Barberia, Oliva, & Slater, 2017; Hofer, Hüsser, & Prabhu, 2017), diminished pain sensitivity (Martini, Kilteni, Maselli, & Sanchez-Vives, 2015), and lower physiological responses to threats (Tieri, Tidoni, Pavone, & Aglioti, 2015). Interestingly, the opposite pattern is seen when people experience strong ownership feelings toward entities or bodies that they perceive as negative. In such instances, greater embodiment is associated with more self-reported negative emotions and a tendency to engage in subsequent reparation behaviors, such as apologizing (as a means of separating oneself from the offensive behavior) (Aymerich-Franch, Kishore, & Slater, 2020; Provenzano et al., 2020).

When considering antecedents of body ownership, the evidence seems to support the valence-asymmetry principle (i.e., negative or positive events trigger the motivation to separate or connect, respectively). Lower embodiment is seen following negative outcomes, as in the case of observed motor errors (Pezzetta, Nicolardi, Tidoni, & Aglioti, 2018), whereas positive features of external objects (Berlucchi & Aglioti, 1997; Porciello et al., 2018) are often incorporated into an extended body schema (Aglioti, Smania, Manfredi, & Berlucchi, 1996). The perception of positive features in others can lead to illusory incorporation of their face into the mental representation of one's own face (Porciello et al., 2018). Tellingly, such enfacement illusions are stronger when the other person is considered nice (Bufalari, Lenggenhager, Porciello, Holmes, & Aglioti, 2014) or physically attractive (Paladino, Mazzurega, Pavani, & Schubert, 2010; Sforza, Bufalari, Haggard, & Aglioti, 2010), or expresses positive emotions (e.g., happiness) (Ma, Sellaro, Lippelt, & Hommel, 2016).

In this regard, body integrity identity disorder is an interesting clinical condition characterized by the non-acceptance of one's own limb(s) and the consequent desire for amputation (Brugger, Lenggenhager, & Giummarra, 2013). Whether the

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negative feelings are the *antecedents* of low body ownership in this condition or the negative feelings are the *consequence* of low body ownership is not clear. We believe that future studies on the treatment of this condition could determine the causal relationship between valence and body ownership, verifying whether enhancing positive feelings toward the body (or parts thereof) enhances embodiment or vice versa.

We propose that sense of body ownership can be included as a procedure of separation and connection, as defined by L&S. Body ownership demonstrably influences one's subjective experience of the world by shrinking or enlarging the perception of one's corporeal self. Further research on whether short and long-term changes in the sense of body ownership modulate its separation and connection power will be pivotal to understanding the potentially plastic nature of grounded procedures.

Highlighting the role of body ownership as a proxy for separation or connection is particularly relevant in contemporary society, where technological advances enable projection of the self into artificial bodies (e.g., robots and avatars). It is possible that, in the not-so-distant future, physical and social interactions will become more disembodied than ever, yet the psychological link between humans and their surrogates will still be deeply influenced by the ever-changing dynamics of corporeal awareness.

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Cleansing and separation procedures reflect resource concerns

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Abstract

We propose that procedures of separation have two functions, namely first, to establish the integrity of individual parts, and second, to make previously joint entities discreet and therefore countable. This allows taking stock of available resources, including evaluating the use of individual objects, a process that is especially adaptive under conditions of threat of contagious disease and resource scarcity.

Lee and Schwarz (L&S) outline a comprehensive model of how cleansing and other grounded procedures serve a common

purpose, namely to achieve a sense of separation. A key question, however, is *why* people aim to keep objects physically or psychologically separate from other entities. In other words, what is the benefit of doing so? One possibility is that such actions allow individuals to more easily keep track of what is important to them. Indeed, Schnall (2017) proposed that disgust can be considered to form part of a behavioral loss aversion system, with a conservation concern aimed at maximizing available resources. Physical cleansing serves to ensure the integrity of one's most precious commodity: a healthy body. It not only removes contaminants, but also facilitates a more general assessment of one's physical health. Taking such an inventory does not require disgust, however; the latter only arises when a threat to resources is perceived.

A key requirement to meeting this goal is to know where the relevant boundaries are, or, as the anthropologist Mary Douglas (1966) put it, to establish what is "matter out of place" (see also Duschinsky, Schnall, & Weiss, 2017). Implicit in this understanding is the metaphor of the body as a container (Schnall, 2014), which involves a differentiation between what is "inside" and "outside," and the boundaries arising from this distinction. Physical cleansing and separation facilitate a clearer appreciation of such boundaries, and establish the integrity of individual parts. Importantly, making previously joint entities identifiable also makes them countable, and the process of taking stock of material resources enables one to evaluate the use of individual objects. Indeed, it has been proposed that the number sense, that is, the ability to intuitively understand changes in quantities, is the result of a domain-specific cognitive mechanism that is already present in young infants (Wynn, 1998), and in a rudimentary form exists even in animals (Gallistel & Gelman, 2000). Thus, grounded procedures readily make apparent everything that counts.

To outline this logic, we consider a psychological condition for which excessive cleanliness coincides with a desire for keeping the environment orderly: obsessive-compulsive disorder (OCD). Although engaging in repetitive cleansing such as handwashing is typically thought of as the most prominent feature of the disorder, it often also involves a compulsion for counting (i.e., arithmomania) (American Psychiatric Association, 2013). For example, this can manifest itself in counting the bricks in a wall, or not wanting to step outside of tiles on the floor during walking. The obsession with counting can be seen as an amplified expression of grounded procedures of separation, involving a fixation not only on cleanliness, but also on quantities of material objects. Thus, it is plausible that one goal behind separation procedures is to provide assurance that one has what one needs, and for some people this is a constantly salient worry.

Also relevant in this context is OCD's close cousin, namely obsessive-compulsive personality disorder (OCPD). It not only involves a desire for cleanliness, but also a preoccupation with details, orderliness, cognitive rigidity, and miserliness – an inability to discard objects and a reluctance to spend money (American Psychiatric Association, 2013). In particular, cognitive rigidity, or the unwillingness to compromise, and the aversion to discard resources, is an example of the overlap between mental representations and sensorimotor modalities. That is, individuals with OCPD are reluctant to relinquish their beliefs as well as their belongings. Furthermore, they are precise with respect to how items are organized, such as the exact arranging of furniture, precise positioning of cushions, preference for set locations for belongings, distaste for untidy rooms, and care with their clothes (Wellen et al., 2007). Such tidiness and particularity with the positioning of one's possessions suggest that this condition may be a extreme expression of the grounded procedures L&S describe.

Many psychiatric conditions fall on the extreme end of a continuum of thoughts and behaviors that, in moderation, are typically adaptive. Indeed, people often find it hard to give them up because such symptoms can come with undeniable benefits. For example, although OCPD is often debilitating with regard to personal relationships, it can be advantageous for career success: OCPD was found to be positively correlated with status and wealth, as measured by socioeconomic status, supervisory responsibilities at work, home ownership, and spacious living conditions (Ullrich, Farrington, & Coid, 2007). This may be because of the fact that individuals with OCPD show less temporal discounting than those without the condition – that is, they are superior at running the cost–benefit analyses that leaves them better-off in the long run (Pinto, Steinglass, Greene, Weber, & Simpson, 2014).

Keeping track of what one owns has clear benefits in general, but it is especially useful in times of scarcity or crisis, and when preparing for possible adversity. For example, highly successful navy submarine personnel were found to score highly on OCPD measures and adherence to rules and regulations (Moes, Lall, & Johnson, 1996). Indeed, grounded procedures are essential in the military, where every item is carefully inventoried and tracked: there is no room for error in assessing equipment when lives are literally at stake.

Grounded procedures involving resource concerns, whether expressed in normal or exaggerated forms, are especially adaptive under conditions of widespread contagious disease, as is the case for the current COVID-19 pandemic. When individuals need to stay away from others who pose a risk of infection, social relationships no longer constitute a source of support. In the early days of the pandemic, stockpiling supplies was maligned in the media as "panic buying." But accumulating materials goods, and monitoring their use and availability, are adaptive when there is a constant threat to one's health. Indeed, in uncertain times it is sensible to run a life's inventory, and ensure that all that is precious is in its rightful place.

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Proper understanding of grounded procedures of separation needs a dual inheritance approach

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Abstract

Grounded procedures of separation are conceptualized as a learned concept. The simultaneous cultural universality of the general idea and immense diversity of its implementations might be better understood through the lens of dual inheritance theories. By drawing on examples from developmental psychology and emotion theorizing, we argue that an innate blueprint might underlie learned implementations of cleansing that vary widely.

The central concept in Lee and Schwarz's (L&S's) model is *grounded procedures of separation*. These are argued to link sensorimotor processes to cognitive processes, specifically physical cleansing to mental dissociation. The concept has to do some heavy lifting to piece together various phenomena: It is more or less explicitly argued to be culturally universal. It is thought to be activated by the emotion of disgust, by engaging in actual cleansing without prior disgust, and even by only remotely associated behavior such as enclosing a note in an envelope. Bafflingly, many behaviors cited as implementing separation through cleansing are either pretend (participants hands are clean to begin with), or are even confounded with the opposite of separation, namely application (e.g., hand sanitizer) or outright contamination (e.g., burning incense). Clearly, learning is required here. Asking a concept to do such heavy lifting requires empirical and theoretical conscientiousness.

Empirically, the integration would benefit tremendously from evidence that the described experimental manipulations do in fact activate mental procedures of separation independently from the downstream consequences (i.e., manipulation checks). Those do not seem to be common in the cited studies.

Theoretically, paying more attention to how the concept of separation is developed ontogenetically will provide a more solid basis for the simultaneous universality and flexibility. The notions of grounding and simulation as used in the target article are based on Barsalou (1999). This seminal paper also theorized how perceptual symbols, the basis for simulations, develop in the first place. Barsalou focused on how these symbols are learned in a process of selective attention and subsequent storing of schematic sensory-motor states in long-term memory. That is presumably also the process assumed by L&S. Repeated experience of physical cleansing is schematized in a separation procedure concept. This concept is also subsequently evoked during mental dissociation (e.g., of the self from failure). The universality of that process might be explained by the fact that all humans have experience cleaning themselve, but that doesn't explain the rich variation on the theme.

However, Barsalou (1999) also noted that the learning process is likely to be influenced by genetic predispositions, for example through constraining the processing of space, objects, movement, and emotion. In his view, "a simulator is both a 'rational' and an 'empirical' system, reflecting intertwined genetic and experiential histories" (p. 586). Such intertwining of genetic and experiential determination is compatible with assumptions of dual inheritance approaches that argue that human biology and culture co-evolve and jointly determine behavior (Boyd, 2017; Boyd & Richerson, 1985; Fiske, 2000; Henrich, 2016). The costs of learning are outweighed by the benefits of acquiring accumulated and locally adaptive knowledge.

Simultaneous universality of basic principles and variability of actual implementations also occurs in phenomena that are already studied from a dual inheritance approach, namely core cognition concepts in developmental psychology and emotion research.

In developmental psychology, the core cognition approach argues that infants' learning is guided by a stock of innate primitives that include conceptual representations (Carey, 2009; Spelke, 2017). This includes basic cognitive concepts (e.g., magnitude and agency) and social concepts (e.g., authority and equality; Sheehy-Skeffington & Thomsen, 2020; Thomsen, Frankenhuis, Ingold-Smith, & Carey, 2011): Although large and up imply power universally in general, exactly what needs to be large and up is learned from culture (Schubert, 2020). Interestingly, the approach assumes that these core concepts are combined (Spelke, 2017) or complemented by culturally driven learning (Carey, 2009). The primitives are assumed to mostly remain active and constant throughout the lifespan, and can surface in adults when higher cognitive processes are taxed by mental load. This approach has concentrated on perception and cognition but could easily be extended to include behavioral output to accommodate procedures such as separation.

In emotion psychology, recent theorizing argues that emotions can be understood as combinations of innate functions that map appraisals onto motivations on the one hand, and culturally learned implementations on the other hand (Fiske, 2020; Fiske, Seibt, & Schubert, 2019). Both have to be learned in context, but their learning is directed by innate blueprints, explaining simultaneous universality and variation of such emotions (Zickfeld et al., 2019).

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In sum, parallel developments in various fields suggest that innate blueprints may underlie the acquisition of concepts that regulate social relations and guide emotional processes. Understanding procedures of separation may also benefit from incorporating dual inheritance. Here is how: First, acknowledging a dual inheritance of human behavior explains both the cultural universality of the general concept of separation and the incredible diversity of its triggers, ranging from washing-off to purifying through smoke. Second, it may well be that the involvement of the innate blueprint differs among the provided examples. It may be particularly prominent in the avoidance response provided by the disgust reactions, and much more incidental in purification by smoke. Third, dual inheritance theory may be key to understanding how the physical procedure of cleansing the body from visible contaminants can facilitate separating the self from associated mental concepts (e.g., a personality trait or a specific social group). As Fiske (2000) pointed out, innate cognitive developmental proclivities would be most successful when they were generative rather than specialized to limited contexts. The grounded procedures of separation versus connection do not only occur in cleansing effects and the cited sympathetic magic effects of contagion. They also manifest in more complex scenarios such as tracking and establishing social alliances or communal relations through bodily markers (Fiske, 2004; Kurzban, Tooby, & Cosmides, 2001). Their adaptive value is immense. Such applications of separation versus connection may be intermediate steps to more remote applications such as separating from an abstract concept like bad luck.

A dual inheritance approach to separation procedures would also generate new predictions about developmental trajectory, cultural differences, language dependence, working memory dependence, and malleability. Finally, considering the evolutionary basis of our phenomena along with their cultural evolution is crucial to establish a cumulative and coherent science, especially in fields such as social cognition that have largely used insulated theories that lack integration into larger frameworks (Muthukrishna & Henrich, 2019).

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A not-so proximate account of cleansing behavior

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Abstract

In this commentary we outline perceptual control theory and suggest this as a fruitful way for Lee and Schwarz (L&S) to fully embody their account of cleansing behavior. Moreover, we take issue with the command control approach that L&S have taken seeing this as an unnecessary cognitive commitment within an embodied model of cleansing behavior.

Lee and Schwartz (L&S) explain the relationship between cleansing behaviors and psychological variables using a grounded procedures approach (GPA). According to L&S, the conceptual underpinning of GPA approaches an embodied cognition view of sensorimotor processing such that there is an increasingly distanced hierarchy of engagement from direct online activation through to partially offline semantic activation. GPA is procedural because L&S link grounding, via context dependence, to a range of possible objectives all of which can change context. They focus upon a particular class of procedure, that of separation, which includes separating dirt from one's hands, leading to the elimination or attenuation of the separated entity.

Implicit within L&S's account is the notion of "command control" delivering separating behaviors as an output. The output behavior is functionally categorized as cleansing but the proximate details of the accomplishment of this task are left unexplained. To be an embodied thesis those details should be fully grounded in neural and sensorimotor mechanisms that explain the connection between the perception of something and behavior. We propose perceptual control theory (PCT) as a framework to address this gap in L&S's thesis (Marken & Mansell, 2013; Powers, 1973a). In its simplest form PCT eschews the view of behavior as a final output, instead seeing behavior as a form of control. PCT sees perception and behavior as a closed-loop system of negative feedback: behavior constantly

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adjusts against environmental disturbances to controlled variables that are specified by internal reference states. A hierarchy of increasingly abstract properties of perception specifies reference states for lower level control loops.

Mansell and Marken (2015) give the example of a puff of air to an eyeball causing a blinking response. This is usually understood as a reflex – a classic input–output (I–O) system. PCT focuses upon what is being controlled: the moisture level of the eye's surface. The air introduces a disturbance to a goal-state (optimal moisture level) and the behavior acts to maintain the perception of that state. Goal specification is internal to the system. In standard I–O paradigms goal specifications are rendered as external behavioral change. For example, in a button press task to ascertain whether a participant has noted a perceptual change on a screen, screen change is the input and the button being depressed is the behavioral difference. For PCT, this is an incomplete account that omits control of the internal perception of the screen. The button press returns the screen to its "resting state," which is the internal goal-specification: perceptual constancy has been restored.

Separation behavior is complex. Washing something away down a drain should be seen as control of an intrinsic goal of perceived cleanliness. That goal can be acquired through learning or evolutionary processes. PCT would split the perception of separation into a hierarchical arrangement of control loops because controlling cleanliness involves other purposes, each with a preferred goal, including positioning oneself in front of a basin, reaching and grasping then turning a tap to have a required pressure and temperature of water and so on. All motor actions are associated with controlled perceptions. The outcome of each action affects perception and will or will not shift perception toward a goal state to achieve homeostasis. At each level, the goal state for a particular kind of perception is compared with perceived input and any discrepancy (error signal) leads to further behavioral adjustments. It is highly likely that within a complex behavior, such as separation, there will be influence between subordinate loops.

It is discrepancy inside the system that converts into output (Powers, 1973a; 2008). What we observe as behavior is a set of immediate – not sequential – effects altering the immediate environment of the system against disturbances that push sensory input away from a preferred reference value; there is, *pace* (Marken, 2009, p. 139), a simultaneous cause–effect loop where variations in perceptions (input) are causing variations in behavior (output) at the same time as variations in output are causing variations in input. Controlling for a higher order abstract self-perception, of the kind L&S describe, requires the accomplishment of simultaneous perceptual control throughout the lower levels of the hierarchy all the way up (Powers, 1973a; 2008). Thus, L&S's account is not sufficiently proximate and requires an articulation of functional dependencies in the hierarchy of perceptual control.

Methodologically, L&S propose finding relationships between representations in the mind of the participant and categories of separation behavior defined by the experimenter. Following Skinner's comments on methodological behaviorism we note, pace (Powers, 1973b), that simply recording stimulus–response (S–R) relationships in the laboratory will not reveal information about any internal cognitive structure. Cognitive psychologists have nonetheless adopted a form of S–R method and derived intentional hypotheses from purely extensional data (Day, 1983). Skinner's radical behaviorism and the antecedent-behavior-consequence model are not unrelated to PCT concerns and we could readily package the consequence as restoration of perceptual equilibrium, the gaining of control. In PCT, the I–O relationship does not reveal the internal properties of the system producing the output, instead, it reflects the environmental feedback function that connects output to controlled input: the quantity of output the participant's control system must produce to bring her perceptions to match an internal reference state.

More generally, PCT claims that the standard I–O approach of cognitive psychology gives the misleading impression that the input caused changes in the output, whereas in fact behavior is one part of a closed loop (Marken, 2009; Powers, 1973b). As a closed-loop explanation of behavior PCT requires a different kind of test – the test for a controlled variable (Powers, 1978). Mansell and Carey (2015) suggest the experimenter alter disturbances to a controlled variable in an environment that allows participants to perceive the consequences of their actions relevant to their goals with the important caveat that through making measurements, new disturbances are not introduced to the controlled variable. We believe this would be a useful experimental paradigm for L&S to pursue, enabling them to remove their assumption of a cognitive link between input and output and to fully ground and embody their approach in perceptual process.

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Considerations of the proximate mechanisms and ultimate functions of disgust will improve our understanding of cleansing effects

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Abstract

To understand the consequences of cleansing, Lee and Schwarz favor a grounded procedures perspective over recently developed disgust theory. We believe that this position stems from three errors: (1) interpreting cleansing effects as broader than they are; (2) not detailing the proximate mechanisms underlying disgust; and (3) not detailing adaptive function versus system byproducts when developing the grounded procedures perspective.

Lee and Schwarz (L&S) argue that recent developments in the science of disgust are unable to explain the consequences of cleansing, which putatively range from decreased condemnation of people who eat their dead pets (Schnall, Benton, & Harvey, 2008) to increased risk taking (Xu, Zwick, & Schwarz, 2012). This conclusion is premature, partially because of limitations in the empirical evidence presented by L&S. For example, the unpublished meta-analysis of cleansing effects described in the target article relies upon trim-and-fill and fail-safe *N* to correct for publication bias. Given that these methods can drastically inflate type-I error rates (Becker, 2005a; Carter, Schönbrodt, Gervais, & Hilgard, 2019), we are skeptical that the broad "domain general" effects of cleansing that motivated the grounded procedures proposal exist.

Nevertheless, cleansing surely has *some* consequences, such as increasing comfort with eating with one's hands, especially if they were recently soiled. Although such consequences might seem too obvious to require either investigation or explanation, simplicity of felt experience and alignment with intuition often belie the complexity of underlying proximate mechanisms and the functions they serve (Cosmides & Tooby, 1994). L&S's dismissal of disgust can serve as an example of the pitfalls of overlooking such complexity.

L&S cursorily describe disgust as "elicited by physically dirty stimuli or morally inappropriate behavior," begging the question of how objects are categorized as "dirty" and behaviors as "inappropriate." Despite L&S's endorsement of Tinbergen's approach, this description overlooks both disgust's function and its mechanistic underpinnings. Such an oversight is unfortunate given the bevy of relevant research exploring how aspects of human psychology, including *pathogen* disgust, function to neutralize infectious microbes and macroparasites – a task similar to that fulfilled by cleansing (Curtis, De Barra, & Aunger, 2011; Hart, 1990; Kupfer & Fessler, 2018; Murray & Schaller, 2016; Oaten, Stevenson, & Case, 2009). Some of these studies have paid especially close attention to proximate mechanisms, arguing that the circuitry underlying pathogen disgust executes pathogen-avoidance functions by regulating physical contact (Lieberman & Patrick, 2018; Tybur & Lieberman, 2016; Tybur, Lieberman, Kurzban, & DeScioli, 2013). According to this proposal, pathogen presence is estimated via sensory mechanisms (e.g., olfactory, visual, and tactile) that have evolved to treat certain features as cues to pathogens. Estimates of pathogen presence are integrated with other information informing contact benefits, which can be specific to a social target (e.g., Are they your baby? A close friend? An enemy? A sexual partner?) or a current state (e.g., Are you in physical combat? Are you sexually aroused?). Then, estimates of the fitness value of contact feed into pathogen-neutralizing behavioral programs, with outputs including the felt experience of disgust and its corresponding facial movements and proximal avoidance.

Inspired by this type of finer-grain approach, research has demonstrated that considerations of disgust's function and underlying proximate mechanisms can help inform topics ranging from political sentiments (e.g., Billingsley, Lieberman, & Tybur, 2018) to psychopathology (e.g., Tybur, Wesseldijk, & Jern, in press) to social exclusion (e.g., Oaten, Stevenson, & Case, 2011). A similar approach might contribute to our understanding of cleansing. For instance, cleansing should update estimates of hand contamination after contact with bodily wastes, fomites, or other people, and hence the likelihood of transferring pathogens to the eyes, mouth, and other vulnerable points of entry. It might also update witnesses' estimates of a cleanser's infectiousness (cf. Ackerman, Tybur, & Mortensen, 2018). Anticipating such effects on observers might in turn influence subsequent cleanser behavior in a number of ways, many of which seem superficially unrelated to disgust.

Note that, similar to most evolutionary psychology research programs, the research on disgust described above seeks to better understand proximate mechanisms by first considering function – one of Tinbergen's other three questions. That said, not every behavioral phenomenon is the functional output of an adaptation, and many discoveries have followed from hypotheses that phenomena are byproducts of adaptations. Consider the seemingly automatic and mandatory racial encoding revealed by decades of social psychology research in the late twentieth century. Kurzban et al. (2001) suggested that such encoding is unlikely to arise from adaptations that have evolved to detect race, because interactions between members of different races have occurred only very recently in human evolutionary history. Instead, they proposed (and demonstrated) that racial encoding is a byproduct of mechanisms that appear to serve a different function: detecting and tracking coalitions and alliances. Byproducts can similarly emerge from pathogen-avoidance adaptations. For instance, recent evidence suggests that trypophobia, the aversion to clusters of holes or bumps (e.g., on lotus flowers or honeycombs), might be a byproduct of anti-pathogen adaptations (Kupfer & Le, 2018). Myriad consequences of cleansing could also reflect byproducts of pathogen-neutralizing adaptations.

To be clear, we do not believe that considerations of adaptations and byproducts are necessary for all research programs. Indeed, many lines of inquiry within the social and behavioral sciences do not aim to carve nature at its joints, but rather aim to describe and catalog phenomena or test the effectiveness of interventions. Problems arise, however, when surface features are relied upon to support (or dismiss) theoretical claims about our evolved human nature. We see L&S's account of grounded procedures as including such problems; it does not address the function of the effects of cleansing, nor does it consider whether such effects might arise as byproducts, perhaps of pathogen-avoidance adaptations.

Hypotheses generated by evolutionary scientists have long been pejoratively described as just-so stories, analogous to Rudyard Kipling's fanciful tale of the elephant getting its long trunk because a crocodile bit and pulled on its nose. Naturally, some evolutionary hypotheses are implausible. But Tinbergen's suggestion to consider not only proximate mechanisms, but also ontogeny, phylogeny, and function, provides us with an approach for discriminating between promising hypotheses and unlikely ones. Based on the empirical evidence forwarded in the target article and the lack of specification of function (or phylogeny or

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ontogeny), we're inclined to categorize grounded procedures as the latter. Future research on the effects of cleansing would benefit from more thoroughly incorporating the burgeoning literature on pathogen-avoidance adaptations, their proximate mechanisms, and their byproducts.

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Incomplete grounding: the theory of symbolic separation is contradicted by pervasive stability in attitudes and behavior

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Abstract

The proposed theory is broad enough to accommodate the reduction or elimination of prior influences by a variety of acts symbolizing separation (including cleansing). However, it does not account for stability in psychological variables, and is contradicted by widely documented stability in people's actual attitudes and behavior over time, in multiple domains, despite people's pervasive everyday acts of symbolic separation.

A good theory, the adage goes, should fit the data like a glove – covering the fingers (i.e., where the phenomenon is found) but not the space in between (where it is not; see Roberts and Pashler, 2000 for a more formal treatment). How does the theory of grounded separation fare under this criterion?

First, is there a robust empirical phenomenon about which to theorize? Lee and Schwarz (L&S) concede that the basic phenomenon (e.g., less influence of past experience on decisions after hand-washing) is still under debate, while Ropovik, Sparacio, and Ijzerman (this treatment) and Ross et al. (this treatment) make compelling cases that the replicability of the basic phenomenon has not yet been established. A replication package for a strong unconfounded test of the phenomenon is needed, including defining any necessary pre-conditions in advance. This would enable a skeptical scientific field to either fully establish the robustness of the effect to its own satisfaction or demonstrate a lack of robustness in a way that would cause proponents to reconsider.

Should robustness be established, the question shifts to generalizability. Is the underlying phenomenon manifested sufficiently broadly across contexts and domains to require a general theory? The authors argue convincingly that the cleansing effects reported in the literature cannot all be explained in terms of either disgust reactions or cleansing as a morality metaphor. The proposed theory can indeed explain a broader range of potentially related effects. However, further research would be needed to determine whether phenomena ostensibly related to notions of connection or separation do in fact operate via the same psychological mechanism. It is not at all self-evident that any effects of closing up or of keeping stimuli, of prior ownership or of shopping via tablet computer on decision-making, for example, involve the same psychological process as cleansing.

The final challenge for an effective theory is to not only anticipate the presence of a phenomenon where it occurs, but also accurately predict *absence* of the phenomenon, where it does

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not. The grounded separation theory fails to specify when such effects would not occur, other than to propose modality as a moderator, because of differences in engagement of sensorimotor capacities (e.g., physical experience having stronger effects than conceptual activation). In fact, the authors are admirably precise about the intended expansiveness of the theory, stating that the theory would be falsified if "acts of separation, such as cleansing, do not result in any attenuation or elimination of an otherwise observed influence."

The theory would therefore be complete if acts of separation (which are highly frequent, as the authors note) do nearly always attenuate or eliminate prior observed influences. The proposed theory therefore makes the remarkable claim that the norm in human psychology must be little or no influence of even the recent past on current attitudes, decision, and behaviors. Past influence should only be observed in the special case when typically ever-present separation-symbolic behaviors, such as handwashing, are absent.

This prediction directly contradicts research in a wide variety of domains, which has identified exactly the kind of long-term stability in attitudes, preferences, and behavior that should be "washed away" by people's frequent separation-symbolic actions. A large research literature has found that personality traits (e.g., the Big Five) are stable over multiple years, and the stability tends to increase over the life span (summarized in Roberts & DelVecchio, 2000), with similar findings for religious belief and practice (Hamberg, 1991). Similar stability over time has been documented for people's optimism (Billingsley, Waehler, & Hardin, 1993), political party identification, and ideological orientation (Freeze & Montgomery, 2016; Green & Palmquist, 1994; Krosnick, 1991). As a particularly striking example, given cleansing effects on optimism (Körner & Strack, 2019), optimism and pessimism were largely stable over the course of a year among women undergoing cancer surgery, regardless of whether they received good or bad news about their condition (Schou, Ekeberg, Sandvik, & Ruland, 2005).

Another research literature has studied state dependence in people's behavior, investigating whether stable patterns of behavior occur specifically because people's current choices are influenced by their past choices (as opposed to stability because of heterogeneous causal factors remaining the same). Evidence for state dependence, a persistent causal influence of prior choices (often years before) on subsequent behavior, has been found for moral behaviors (charitable giving and volunteering, Choi & Chou, 2010; Meer, 2013; criminal offending, Blokland & Nieuwbeerta, 2010; Nagin & Paternoster, 2000), morality-relevant behaviors (voting, Denny & Doyle, 2009) and behaviors that are largely nonmoral (consumer purchasing, Dubé, Hitsch, & Rossi, 2010).

For example, consider a typical person's morning routine: she wakes up, showers, changes into her work clothes, closes her lunch into a container, exits her house, closes and locks the front door, dumps the kitchen garbage bag in the outdoor container, gets in her car and drives to work (trying to avoid other cars), and walks into her office. Between waking up and 9 AM, she has cleansed, changed, enclosed, destroyed, avoided, distanced, and changed context: all "grounded procedures" carried out through physical experience, ostensibly the most impactful modality.

Nevertheless, voluminous research and everyday experience both tell us that her personality, political views, morality, religious beliefs, tastes, and preferences will be quite unchanged, not only from the day before, but often even from the year before. She will generally engage in the same hobbies, chat with the same friends, support the same political party, donate to the same charities, shop at the same store for largely the same goods, and have similar feelings about her life and her future, with her past behavior continuing to drive her current behavior, no matter how many everyday acts of symbolic separations she conducts.

In short, the theoretical advance here is broadening without "tightening," re-categorizing psychological phenomena without providing a more precise glove-like description of human behavior. The result, I fear, is instead a quite large mitten-theory with perhaps only a very small empirical hand inside; a theory of instabilities spotted in the lab that fails to account for the actual pervasive stability in the typical person's everyday life.

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Grounded procedures of connection are not created equal

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Abstract

Lee and Schwarz propose that grounded procedures can also be related to connection rather than separation. Drawing on consumer behavior research, we point to different grounded procedures of connection – in terms of the motor actions involved, their salient properties, and their motivational conditions – and discuss how procedures of separation may be affected by the procedures of connection that precede them.

In their paper, Lee and Schwarz (L&S) argue that grounded procedures may not only help individuals in separating from an entity but may also allow them to establish a mental connection to an entity. In this manner, procedures of connection may be considered as the flipside of procedures of separation. Although we agree with this notion, we also think that procedures of connection need to be conceptualized more precisely. In particular, as procedures of separation are typically preceded by procedures of connection (e.g., washing away something that has become connected to you), a more fine-grained analysis of these procedures may also enhance our understanding of the mental and physical processes associated with separation. Put differently, a full account of how people separate from an entity must include an account of how they connect to that entity in the first place.

To this end, it is useful to draw on research in consumer behavior that has examined how acts of consumption allow people to connect to more abstract entities. Although consumers draw on a range of procedures to ground mental connection of one psychological entity (e.g., the meaning associated with a product) to another (e.g., their self), the nature of these procedures, their psychological aims, and their corresponding motor actions differ strongly. For instance, individuals may ground mental connection by *touching* a physical entity such as a product. Touching may not only be triggered by the desire to learn more about the product, but also by the desire to establish a mental connection with the product or the meaning associated with the product (Lastovicka & Sirianni, 2011; Peck & Childers, 2003; Peck & Shu, 2009). As such, touching a product enhances feelings of psychological ownership and these feelings may emerge regardless of legal ownership (Peck, Barger, & Webb, 2013). Hence, touching may allow a person to develop a mental connection through a temporary physical connection (Nägele, von Walter, Scharfenberger, & Wentzel, 2020).

Mental connection may also be grounded through *incorporating* or *penetrating* an entity. The former procedure refers to incorporating an external entity into one's body, such as eating or drinking something, inhaling a fume, or getting a tattoo (Escalas & Bettman, 2003; Johnston, Szabo, & Rodney, 2011), whereas the latter one entails being encompassed by an external entity, such as being held in the arms by a loved one, wearing a particular garment, or sitting in one's car (Adam & Galinsky, 2012). Although incorporating and penetrating refer to different bodily processes, they share a common psychological aim – that of creating a temporal or permanent unity between an external entity and one's body. Hence, these procedures may be particularly effective for including the meaning of an external entity into one's extended self (Belk, 1988).

Finally, mental connection may also be facilitated through *creating* an entity. Consumers that actively participate in the creation of a product (e.g., assembling IKEA products, building Lego cars, or printing products with a three-dimensional printer) typically demonstrate a higher valuation of this product afterward (Kaiser, Schreier, & Janiszewski, 2017; Mochon, Norton, & Ariely, 2012; Wiecek, Wentzel, & Erkin, 2020). Although creating a consumption-related object may increase feelings of ownership for that object (Wiecek et al., 2020), it may also fulfill more specific psychological aims. That is, successfully building an object may fulfill consumers' desire to signal a competent identity to themselves and to others and may thus serve a self-validation goal (Mochon et al., 2012).

Although this list of procedures of connection – touching, incorporating, penetrating, and creating – is probably not exhaustive, it serves to show that people rely on very different motor actions to ground mental connection and that different actions may serve different psychological goals. Hence, an extension of L&S's model would benefit from a more detailed analysis of grounded procedures of connection.

This kind of analysis will also help to extend the model in a different manner. If, as L&S suggest, procedures of connection are the flipside of procedures of separation, then it is important to understand how these two procedures are related. In some cases, an act of separation will reflect the logical opposite of the corresponding act of connection. For instance, although *putting on* a particular item of clothing may help individuals to connect with an external entity (e.g., a football fan wearing a jersey of his or her favorite team), *taking off* that same item will help them to disconnect from it. In a similar vein, painters such as Jasper Johns, Francis Bacon, and John Baldessari were notorious for destroying some of the works they had created, Baldessari even taking the trouble of burning his work in a crematorium.

Although these examples point to a conceptual alignment between procedures of connection and separation, such matches are probably the exception rather than the norm. If, as proposed by L&S, procedures of connection and separation are domain-general, people may rely on different procedures for connecting than for disconnecting. Against this background, it is not only important to understand how people use grounded procedures to separate from an entity but also to comprehend how these procedures are affected by the specific procedures of connection that precede them. Arguably, the extent to which procedures of separation are aligned with preceding procedures of connection may depend on the *specificity* of the underlying motivational process (i.e., procedures of connection that serve very specific psychological aims may only be unraveled through equally specific procedures of separation, whereas procedures that serve more generic aims can be dissolved through many different separation procedures) or the *engagement* of the initial sensorimotor experience (i.e., connections that are formed through high sensorimotor engagement, such as actual physical movement, can only be undone through an equally engaging procedure of separation, whereas connections that are forged through lower engagement, such as offline simulation, may be disbanded by procedures differing in engagement). Understanding such conceptual links will not only help in predicting which specific procedures people

may use for separating from an entity but may also enhance our understanding of the complementary nature of connection and separation.

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The role of goal-generalization processes in the effects of grounded procedures

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Abstract

This commentary provides an interpretation of the effects of grounded procedures in terms of the goal-generalization processes involved in coping with negative feelings and identifies some implications that might not yet have been considered.

Lee and Schwarz (L&S) provide considerable evidence that separation and connection are fundamental processes that are evident in both cognitive and motor behavior. They couch the phenomena they review within the framework of grounded cognition proposed by Barsalou (1999, 2008) but apply it to procedures as well as single concepts. In this commentary, I discuss the mental processes underlying the phenomena from a somewhat different theoretical perspective that specifies the cognitive processes that underlie the phenomena.

Goal systems theory

As Kruglanski et al. (2002; see also Wyer, in press) postulate, sequences of goal-directed actions can be stored in memory as complex concepts, or *plan-goal schemas* that are activated and used to attain the objective to which they pertain. Each schema consists of a goal concept preceded by a series of action concepts. The latter concepts, in turn, can refer to either cognitive or motor acts that in combination describe a means of attaining the goal at hand. The concepts that compose a plan-goal schema can exist at different levels of generality. Thus, deciding which of two products to buy and deciding which of two animals is larger might both contain elements of a more general plan-goal schema that pertains to making comparative judgments.

One feature of goal systems theory, *equifinality*, is particularly applicable to the phenomena identified by L&S. Equifinality refers to the fact that more than one plan-goal schema may accomplish the same objective. Put another way, several different plan-goal schemas might terminate in the same goal concept. When a goal is activated, different schemas might be applied, depending on situational features that happen to be salient at the time.

The equifinality construct is particularly useful in conceptualizing the indirect effects of negative feelings and emotions on behavior that is intended to cope with these reactions (Wyer, in press; see Wyer, Dong, Huang, Huang, & Wan, 2019). That is, experiencing a negative emotion presumably activates a desire to reduce or eliminate this aversive state and this goal might activate a plan-goal schema in a later situation and elicit behavior that is independent of the conditions that led the emotion to be eliminated.

Wyer et al. (2019) analyze the indirect effects of numerous negative emotions, including embarrassment, jealousy and envy, guilt and shame, anger, fear, and nostalgia. As but one example, stimulating individuals to feel embarrassed in one situation activates a motive to avoid contact with people who are likely to evaluate them negatively. This goal, once activated, influences reactions to persons in quite unrelated situations (Wan & Wyer, 2020). Moreover, it increases preferences for dark glasses, which symbolically allow them to hide their face and restorative facial cream, which allows them to "save face" (Dong, Huang, & Wyer, 2013). The processes postulated by L&S are analogous. If engaging in immoral behavior motivates individuals to eliminate feelings of guilt, this motive could activate a plan-goal schema pertaining to "cleansing," stimulating behavior that could symbolically attain this goal.

This conceptualization makes salient a further consideration concerning the priority that governs the selection of different means of coping with negative emotions. Symbolically "washing away" feelings of guilt may be only one of several ways of coping with the feelings elicited by an immoral act. For example, people might simply deny the importance of the act or justify its occurrence in terms of its potentially desirable consequences. It is unclear which strategy is used when all are potentially viable.

In this regard, studies of the use of hand washing as a strategy for coping with negative feelings (Xu, Zwick, & Schwarz, 2012; Zhong & Liljenquist, 2006), participants are usually told explicitly

to wash their hands before the dependent variable is assessed. Whether this behavior would occur spontaneously in the absence of situational demands is unclear. Symbolic coping strategies might have high priority outside the laboratory only when situational factors make the use of these strategies salient.

A final observation

L&S's conceptualization implicitly assumes that individuals interpret the physical acts they perform in a way that allows them to symbolically distance themselves from the emotion-eliciting event they are experiencing. This assumption is likely to hold in the paradigm they have used to demonstrate the phenomena. In the "hand washing" paradigm, for example, participants do not wash their hands until after the emotion-eliciting event (an immoral act, a gambling loss, and so on) has been made salient and the motivation to dissociate themselves from the event has been induced. In this case, they might spontaneously recognize the symbolic utility of interpreting their behavior as "cleansing" and act accordingly.

However, there are instances in which this might not be true. Suppose, for example, that individuals wash their hands *before* they think about the event that precipitates their negative emotions. In this case, it is unclear whether individuals would spontaneously interpret their behavior in a way that allows them to dissociate themselves from the event they encounter subsequently. They might not consciously interpret it in any way at all.

I know of no evidence that directly bears on this possibility. However results of a study by Dong, Dai, and Wyer (2015) are suggestive. In this study, groups of participants who had engaged in synchronous exercises were later asked to perform a product preference task. Their behavior induced a "conformity" mindset, leading them to choose products that were normatively the most popular. Then participants performed the same exercises in time to a metronome, however, they apparently did not interpret the behavior as synchronous (e.g., "conforming") and so it had no impact on their later product choices.

In Dong et al.'s study, there was no obvious motivation to reinterpret the synchronous behavior as "conformity" at the time the product preference task was performed. Be that as it may, the study points out that the interpretation of physical behavior in a way that has symbolic implications might not occur spontaneously and that conditions that discourage this interpretation might qualify the results that L&S report.

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Authors' Response

Grounded procedures in mind and society

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Abstract

Our commentators explore the operation of grounded procedures across all levels of analysis in the behavioral sciences, from mental to social, developmental, and evolutionary/functional. Building on them, we offer two integrative principles for systematic effects of grounded procedures to occur. We discuss theoretical topics at each level of analysis, address methodological recommendations, and highlight further extensions of grounded procedures.

R1. Introduction

Hygienic care is a human universal (Brown, 1991). Physical cleansing is part of our daily routines. It confers health benefits and survival value (Boyce & Pittet, 2002; Kampf & Kramer, 2004). It carries symbolic meanings, as manifest in customs and beliefs across cultures and religions (Douglas, 1966). Experimental work has shown its cognitive, affective, and behavioral effects. What explains its psychology?

We proposed that physical cleansing involves separating one physical entity from another (e.g., washing dirt away from one's hands) and that its sensorimotor procedures ground mental procedures of separating one psychological entity from another (e.g., dissociating immoral behavior from oneself). Separation can attenuate or eliminate the influence of the separated entity. This proximate mechanism for the psychology of cleansing complements existing accounts (e.g., moral purity, disgust). It can be generalized to other physical acts of separation (e.g., enclosure of an entity) and its flipside, connection (e.g., touching an entity). Together, grounded procedures of separation and connection offer an intermediate level of analysis, capturing nuances and generating predictions that are more general than conceptual metaphor theory but more specific than grounded cognition. The

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Table R1. Diverse themes and foci of commentaries

Theme	Focus	Commentaries
Mental mechanisms of grounded procedures	Neural and perceptual	Ekves, Prystauka, Davis, Yee, and Altmann; Sigger and Dickins
	Affective and cognitive	Körner and Strack; Ponsi, Era, Fini, and Falcinelli
	Metacognitive	Briñol and Petty
Social perspectives on grounded procedures	Sociocultural	Kwon, Glenberg, and Varnum; Horner and Greenberg; Gilead, Trope, and Lieberman; Rossignac-Milon and Higgins; Lee and Esposito; Oyserman; Felisatti, Fischer, Kulkova, Kühne, and Michirev
	Historical	Bilewicz and Bilewicz
	Existential	Horner and Greenberg
Individual differences and clinical manifestations of grounded procedures	Individual differences	Fetterman, Robinson, and Meier
	Clinical manifestations	Schnall and Henderson; Haberkamp and Schmidt
Developmental and evolutionary/functional analyses of grounded procedures	Ontogenetic bases and developmental trajectory	Gilead, Trope, and Lieberman; Gerdin, Venkatesh, Rottman, and DeJesus
	Evolutionary process and adaptive function	Schubert and Grüning; Tybur and Lieberman
Further extensions of grounded procedures	Additional candidates for intrapersonal and interpersonal forms of separation and connection	Légeret and Hoffrage; Felisatti, Fischer, Kulkova, Kühne, and Michirev; Scattolin, Panasiti, and Aglioti; Wyer
	Various physical forms of cleansing, separation, and connection	Briñol and Petty; Ekves, Prystauka, Davis, Yee, and Altmann; Wentzel, von Walter, and Scharfenberger; Kwon, Glenberg, and Varnum; Urminsky; Kardos
Methodological recommendations and empirical support for cleansing effects	Meta-analysis and *p*-curve	Ross, van Aert, van den Akker, and van Elk; Ropovik, Sparacio, and IJzerman

concept of grounded procedures integrates classes of phenomena typically couched in different theoretical traditions (e.g., disgust emotion, conceptual metaphor, sympathetic magic, positive contagion, embodied attitude) and invites new questions about the interplay between mental and physical processes.

Indeed, exciting new questions are raised and addressed in the commentary process. We are privileged to have received 27 commentaries that offer thoughtful interpretations and elaborations of grounded procedures at different levels of analysis (Table R1), including neural, perceptual, affective, cognitive, metacognitive, sociocultural, historical, existential, personal, clinical, developmental, and evolutionary/functional. Many commentaries suggest further extensions of our model to generate broader predictions. The diverse topics covered relate to two integrative principles spelled out in the target article, which underlie the systematic effects of grounded procedures. We will summarize these principles (sect. R3) and then relate them to the themes summarized in Table R1 (sects. R4–R8). Before delving into such theoretical richness, we also address methodological recommendations and questions (sect. R2).

R2. Methodological recommendations and empirical support for cleansing effects

We appreciate the methodological recommendations offered in a couple of commentaries (**Ross, van Aert, van den Akker, & van Elk [Ross et al.]**; **Ropovik, Sparacio, & IJzerman [Ropovik et al.]**) for our comprehensive meta-analysis of cleansing effects (500+ effect sizes from 200+ experiments; Lee, Chen, Ma, & Hoang, 2020a). Applying the contemporary methods they recommend, including PET-PEESE (Stanley & Doucouliagos, 2014), parameter selection modeling (McShane, Böckenholt, & Hansen, 2016), and *p*-uniform* (van Aert & van Assen, 2018), as expected the overall effect estimates drop in size (from the small-to-medium range to the small range) and remain statistically significant. This indicates that publication bias alone is unlikely to account for the observed results, alleviating concerns about overall empirical support for cleansing effects.

This conclusion contrasts with **Ropovik et al.**'s strong claim that "there is no support for the replicability of cleansing effects in the first place and thus no need to develop a theoretical account of grounded procedures." They draw this conclusion on the basis of a *p*-curve analysis of (i) a small subset of the entire body of experimental research on the psychological consequences and antecedents of physical cleansing (namely, seven out of several hundred effects), which (ii) included only some of the replication studies and (iii) excluded all of the original studies. The procedures they applied to the selected studies (iv) did not follow core steps of best practice recommendations (Simonsohn, Nelson, & Simmons, 2014b; Simonsohn, Simmons, & Nelson, 2015), (v) included *p*-values that should be excluded, and (vi) excluded *p*-values that should be included. A detailed discussion of the assorted errors exceeds the space limit of this Response; we provide it in an Appendix available at https://osf.io/sxz97/?view_only=630af79ee6c149a5833a4d2fbb4cd560. When best practice recommendations are followed, the effects addressed by Ropovik et al. show evidential value. Such evidential value is found regardless of whether the analysis includes only the replications Ropovik et al. themselves selected or includes the original experiments

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along with the replications. Ropovik et al.'s errors concerning the identification and specification of the *p*-values also undermine the conclusions from their Monte Carlo simulations.

These shortcomings are important to recognize in the present context because the pre-print of **Ropovik et al.**'s *p*-curve analysis on PsyArXiv led two other commentaries (**Urminsky**; **Ross et al.**) to accept their unwarranted conclusions at face value. It also led Urminsky to claim that "Lee and Schwarz (L&S) concede that the basic phenomenon (e.g., less influence of past experience on decisions after hand-washing) is still under debate" – a claim that is discrepant from both the content of our target article and the empirical evidence.

Independent of specific statistical issues, our view on the relationship between theory and data is that a careful theoretical analysis is essential for the discovery of robust effects. Theory informs the development of manipulations and measures that effectively tap into relevant constructs – a prerequisite for producing coherent and replicable results. Here, converging support for cleansing effects from meta-analytic work and proper *p*-curve analysis, together with a range of other separation and connection effects covered in the target article, reinforces our stance that the phenomena merit theorizing. This stance seems to be shared by 24 other commentaries, which grapple with a rich diversity of theoretical topics. We now turn to these topics.

R3. Integrative principles underlying systematic effects of grounded procedures

Underlying a range of observations in the commentaries are two core themes of social psychology, namely, situationism and construal (Ross & Nisbett, 1991; Taylor, 1998). First, for systematic effects of grounded procedures to occur, there needs to be some *salient content* on which the physical act of separation or connection is brought to bear; that is, there needs to be something on the actor's mind that the act separates from or connects to. Second, the physical act needs to be *subjectively construed* as separation or connection; merely rubbing one's hands does not constitute an act of physical or psychological separation, unless one perceives it as cleaning one's hands.

R3.1. Salient content

As noted in the target article (sect. 4.1), "cleansing exerts its influence on whatever domain is salient to the person in a given situation. This context sensitivity of cleansing effects is consistent with situated perspectives on mental processes (Mesquita, Barrett, & Smith, 2010; Smith & Semin, 2004) and parallels the observation that feelings and metacognitive experiences are brought to bear on what is in the focus of attention at the time of the experience (Schwarz, 2010, 2012)." With salient content, there is a focal domain being separated from or connected to, producing systematic effects. Without salient content, there is no focal domain to separate from or connect to, so no systematic effect is expected.

We agree with **Wyer** and **Briñol and Petty** that an experience that comes *before* cleansing is more likely to be separated from the self than one that comes *after* cleansing, because an experience that comes before cleansing is more likely to be salient during cleansing than an experience that comes after cleansing. Exceptions are plausible. Suppose you shook someone's hand and later learn about the person's serious misdeeds. Most likely, you would feel better remembering that you did wash your hands after the handshake (than if you did not), even though the "experience" of contaminating contact followed rather than preceded the cleansing. Nevertheless, we expect the cleansing effect to be even stronger if you had already known about the person's misdeeds before shaking their hands and washing yours.

Related manifestations of salient content can be seen in religious and cultural practice. "For instance, getting rid of a sin often requires recounting it first" (**Kardos**). One's sin is made salient, then separated from oneself. Similarly, traditional Chinese place their hands above an incense burner for purification and removal of bad luck before touching the god of wealth to receive good luck. One's bad luck is made salient, then separated from oneself, before connecting oneself to good luck.

Missing the role of salient content results in mispredictions about the influence of grounded procedures. **Urminsky** argues that attitudes and behaviors that are stable over extended periods of time contradict our observation that physical acts of separation exert attitudinal and behavioral influence. This argument is misguided for several reasons. First, it ignores the existence of long-term *changes* in attitudes and behaviors (e.g., risk preference; Schildberg-Hörisch, 2018) as well as personality (Atherton, Grijalva, Roberts, & Robins, 2020; Caspi, Roberts, & Shiner, 2005). Second, it focuses on the pervasive occurrence of physical separation but ignores the equally pervasive occurrence of connection in daily life (cf. **Kardos**). Third and most fundamentally, the grounded procedures prediction is not that people change their attitudes and behaviors as frequently as they wash their hands or touch objects of daily life; it is that separating and connecting can remove aspects from, or add aspects to, the salient content that people consider as they form attitudinal judgments and make behavioral decisions. How much that influences the final judgment or decision depends on which additional contents are considered, consistent with the logic of mental construal (Bless & Schwarz, 2010; Schwarz, 2007).

The principle of salient content also has methodological implications. Systematic effects of separation or connection can only be observed when most participants in a study have the same salient content in mind. If each participant separates from or connects to something else, no systematic effect will be apparent when conditions are compared.

R3.2. Subjective construal

The psychological effect of grounded procedures further depends on how the physical act is construed in a given context. As noted in the target article (sect. 3.1), "the principle of context-dependent attribute salience implies that the same sensorimotor experience can be construed differently to highlight different salient attributes, resulting in different effects." A physical act subjectively construed as separation (or connection) can be expected to attenuate (or accentuate) the influence of salient content. The same physical act subjectively construed as something else cannot be expected to produce the same effect (as demonstrated in Körner & Strack, 2019 and pointed out by **Körner & Strack**).

One reading of these properties may be that the sensorimotor experience *per se* of a physical act does not matter at all; only the subjective construal of it does (**Briñol & Petty**). We take a milder stance, for two reasons. First, although experimental manipulations of the subjective construal of a physical act of cleansing can produce different effects (Kim, Duhachek, Briñol, Lee, & Petty, 2020; Körner & Strack, 2019), in the absence of such manipulations, people typically do construe physical acts of cleansing as separating contaminants. Default subjective

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construals of this sort are likely to characterize many physical acts of separation (e.g., destroying an object, throwing it away) and connection (e.g., touching an object, keeping it close). Second, actual sensorimotor experience (e.g., washing hands) tends to produce stronger effects than merely conceptual activation (e.g., scrambling cleansing-related words), suggesting that sensorimotor experience does contribute to cleansing effects (target article, sect. 4.3) and likely other grounded procedures. Overall, our stance is that both subjective construal and sensorimotor experience matter. We expect subjective construal (whether by default or by manipulation) to matter more for the effect direction and sensorimotor experience (varying from strongest to weakest engagement; related to **Haberkamp & Schmidt**'s notion of parametric manipulation) to matter more for the effect size.

The role of subjective construal underlies an issue raised by **Schubert and Grüning**: "Bafflingly, many behaviors cited as implementing separation through cleansing are either pretend (participants hands are clean to begin with), or are even confounded with the opposite of separation, namely application (e.g., hand sanitizer) or outright contamination (e.g., burning incense)." Using hand sanitizer indeed involves applying it to one's hands, but the subjective construal of the physical act is sanitizing, that is, killing germs from one's hands, as is evident from product descriptions on its packaging. Burning incense, in the cultural context in which we discussed this example, is construed by traditional Chinese as purifying the air, driving away insects, and getting rid of negative energies (*Incense – Chinese Customs*, n.d.), all about separating things from oneself.

Beyond these consequences, subjective construal may also be relevant to antecedents of separation. **Kardos** notes, "The dilemma of dirty money is an example for desiring things that are not clean." It may or may not be a dilemma. Dirty money has been shown to elicit "selfish, greedy, and exploitative" desires and behaviors (Yang et al., 2013, p. 473), consistent with the metaphorical association of dirtiness with immorality (Lakoff & Johnson, 1999; Lee & Schwarz, 2011, 2016). And dirty money, despite being dirty, is still money (Tasimi & Gross, 2020). It affords at least two subjective construals: physical dirtiness and monetary value. Their relative salience and utility may determine the direction and strength of motivation toward dirty money.

These observations highlight that changing the subjective construal of a physical act can change its consequences and antecedents. Note that subjective construal can take place within an individual mind – or in a shared reality across minds, a theme we will pick up again in sect. R5.

R4. Mental mechanisms of grounded procedures

Findings reviewed in the target article indicate that physical acts of separation (e.g., cleansing) can attenuate the typical influence of a prior experience by way of psychological separation. A question arises: What exactly is being separated from what? Is an experience associated with the past self being separated from it? Or is the past self being separated from the present self? Our commentators postulate a rich variety of mental mechanisms, from neural to affective to cognitive to metacognitive ones, with empirical implications.

From the perspective of neural representation, a present object or event overlaps both spatially and temporally with a past version of itself, which in turn is associated with specific episodic experiences in the past ("intersecting object histories"; Altmann & Ekves, 2019). Accordingly, "any event that reduces the overlap between the current and the prior self will have consequences for one's perception of objects and events associated with that past self" (**Ekves, Prystauka, Davis, Yee, & Altmann [Ekves et al.]**). Because cleansing "is a highly salient separation from the self," it reduces the overlap between the past self and the present self, hence attenuating the influence of the former on the latter. We share Ekves et al.'s prediction that other salient acts of separation should do the same, such as "moving into a different room," consistent with experimental evidence that changing physical contexts (e.g., walking through doorways) attenuates memory (Radvansky & Copeland, 2006) and fatigue (Mead & Levav, 2016) from the previous context. Following this logic, physical acts of separation may produce other consequences of self-discontinuity, such as reduction in nostalgia (Newman, Sachs, Stone, & Schwarz, 2020; Sedikides, Wildschut, Routledge, & Arndt, 2015) and amplification of self-directed change in gambling (Kim, Wohl, Salmon, & Santesso, 2017) and other addictive behaviors (Kim & Wohl, 2015).

Turning the focus to affective and cognitive processes, **Körner and Strack** offer an array of predictions: cleansing may neutralize or eliminate prior feelings, increase psychological distance between an event and the self, enhance abstract construal of the event, highlight its central and enduring features (Trope & Liberman, 2010), trigger a new mindset ("reset"), increase openness to new experience, and enhance breadth and flexibility in thought and behavior (McCrae & Costa, 1997). Agreeing with these predictions (target article, sect. 6.2), we add that they are likely to occur fairly automatically, that is, efficiently and with little conscious awareness, intention, or effort (Bargh, 1994). Notice we said "little," not "zero," because some awareness is necessary for construing a physical act as being about cleansing or separation. Such construal tends to occur by default (sect. R3.2) and should not require much executive resources. Accordingly, we consider grounded procedures to be less dependent on executive resources than assumed by **Ponsi, Era, Fini, and Falcinelli (Ponsi et al.)**, but we share their interest in testing if cognitive load would moderate the effects of grounded procedures.[1] To date, such tests are missing.

In addition to cognitive (what and how one thinks) and affective processes (how one feels), metacognitive processes (how one thinks and feels about one's thoughts) are also expected to be involved in grounded procedures. **Briñol and Petty** focus on "the important distinction between having thoughts and using them (i.e., primary vs. secondary cognition; Briñol & DeMarree, 2012; Jost, Kruglanski, & Nelson, 1998)." We agree that the perceived informational value of one's own thoughts, which they refer to as validation of the thoughts (Briñol et al., 2018), plays a key role in any judgment (Schwarz, Sanna, Skurnik, & Yoon, 2007).

Cognitive, affective, and metacognitive processes are not mutually exclusive. They can interact with each other, as highlighted in research on the interplay of feeling and thinking (for a review, see Schwarz & Clore, 2007). Their relative contributions can be disentangled by testing process-specific moderators and outcomes (Lee & Cecutti, in press), which we consider an important part of the "next generation" of investigation into grounded procedures.

R5. Social perspectives on grounded procedures

Several commentators highlight the utility of thinking about the operation of grounded procedures in sociocultural, historical, and existential contexts. **Kwon, Glenberg, and Varnum (Kwon**

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et al.), for example, identify four kinds of interplay among ecology, culture, and grounded procedures. We summarize them in Figure R1, which also organizes other commentators' suggestions about how sociocultural forces may matter.

Path 1-2-3 highlights that physical acts of separation and connection may be one of the mechanisms by which ecological reality or features of the physical environment ("environmental inputs" in **Kwon et al.**'s terms) shape cultural tendencies ("cultural outputs"; e.g., independence vs. interdependence, high vs. low social class). Consistent with this point and adding to Kwon et al.'s examples of resource scarcity, research has found that different modes of physical labor, afforded by different ecological conditions, predict different cultural orientations and corresponding cognitive styles. Farming and fishing communities, which emphasize harmonious social coordination, showed more holistic cognitive styles than did herding communities, which emphasize individual decision-making and social independence, even though all three communities were in the same national, geographic, ethnic, and linguistic region of Turkey's eastern Black Sea (Uskul, Kitayama, & Nisbett, 2008). Within the category of farming, rice-growing requires more social coordination (e.g., irrigation networks) than wheat-growing; accordingly, rice farmers showed more interdependence and holistic cognitive styles (Talhelm et al., 2014) and tighter social norms (Talhelm & English, 2020) than did wheat farmers, even within the same country and controlling for factors such as modernization, population density, and pathogen prevalence. Pathogens and diseases do matter though, as in Kwon et al.'s example of path 4-5 (see also sect. R7.2).

Path 6 points out that the link between cultural dimensions – from social class to religion to nationalism (**Kwon et al.**; **Horner & Greenberg**) – and psychological separation and connection (e.g., independent self-construal, religiosity, patriotism) can be strengthened by physical acts of separation and connection (e.g., moving away from home, bowing heads together in prayer, wearing a pin of national flag), because these acts concretize, symbolize, and stabilize the experience (**Gilead, Trope**, & **Liberman [Gilead et al.]**). Path 7 further notes that culture can shape the link between physical and psychological separation or connection, which can be manifest in at least three ways: shared reality, vicarious experience, and sociocultural connection.

A physical act is subject not only to an individual's own construal (sect. R3.2), but also to socially shared construal, or shared reality (**Rossignac-Milon & Higgins**). Just like individual construal, shared reality can go hand in hand with sensorimotor experience and accentuate its influence. This is compatible with Rossignac-Milon and Higgins's proposal "that acts of cleansing and other acts of separation and connection have more powerful effects when they are grounded in *shared practices* – in a shared reality." Rossignac-Milon and Higgins go further though by suggesting that "it is the shared reality that makes baptism purifying and not the physical act of splashing water." Our take is that the two are mutually compatible. Put it this way: Why is the physical act of purification by water such a common ritual, imbued with spiritual meanings, across religions in the first place? Because, we argue, spiritual purification is about separating one's past and present (especially in highly public forms of commitment to a new identity, as in baptism), and this abstract sense of psychological separation can be grounded in physical acts of separation that are common in daily life and relatable to all, such as cleansing, to both confer meaning and signal commitment (**Gilead et al.**). Essentially, a physical act and the socioculturally shared reality around it work together synergistically to reinforce each other's influence.

An offshoot of shared reality is that someone else's reality can feel like my reality – if I have an interdependent self-construal of which the other person is a part. That predicts that a close other's or an ingroup member's misdeed and underperformance may feel like one's own (**Kwon et al.**), especially in interdependent communities (**Lee & Esposito**), eliciting a vicarious desire to cleanse or engage in other acts of separation. Empirical details remain to be explored, including whose experience and what kind of vicarious experience triggers separation (or connection), what can versus cannot be separated (or connected), and whether the effects vary by culture. For example, are highly interdependent (vs. independent) Germans more aversive to wearing Hitler's sweater and more eager to have it washed?

Regardless of its particular content, any shared reality is, by definition, shared with others. It involves a sort of sociocultural connection, an idea central to **Oyserman**'s commentary. This is a different kind of connection from our primary focus, one that may be called "third-order" connection. Purification rituals, for example, involve physical separation of contaminants from one's body (first order), which grounds psychological separation of sins from one's self (second order), and in doing so, provides sociocultural connection to one's religious community (third order). This involves a noteworthy duality of individual-level psychological *separation* (second order) and collective-level sociocultural *connection* (third order). Although the link between physical and psychological (i.e., first and second order; path 2 in Fig. R1) is robust (a view shared by **Felisatti, Fischer, Kulkova, Kühne**, & **Michirev [Felisatti et al.]**), whether the effect of a physical act (first order) is driven by the psychological experience it grounds (second order) or the sociocultural meaning it affords (third order) is likely to vary by context and culture.

Building on this duality, **Oyserman** notes prior evidence that individualistic (vs. collectivistic) cultural orientations tend to involve mental procedures of separation (vs. connection; Oyserman, Sorensen, Reber, & Chen, 2009). As cultural mindsets of individualism–separation and collectivism–connection can be activated by situational cues (Oyserman & Lee, 2008), she made a number of predictions (e.g., positive valence from sociocultural connection itself and from its cultural fit), one of which is that cleansing is more likely to be experienced as connection (rather than separation) when a collectivistic (rather than individualistic) cultural mindset is activated. It turns out even when a collectivistic cultural mindset was activated for members of a collectivistic culture, cleansing conferred a sense of separation from one's immorality (Lee, Tang, Wan, Mai, & Liu, 2015). Such evidence does not rule out the possibility of heightened sociocultural connection, but does reinforce the robustness of the basic link between physical and psychological separation in cleansing behavior.

A different kind of sociocultural influence is hypothesized by **Bilewicz and Bilewicz**, who propose from a historical perspective "that the metaphor of cleansing was a by-product of modernisation processes in human culture and agriculture," primarily in the last few centuries. Historical consideration, rare in social psychological theorizing and research, should deepen our understanding of contextual variations of grounded procedures. In this particular case, metaphorical links between cleansing and morality have been prevalent across diverse religious traditions for much longer than a few centuries. Despite historical changes in the prominence of cleansing metaphors in societal discourse, it seems likely that

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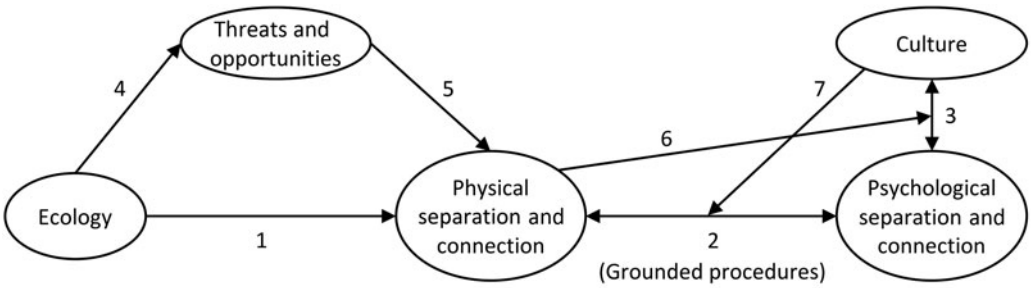

Path	Conceptual meaning	Example
Kwon et al. (commentary)		
1-2-3	Ecological reality leads to experiences of physical separation and connection, which ground psychological separations and connections that form cultural tendencies	Resource scarcity (vs. abundance) often leads to more (vs. less) sharing of physical space (e.g., smaller homes) and coordination of physical activity (e.g., coordinated labor), which facilitate interdependence (vs. independence)
4-5	Ecological reality presents threats and opportunities that elicit collective desires for physical separation and connection	Small-scale societies with greater (vs. less) historic disease prevalence tend to use less physical greetings (e.g., bowing rather than hugging & kissing)
6	Physical separation and connection are part of cultural norms and rituals that instantiate psychological separation and connection	Joining hands in prayer; relocation from home as a coming-of-age ritual
7	Cultural orientations moderate the influence of physical separation and connection on psychological separation and connection	With an interdependent self-construal, washing one's hands may reduce not only personal guilt, but also vicarious guilt about immoral acts by one's group
Lee & Schwarz (target article)		
2	Physical separation and connection ground psychological separation and connection	Physical cleansing separates past behavior from present judgment; physical touch connects an object to self

Figure R1. Interplay among ecology, culture, and grounded procedures.

cleansing serves as a grounded procedure of separation across historical contexts.

Finally, sociocultural reality serves existential functions. Because culture is bigger than an individual, longer-lasting than their lifetime, and typically construed as uniquely human, conforming to one's sociocultural values and practices can alleviate one's existential angst (Greenberg, Solomon, & Pyszczynski, 1997; also Burke, Martens, & Faucher, 2010; for a recent debate, see Klein et al., 2019 and Chatard, Hirschberger, & Pyszczynski, 2020). **Horner and Greenberg** suggest that grounded procedures of separation and connection also serve existential functions, which seems plausible for several reasons. The same threats that activate death-related thoughts also elicit desires for separation such as cleansing. Reminders of humans' animality (e.g., feces, blood) elicit disgust and physical separation. And death anxiety, which is particularly intense among individuals with low self-esteem, is buffered by physical touch with a person or a teddy bear (Koole, Tjew, Sin, & Schneider, 2014). These findings are compatible with the possibility that grounded procedures of separation (e.g., cleansing) and connection (e.g., touching) play a causal role in ameliorating existential concerns.

Sociocultural, historical, and existential perspectives highlight the social embeddedness and functions of grounded procedures. In addition to these contextual factors, individual differences exist in separation and connection effects, with clinical manifestations at the extreme ends. We turn to these variations now.

R6. Individual differences and clinical manifestations of grounded procedures

Complementary to the experimental study on grounded procedures reviewed in our target article, **Fetterman, Robinson, and Meier (Fetterman et al.)** suggest adopting an individual-differences approach. We agree. Converging multimethod evidence reduces the ambiguities associated with any single method, including the ambiguities of situational manipulations (emphasized by personality psychologists) and the ambiguities of observed individual differences (which can be confounded by other unknown individual differences; emphasized by social psychologists).

Both approaches complement one another and often predict interactive effects. "To the extent that purity concerns motivate cleansing behavior, for example, individuals who value purity

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more – as a moral foundation (Graham et al., 2011) – should display the effect to a greater extent" (**Fetterman et al.**). Indeed, political conservatives, who value purity more than liberals do, show stronger cleansing effects elicited by prejudice toward gay men (Golec de Zavala et al., 2014, Study 4). Obsessive-compulsive disorder (OCD) patients, often with cleansing compulsions, show stronger cleansing effects related to morality than do people without OCD (Reuven et al., 2014). And people can wash away their post-decisional dissonance (Lee & Schwarz, 2010a) – unless they have compromised decision-making abilities (De Los Reyes, Aldao, Kundey, Lee, & Molina, 2012). All of these findings demonstrate the moderating role of individual differences in cleansing effects.

At far ends of the individual-differences spectrum are clinical manifestations of grounded procedures, which are thought-provoking and worth examining. Cleansing-related thoughts and behaviors figure prominently in OCD and obsessive-compulsive personality disorder (OCPD). As **Schnall and Henderson** note, repetitive counting of things is another common symptom, which may reflect a function of grounded procedures of separation, namely, to separate entities, making them countable to take stock of their value as resources. Schnall and Henderson also point out that OCPD is associated with less temporal discounting (Pinto, Steinglass, Greene, Weber, & Simpson, 2014), higher socioeconomic status, and greater material resources (Ullrich, Farrington, & Coid, 2007). Fascinating questions arise: Are these outcomes (generally seen as positive) driven by the heightened need for counting, separation, or both? Is counting merely associated with separation, or causally linked to it? If so, which causes which? Do the severity and symptomatology of OCD and OCPD track the effects of grounded procedures?

Beyond OCD and OCPD, other clinical predictions are made by **Haberkamp** and **Schmidt**. In moral contexts, grounded procedures of separation have shown stronger effects in clinical samples of hypermorality (e.g., OCD, as demonstrated by Reuven et al., 2014 and D'Olimpio & Mancini, 2014) and may show *weaker* effects in clinical samples of hypomorality (e.g., antisocial personality disorder). In non-moral contexts, physical separation can reduce social threats (Lee et al., 2020b), and this effect may be stronger among clinical samples of social anxiety disorder. Such considerations suggest that the efficacy of cognitive-behavioral therapies may be enhanced by explicitly incorporating cognitive processes of mental separation and behavioral practices of physical separation. Related ideas and practices are part of the popular pseudoscience of "neuro-linguistic programming" (Bandler & Grinder, 1975) and may have contributed to its lay appeal. Systematic investigations into potential therapeutic effects of separation and connection can shed light on the clinical utility of grounded procedures.

R7. Developmental and evolutionary/functional analyses of grounded procedures

As the title of our target article indicates, grounded procedures are posited as a proximate mechanism. Theorizing about this mechanism can be extended to its ontogenetic basis, developmental trajectory, evolutionary process, and adaptive function.

R7.1. Developmental analyses

Conjectures about the ontogeny of the link between physical cleansing and psychological separation are offered by **Gilead et al.**, who suggest that it may be the result of an innate primitive, statistical learning, or sociocultural meaning. Our perspective is that the goal of a procedure generalizes over developmental time, from the specific goal of cleansing in a particular domain (e.g., separating contaminants from one's body) to a more general goal of separating any physical entities from one's body, to a mental experience of separating psychological entities from one's self. It is a process of abstraction that involves both statistical learning (which, as Gilead et al. noted, requires subjective construal; sect. R3.2) and sociocultural reinforcement (sect. R5). We are agnostic about the presence of innate primitives. To illustrate why, consider the development of cleansing behavior.

Infants do not seem to show a strong desire for cleansing, perhaps because they are not disgusted by the things that disgust adults (e.g., feces and mess; Rozin & Fallon, 1987). Because innate predispositions can emerge later in life (e.g., romantic attraction emerges during puberty; Curtis & Biran, 2001), the absence of an early desire for cleansing does not necessarily imply the absence of an innate primitive. But the extended effort involved in socializing young children about cleansing (**Gerdin, Venkatesh, Rottman, & DeJesus [Gerdin et al.]**) seems more compatible with sociocultural reinforcement of a learned construal of what needs to be cleansed and what cleansing means. We therefore join Gerdin et al.'s call for investigations into how grounded procedures unfold from infancy to childhood – in fact, even into adolescence and adulthood – and agree with many of their predictions. We doubt, however, that knowledge about the threatening nature of contaminants is required to learn about separation. Although parents are likely to emphasize this rationale in cleansing education, separation is just as well exemplified by washing one's favorite jam off one's sticky fingers.

Gerdin et al. also suggest, "If grounded procedures of separation are the proximate mechanism behind all of these domains, then one may predict that children will display cleansing effects and other 'separation effects' at similar developmental time points. Children should start cleansing themselves of dirt and germs at the same time they begin to separate themselves from social outgroup members." Not necessarily. A proximate mechanism of cleansing does not necessitate that all forms of physical and mental separation emerge at the same developmental timepoint. To illustrate, consider disgust. Disgust can be a proximate mechanism for adults' disapproval of certain moral violations (Chapman & Anderson, 2013), but this does not necessitate that physical and moral disgust emerge at the same developmental timepoint. Instead, disgust generalizes from physical to moral events as the child develops (Danovitch & Bloom, 2009). Similar trajectories may hold for grounded procedures of separation.

R7.2. Evolutionary/functional analyses

Schubert and Grüning highlight the broad utility of "dual inheritance approaches that argue that biology and culture co-evolve and jointly determine behavior." Given the adaptive functions of cleansing and disgust (e.g., for pathogen avoidance; **Tybur & Lieberman**) and the rich sociocultural meanings around them (sects. R5 and R7.1), we have no doubt that they have been subject to processes of biological and cultural evolution. One prediction is that "the involvement of the innate blueprint differs among the provided examples. It may be particularly prominent in the avoidance response provided by the disgust reactions, and much more incidental in purification by smoke" (Schubert & Grüning). Testing whether differential adaptive values translate into differential effect sizes and elicitation likelihoods will bear on the evolutionary perspective.

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Related to this line of thinking, cleansing effects are overall stronger in sexual than non-sexual moral violations (Lee et al., 2020a). More generally, testing specific predictions derived from co-evolutionary perspectives on cleansing and other physical acts of separation and connection will facilitate integration of the proposed proximate mechanism with more distal explanations (Tinbergen, 1963/2010).

By outlining the functions, mechanisms, and byproducts of disgust and how these inform diverse topics (e.g., politics, psychopathology, social exclusion), **Tybur and Lieberman** argue that "A similar approach might contribute to our understanding of cleansing…. Myriad consequences of cleansing could also reflect byproducts of pathogen-neutralizing adaptations." We share these interests and submit that separation is an adaptive aspect of disgust (sect. 3.2) that serves as a proximate link from disgust's primary functions (separation from disgust elicitors) to its byproduct phenomena (separation in general). Tybur and Lieberman further point out that "L&S's account of grounded procedures… does not address the function of the effects of cleansing, nor does it consider whether such effects might arise as byproducts, perhaps of pathogen-avoidance adaptations." This is a fair critique and we elaborate on the functions of grounded procedures below.

Cleansing undoubtedly serves pathogen-avoidance functions, as shown in public health research and recommendations (Boyce & Pittet, 2002; Kampf & Kramer, 2004; Pittet, Allegranzi, & Boyce, 2009) as well as psychological investigations (Rozin & Fallon, 1987). But there is more to cleansing than pathogen avoidance, as indicated by the domain-general consequences of cleansing (sect. 4.1), which may be overgeneralizations of the behavioral immune system (Schaller, 2015; Schaller & Park, 2011). Zooming out from the specific case of cleansing, grounded procedures of separation and connection in general serve at least three functions. (i) They serve the *epistemic* function of using tangible, physical experience to scaffold intangible, mental operations (target article; Landau, 2017; Williams, Huang, & Bargh, 2009). (ii) They serve the *experiential* function of concretizing (**Gilead et al.**) and intensifying (**Horner & Greenberg**; **Kwon et al.**) the psychological experience of separating from or connecting to objects and their associated events, experiences, and sense of self. (iii) They serve the *sociocultural* function of instantiating shared reality (**Rossignac-Milon & Higgins**), connecting people to their identified community (**Oyserman**), and helping them ameliorate existential concerns (Horner & Greenberg). Given these epistemic, experiential, and sociocultural functions of grounded procedures, both their phylogeny and ontogeny are likely to be driven by cultural forces alongside biological ones (**Schubert & Grüning**).

R8. Further extensions of grounded procedures

Several commentaries inspire further extensions of grounded procedures. These include additional candidates for intrapersonal and interpersonal forms of separation and connection as well as various physical forms of cleansing, separation, and connection.

R8.1. Additional candidates for intrapersonal and interpersonal forms of separation and connection

Felisatti et al. hypothesize that arithmetic operations of subtraction and addition confer a psychological sense of separation and connection, respectively. Supportive evidence for these links has been found in semantic priming (Bassok, Pedigo, & Oskarsson, 2008), math education (Sinclair & Heyd-Metzuyanim, 2014), and attitude change (Paredes, Guyer, Briñol, & Petty, 2019). If mathematical thinking and psychological experience are not only related to each other (predicting cross-domain priming effects), but also similarly grounded in physical acts of separation and connection (Felisatti et al.), it would imply that physical experience scaffolds some of the most abstract mental representations key to humans' success, from math (Lakoff & Núñez, 2000) to culture (Oyserman et al., 2009).

Physical acts of separation and connection can be contrasted with each other, but both involve bodily action. It seems obvious that one's body is owned by oneself; nevertheless, people differ in their subjective sense of body ownership. **Scattolin, Panasiti, and Aglioti (Scattolin et al.)** suggest that a high (vs. low) sense of body ownership may be experienced as connection to (vs. separation from) oneself, a possibility raised by their observation that variations in body ownership show parallel properties to those of grounded procedures, including domain- and valence-general consequences (target article, sects. 4.1 and 4.2) and valence-asymmetric antecedents (sect. 4.4). In addition to body ownership, continuity (vs. discontinuity) between one's past and present self may be another intrapersonal form of connection (vs. separation), according to **Légeret and Hoffrage**, who also suggest social inclusion (vs. exclusion) as an interpersonal form of connection (vs. separation).

Intrapersonal and interpersonal (i.e., non-physical) forms of separation can be recruited in the maintenance of a positive self-evaluation (e.g., by separating an immoral behavior from one's self-view or distancing oneself from an outperforming other; Tesser, 2000). When non-physical forms of separation as well as physical ones (e.g., cleansing) are all readily available, **Wyer** asks, which kind of strategies do people use? We suggest several determinants, including individual differences in (i) habitual behavior and (ii) chronic thought and feeling, and situational differences in (iii) fit and (iv) salience, reminiscent of the social cognition principles of accessibility and applicability (Higgins, 1996). People who habitually wash their hands or take a shower when they feel anxious, stressed, guilty, or unpleasant in other ways are likely to keep exhibiting these behaviors. The same applies to people who chronically think about and feel the urge for cleansing (e.g., OCD patients; sect. R6). Different situations can also trigger different emotions, motivations, and actions (target article, Table 2). A physical form of separation is more likely to occur when it matches the psychological features of a given situation. Such occurrence, contrary to Wyer's expectation, can be spontaneous, as when participants spontaneously cleansed themselves after thinking about unpleasant sexual encounters (Elliott & Radomsky, 2009, 2012; Fairbrother, Newth, & Rachman, 2005; Herba & Rachman, 2007).

R8.2. Various physical forms of cleansing, separation, and connection

Vicarious cleansing (e.g., watching someone wash their hands) can influence one's attitudes and behaviors, though less strongly than actual cleansing does (e.g., washing one's own hands; Xu, Bègue, & Bushman, 2014). The reason, **Briñol and Petty** speculate, is that actual experience, relative to vicarious or imagined experience, is more strongly linked to the self (see also target article, sect. 6.1). **Ekves et al.**, drawing on the theory of intersecting object histories (sect. R4), further predict that the effect of

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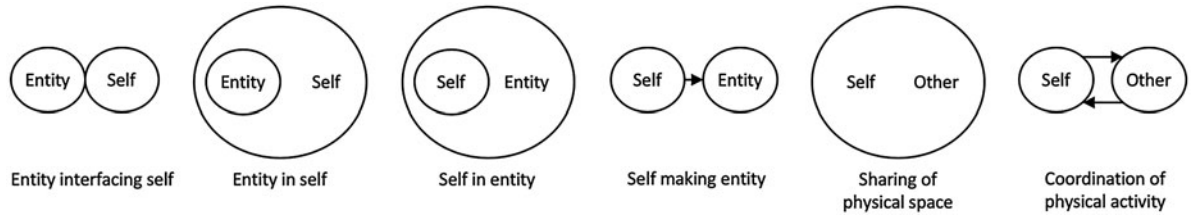

Figure R2. Varieties of grounded connection.

watching someone else will be graded: "The more history the person you are watching shares with you (is it your partner, your friend, or a stranger?), the stronger the effect should be on you." We agree with these predictions.

There are other physical forms of separation than cleansing, such as movement away from the self and enclosure of objects (target article, sect. 4.5). Recent research showed that when 5- to 6-year-olds were seated at a table and had the opportunity to cheat by peeking at an answer sheet on a nearby table without leaving their seat, simply having a physical barrier that separated the two tables reduced cheating behavior by half – even though the barrier was merely an empty frame that did not interfere with the ability to peek or when the barrier was merely imagined (Zhao et al., 2020). When separation is less subtle and more intentional, and when the entity being separated is not a random object in an experiment but a personally meaningful object with strong associations with one's past self (e.g., a wedding ring), stronger effects are expected (**Ekves et al.**).

Turning from separation to connection, **Wentzel, von Walter, and Scharfenberger (Wentzel et al.)** recommend exploring different physical forms of grounded connection, including touching a physical entity, incorporating it (e.g., eating or drinking it), being encompassed by it (e.g., wearing it), and creating it. These can be redescribed (Fig. R2) as entity interfacing self, entity in self, self in entity, and self making entity. When the entity is another person, connection can also occur by sharing of physical space and coordination of physical activity (**Kwon et al.**). Such diverse forms may be construed as different versions of connection that underlie different but related psychological notions (e.g., ownership, interdependence), much like different forms of separation have different shades of meaning (target article, Table 2). Notwithstanding these differences (as noted by **Urminsky**), grounded procedures are posited at a level of abstraction that integrates multiple classes of phenomena, all of which involve various physical forms of separation and connection.

Although separation and connection can be examined independently of each other, predictions can also be made about their interplay. For example, if people expect opportunities of separation (e.g., handwashing) in the near future, they should be more willing to connect with negative entities (e.g., tainted money) at the moment (**Kardos**). More generally, expected opportunities of separation or connection should increase people's current willingness to engage with an undesirable entity or disengage from a desirable entity, respectively.

In daily life, physical acts of separation can precede connection (e.g., removing one's bad luck with incense before receiving good luck from the god of fortune; sect. R3.1) or vice versa (e.g., touching dirt to get rid of it from one's shoes; **Kardos**). What physical forms of separation and connection are capable of counteracting each other's influence? **Wentzel et al.** predict two determinants. (i) Procedures of separation/connection that serve specific (vs. more general) goals are applicable to specific (vs. broader) kinds of situations. (ii) Procedures of separation/connection with high sensorimotor engagement (e.g., actual movement) are counteracted only by procedures of connection/separation that also include high sensorimotor engagement, whereas procedures with low sensorimotor engagement (e.g., simulated movement) are counteracted by procedures with low or high sensorimotor engagement. Adding to these predictions, we draw on Figure R2 to predict that (iii) each form of connection is most likely to counteract and be counteracted by a form of separation that does the exact opposite (e.g., breaking the interface between an entity and oneself, taking an entity out of oneself). We are excited about future research into the spontaneous or strategic interplay between grounded procedures of separation and connection in people's mind and their social reality.

Notes

1. Another observation by **Ponsi et al.** is that cleansing effects were found to be stronger among individuals with OCD than individuals without OCD (Reuven et al., 2014), but weaker among individuals who score high on compromised decision-making (rumination, generalized anxiety, and intolerance of uncertainty) than individuals low on it (De Los Reyes et al., 2012). Ponsi et al. interpreted these different patterns of results through the lens of available executive resources. We favor an alternative interpretation: the anxiety in OCD is about cleanliness, but the anxiety in compromised decision-making is not about cleanliness, so a manipulation of cleansing exerts stronger effects on the former but weaker effects on the latter.

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